

MINISTRY OF FORESTS
Selkirk Natural Resource District

**Golden TSA
Forest Health Strategy 2022-23**



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Spruce Beetle



Wood River Area 2019-2020 IBS harvesting – Catherine Brady

Cover: Provided by Marnie Duthie-Holt - Extensive Spruce beetle attack at Summit area of Glacier National Park (September 2020).

Table of Contents

1	GOAL	5
2	OBJECTIVES	5
3	TSA DESCRIPTION	5
4	TSA PRIORITY RANKING OF FOREST HEALTH AGENTS	8
5	FOREST HEALTH AGENTS - STRATEGIES AND TACTICS	10
5.1	Defoliators	10
5.2	Diseases	11
5.3	Insects	12
5.4	Mammals	14
5.5	Abiotic factors	15
6	MANAGEMENT OBJECTIVES FOR PRIORITY FOREST HEALTH AGENTS	15
7	ROLES AND RESPONSIBILITIES	18
8	BMU STRATEGY FOR IBS, IBD and IBM	20
9	RECOMMENDED ACTIVITIES TO MANAGE IBS, IBD and IBM	21
10	PRIORITY ACTIVITIES IN BMUs	23
11	2023-24 FISCAL YEAR TACTICAL PLAN	23
12	STOCKING STANDARDS	23
13	NON-RECOVERABLE LOSSES	24
14	CONCLUSION	25
15	Information Links and Reference Material	25



High levels of Douglas-fir beetle attack in TFL14 (September 2022).



Western balsam bark beetle galleries.



Western hemlock looper beat sheet sampling to determine population levels.

1. GOAL

The goal of this Forest Health Strategy is to serve as a resource for directing forest health management and for communicating hazards or other relevant information on major pests in the Golden Timber Supply Area (TSA) and other area-based tenures with Golden TSA - Woodlots. It provides some of the tools necessary to improve sustainability and resiliency of forested ecosystems by identifying strategies and tactics to minimize losses from damaging insects, diseases, and abiotic disturbances. The Provincial Forest Health Strategy guides government's forest health program to achieve the goals of:

- maintaining and improving the productivity of British Columbia's forests
- extending the supply of the remaining timber resource
- protecting other forest resource values

2. OBJECTIVES

The overall objective is to minimize timber losses and the hazard and risk from forest health factors by:

- Maintaining a detection program for forest health agents over the land base;
- Assessing the potential risks and impact of the identified forest health agents on resource values and timber supply;
- Identifying prevention and suppression strategies and tactics for major pests;
- Implementing ecologically sound, economically feasible and socially acceptable mitigating strategies and tactics to address forest health agents while considering constraints and limitation placed on the land base;
- Encouraging and fostering knowledge sharing on forest health agents amongst the Golden TSA forest stakeholders, primarily forest tenure Licensees;
- Evaluating management practices for the purposes of adaptive management; and
- Provide strategic direction for management activities.

2.1 Provincial Forest Health Mandate

The goal of the Provincial Forest Health Program is to manage pests to meet forest management objectives. The provincial government's three key strategic forest health objectives are to:

1. **Forest Health Factors are detected and assessed.**
New and recurring disturbances caused by forest health factors are detected, and assessments of risk and impact to forest resource values are provided.
2. **Practices are adapted to accommodate known forest health risks.**
Evidence-based information is used to develop recommendations and modify forest management practices to mitigate the impacts of forest health factors.
3. **Resources are protected.**
Forest resource values are protected from forest health factor damage through appropriately applied direct management actions including treatment and monitoring. This includes the support and implementation of proactive management activities.

Additional information on the Provincial Forest Health Program can be found at:

<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health>

3. GOLDEN TSA DESCRIPTION

The Golden Timber Supply Area (TSA) lies in the East Kootenay area of the Kootenay Boundary Natural Resource Region and is administered by Selkirk Natural Resource District, Revelstoke office. The Golden TSA lies within the traditional lands of the Okanagan, Secwepemc and Ktunaxa Nations though there are no current First Nations communities within the TSA boundary.

The TSA covers 902,000 hectares; it is bounded by the Selkirk and the Purcell Mountains to the west and the Rocky Mountains to the east. It straddles the Rocky Mountain Trench and the Columbia River Valley, which runs through the town of Golden and northward to the Big Bend area near the Mica Dam. The TSA is bordered by three National Parks; Kootenay, Yoho, and Glacier, as well as Hamber and Cummins Lake Provincial Parks.

The following Beetle Management Units (BMUs) are included in the Golden TSA. All BMUs follow landscape unit boundaries. This strategy excludes National Parks.

Table 1: BMUs covered by the forest health strategy.

BMU#	BMU Name	BMU#	BMU Name	BMU#	
G01	Upper Wood	G11	Goosegrass	G21	Blacberry
G02	Molson/Dainard	G12	Windy/Austerity	G22	Quartz
G03	Lower Wood	G13	Bachelor	G23	West Bench
G04	Tsar	G14	Ventego	G24	Canyon
G06	Kinbasket	G15	Esplanade	G25	Mount Seven
G07	Sullivan	G16	Blackwater Ridge	G26	Kicking Horse/Beaverfoot
G08	Foster/Garrett	G17	Hope/Goodfellow	G27	Ice/Moose
G09	Chatter/Prattle	G18	Valenciennes	G28	Kootenay
G10	Bush River	G19	Bluewater/Waitabit	G29	Swan
		G20	Moberly		

Most of the Golden TSA lies in the interior wet belt of the province. The major biogeoclimatic zones include the Interior Cedar Hemlock, Engelmann Spruce-Subalpine Fir, Montane Spruce, Interior Douglas-fir and Alpine Tundra zones.

The species distribution within the Golden TSA THLB is available in Table 2 with Sx, Fdi and Pli making up over 78% of the volume.

Table 2: Golden TSA THLB Species volumes for > 60 year old stands (2021).

Species	Leading Species Total Volume m3	2nd Species Total Volume m3	3rd Species Total Volume m3	4th Species Total Volume m3	5th Species Total Volume m3	Total Volume	Species Volume %
SX	6,307,141	2,005,327	649,503	129,525	8,938	9,100,435	35.5%
FDI	5,337,324	1,058,172	382,155	144,849	17,724	6,940,223	27.0%
PLI	2,452,529	868,022	490,105	126,429	22,943	3,960,028	15.4%
BL	517,223	933,027	264,275	165,085	33,173	1,912,783	7.5%
HW/HM	997,004	507,743	168,792	65,736	9,583	1,748,859	6.8%
CW	778,606	308,113	126,091	42,382	5,519	1,260,711	4.9%
AT	24,972	153,821	115,637	76,970	16,776	388,176	1.5%
PW	36,134	69,024	43,463	36,381	13,498	198,500	0.8%
PA	17,922	15,351	20,706	10,353	3,483	67,815	0.3%
ACT	853	11,148	21,497	11,367	11,634	56,499	0.2%
EP	183	5,952	12,076	9,194	2,464	29,870	0.1%
LA	-	95	50	2	-	147	0.0%
Totals						25,664,046	

Approximately 36.5% of the total area of the Golden TSA is considered productive forest land. The remaining 63.5% is considered non-productive (i.e. rock, ice alpine, roads, etc.). Within the productive land base, 32.7% is considered available for timber harvesting.

The Golden TSA is characterized by steep mountainous terrain in the north, with gentler and wider valleys in the south. The mountainous environment creates varied climates and growing conditions, resulting in diverse forests. In the more predominant, wetter parts of the TSA, valley bottoms are covered with cedar and hemlock, and stands of spruce and subalpine fir occupy the higher elevations slopes. The southern portion of the TSA experiences a significantly drier climate and the drier valley bottoms are occupied by Douglas-fir forests, while lodgepole pine is often found at higher elevations.

The current area estimated to be economically and environmentally suitable for harvesting – the ‘timber harvesting land base (THLB) – covers 141,530 hectares. A significant portion of the crown forest land base is unavailable for timber harvesting due to its inoperability, environmentally sensitive areas, unstable soils, steep slopes sites with low timber productivity and problem forest types. Other resource constraints on the land base include but not limited to Ungulate Winter Range, Caribou Habitat, Old Growth Management Areas and Connectivity Corridors.

Bark beetles have posed a significant threat to the management objectives of many of these resources. Mountain pine beetle (IBM), Douglas-fir beetle (IBD) and spruce beetle (IBS) are classed as priority forest health agents. Over the entire land-base, the susceptible host area for IBM is 163,022 hectares primarily in the southern portion of the TSA, for IBD 171,110 hectares again primarily in the southern portion of the TSA and for IBS 336,883 hectares.

Comprehensive descriptions of the Golden TSA are included in the following documents:

Golden TSA Website

<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/timber-supply-review-and-allowable-annual-cut/allowable-annual-cut-timber-supply-areas/golden-tsa>

- Data Package
- Analysis Report
- Rational for Allowable Annual Cut Determination

Kootenay-Boundary Land Use Plan

<https://www2.gov.bc.ca/gov/content/industry/crown-land-water/land-use-planning/regions/kootenay-boundary/kootenay-boundary-rlup>

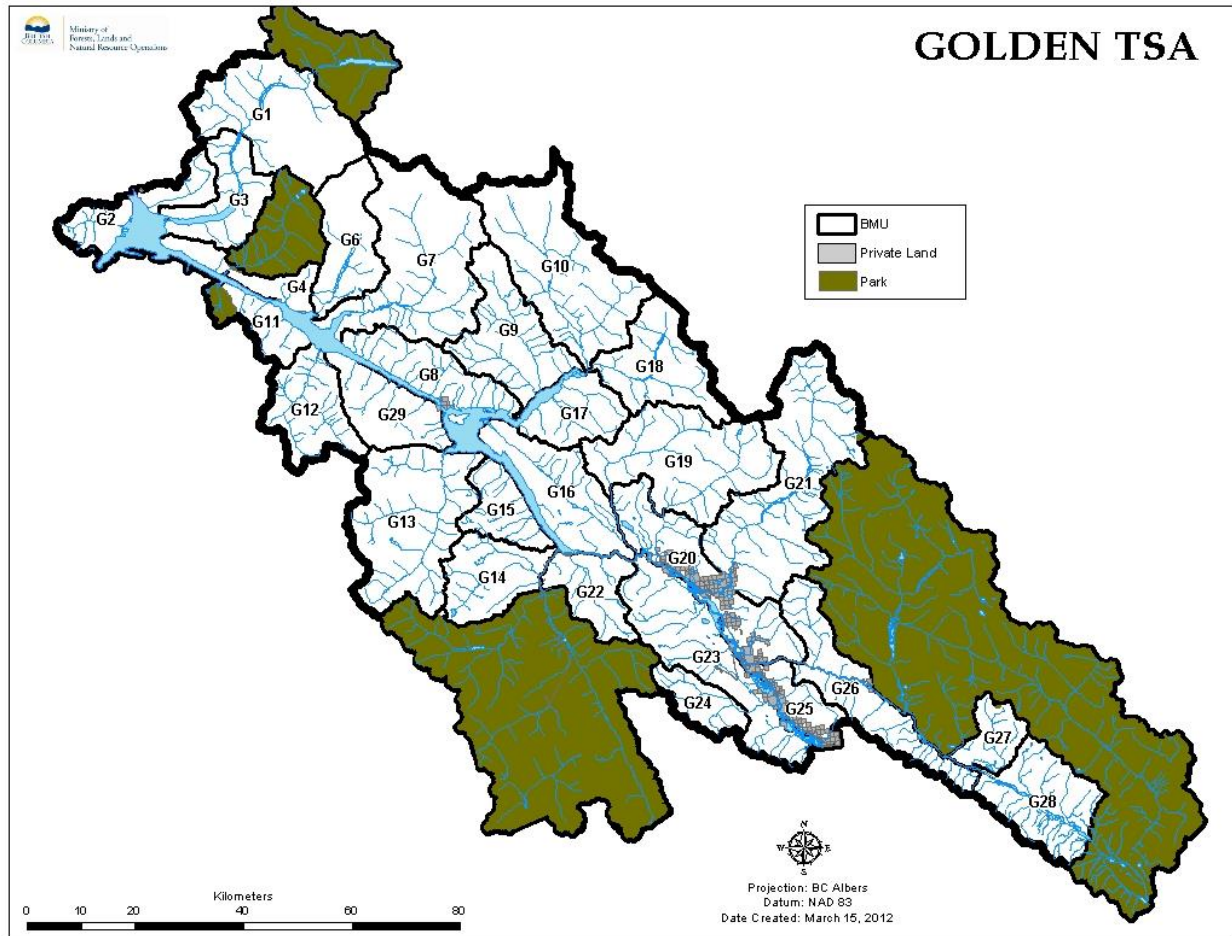


Figure 1: Map of Golden TSA, identifying BMUs, National and Provincial parks and private land.

4 TSA Priority Ranking of Forest Health Agents

The priority forest health agents have been ranked following the Provincial Forest Health Strategy (Table 3).

Rankings were based on the following factors:

- The collective knowledge of the regional and district forest health specialists, forest managers, licensees and contractors
- Historic recorded occurrence patterns
- Known or suspected impacts to forest resource values, based on the knowledge of local forest professional and regional forest health specialists
- Availability of operational detection and treatment methods
- Costs and benefits of applying detailed detection and treatment activities
- Overall level of knowledge about the hazard and risk zones
- Distribution of pest and current incidence levels

The rankings are somewhat subjective, so an additional approach is to consider what the impact of the forest health factor would be equivalent to in terms of area. This approach provides a useful perspective to the rankings and generally applies as follows:

<u>Ranking</u>	<u>Predicted potential damage loss per year (ha)</u>
Very High	>400
High	200-400
Moderate	100-200
Low	50-100
Very Low	<50

Note: some abiotic injuries (i.e. flooding) are not ranked, as the severity can change with each event. Also note, that not all forest health factors are ranked, only the more significant pests within the Golden TSA.

Table 3: Ranking of Forest Health agents by potential impact on forest management activities in the Golden TSA

	Very High	High	Moderate	Low
Defoliators			Western hemlock looper	Black army cutworm, Birch leafminer, Aspen serpentine leafminer
Diseases	Armillaria root disease	White pine blister rust	Western gall rust	Dothistroma, Lophodermella, Hard pine rusts (Stalactiform blister rust, Comandra blister rust)
Insects	Spruce beetle, Douglas-fir beetle, Western balsam bark beetle	Mountain pine beetle	Spruce weevil	
Mammals			Bear, Voles	Deer, Moose
Abiotic Factors	Fire	Drought	Windthrow	

Table 4 provides an overview of the activity status of some of the priority forest health agents which were reported during the 2020, 2021 & 2022 provincial aerial overview surveys (AOS). Note that spot tree counts have been incorporated into the severe category of damage based on a fraction of a hectare per spot. Priority ranking is based on risk of current and future non-recoverable losses. IBS, IBB, IBD and Fire are Priority 1's and represent the largest current losses of higher value timber species and area and the bark beetles have the potential to cause further losses if not managed/ harvested. Western Hemlock Looper remains a significant priority 2.

Table 4: Summary of 2020-2022 Golden TSA significant Forest Health damaging agents observed in the AOS.

FH Agent	Common Name	2022 Affected Area (ha)	2021 Affected Area (ha)	2020 Affected Area (ha)	Trend	Current Impact on Timber Supply	TSA Priority
IBS	Spruce beetle	348	2,218	1,977	Significant Decrease	High	1
IBD	Douglas-fir beetle	590	709	374	Slight Decrease	Very High	1
IBB	Western balsam bark beetle	11,798	11,052	11,985	Static	Very High	1
IDL	Western Hemlock looper	3275	1,509	1473	Significant Increase	Very High	2
NB/ NBP	Fire/ Post Fire Mortality	0	1,520	137	Significant Decrease	High	1
IBM	Mountain pine beetle	0	229	445	Significant Decrease	Very Low	3
AB	Bear	72	0	48	Slight Increase	Very Low	3
DFS	Dothistroma Needle Blight	0	24	49	Static	Very Low	3
ID6	Aspen serpentine leafminer	850	8,686	6,638	Significant Decrease	Very Low	n/a
ND	Drought (foliage)	0	1,526	0	Significant Decrease	Low – Very Low	3
DFH	Larch Needle Blight	0	23	0	Slight Decrease	Nil	n/a
NF	Flooding	0	13	9	Static	Very Low	n/a
NS	Slides	1	0	8	Static	Very Low	3
NW	Windthrow	0	93	10	Slight Decrease	Nil	2

5 FOREST HEALTH AGENTS - STRATEGIES AND TACTICS

5.1 DEFOLIATORS

Western hemlock looper IDL (*Lambdina fiscellaria lugubrosa*)

Looper affected area more than doubled to 3,275 compared to 1,509 ha in 2021 and 1473 ha in 2020. Most of the 2022 attack was considered Trace (about 75%) with the balance in Light Severity. 2022 areas of significant attack included Kinbasket River Valley, mouth of Wood Arm, Cummins River (Provincial Park), and Glacier National Park. The current management strategy is to monitor and if necessary, consider spraying with Btk. Monitoring is through the aerial overview survey and ground sampling carried out at the Regional level. The last outbreak of western hemlock looper occurred in 2002-2003, defoliating approximately 16,000 hectares of forest land in the northern portion of the Golden TSA. The preferred host of the looper is western hemlock followed by sub-alpine fir, western red cedar and white spruce and found primarily in mature and overmature hemlock and hemlock-cedar stands.

Aspen serpentine leaf miner ID6 (*phyllocnistis populiella*)

2022 saw a significant drop of Aspen Leaf Miner affected area to only 850 ha and was mapped primarily as Light and the balance in Moderate. This compares to 8,686 ha in 2021 and 6,638 ha in 2020. ID6 attacks trembling aspen and occasionally black cottonwood. Larval mining reduces tree photosynthesis and water vapour conductance. Heavy attacks can reduce tree growth, cause branch dieback and even cause tree mortality. Foliage discoloration and associated premature leaf fall may reduce the aesthetic

value of trees on recreation sites. The impact of these pests and diseases on the TSA is not significant. No management is planned.

Birch leaf miner IDN (*Fenusa pusilla*) (Birch Decline)

No Birch leaf miner was observed from 2020 to 2022. It had been identified on the annual aerial overview survey sporadically in the TSA over the last many years. This insect is not being managed though the presence of this insect and climate change could impose challenges on future management.

Black army cutworm (*Actebia fennica*)

The black army cutworm hazard is highest when a site is burnt in the spring and no herbaceous food source is available. Most mortality occurs among those seedlings that are more than 60% defoliated. Hosts are spruce, lodgepole pine, western larch, Douglas-fir and trembling aspen with Douglas-fir and spruce being highly susceptible and lodgepole pine being relatively resistant to damage. The number of blocks broadcast burnt in recent years has been relatively low in the Golden TSA. Any Wildfire areas to be salvaged and planted or existing openings to be replanted should consider this issue. No reports of cutworm problems have been reported by the Licencees.

For blocks burned in the spring (May-June) of the previous year, planting should be delayed until most cutworms have pupated. This allows seedlings 1 year to establish before being subjected to attack; sites also gain an additional summer to “green-up” and provide cutworms with alternative food sources. If cutworm damage is expected when seedlings are planted, the simplest and fastest approach is to plant on moist sites as early as possible in the spring; on sites where significant moisture stress is expected delay planting for 1 year.

5.2 DISEASES

Armillaria root disease DRA (*Armillaria ostoyae*)

Armillaria has been identified as a significant issue throughout the TSA. This disease is not typically observed in the AOS.

Management of Armillaria and other root diseases in the TSA is recommended to follow the “[Managing Root Disease in BC](#)” guide published by MoF (2018). Stocking Standards for Free Growing Stands are contained in each licensee’s Forest Stewardship Plan and have been developed to address this disease. Harvested ICH stands of a suitable nature should be considered for stump removal treatments post-harvest to reduce DRA levels. Treatment of stands other than the ICH should also be assessed for DRA levels or only after discussions with MoF Regional Pathologist.

Young plantations with Armillaria tend to suffer a distinct early wave of mortality due to young roots contacting infected stump systems. Mortality usually peaks between 9 and 20 years after planting. Thus, applying free-growing surveys after this time period would provide the most useful information on plantation success. A later FG survey than typical is recommended for areas with known Armillaria, such as ICH sites.

RESULTS data indicates that only 16.2 hectares (3 openings) of stump removal has been completed in the last 14 years of which 13.2 ha is within the TSA and the balance within a woodlot. No Stump removal has been recorded for 2021. This number is low given the high % of ICH stands in Golden TSA and potential susceptibility of these areas to DRA. Limiting factors are likely large stump size and steep slopes but where these are not limiting factors it is **recommended that all Licencees should be considering treatments in high risk areas where feasible (MoF 2018).**

White pine blister rust DSB (*Cronartium ribicola*)

White Pine blister rust is an introduced pathogen which has caused extensive mortality of western white pine and whitebark pine. The availability of disease-resistant white pine makes it possible to ensure this valuable timber species is restored. Disease resistant white pine should be promoted as a reforestation species on appropriate sites. Based on successfully yielding approximately 65% survivorship of white pine, a similar rust-resistance effort should continue to be supported for whitebark pine, which is occasionally harvested, federally endangered, and especially valuable for wildlife. Forest Licencees are encouraged to consider planting rust resistant Pw seedlots.

Hard pine rusts - Western gall rust DSG (*Endocronartium harknessii*), Stalactiform blister rust DSS (*Cronartium coleosporioides*), Comandra blister rust DSC (*Cronartium comandra*)

Hard pine rusts are a moderate concern in the pine plantations south of the Bush Arm. The loss impact on the TSA is unclear but will impact the future rotation to some degree with timber mortality and quality losses. Free Growing surveys and declarations should be modified to ensure stands are not declared free growing without the stand being old enough or tall enough to more fully express the potential problem with these diseases, especially in ICH sites where Pli is planted or regenerated. Where possible, a mix of species is highly recommended to be planted or regenerated naturally.

Whitebark and Limber Pine Decline

Whitebark pine (*P. albicaulis*) often occurs within harvest units at elevations above 1600 meters. The causes are primarily white pine blister rust and mountain pine beetle. To a lesser extent, the exclusion of fire has favoured its less fire-hardy competitors. As a result, this tree species was placed on the federal endangered species list in 2012. Whitebark pine is valuable to grizzly bears and many other wildlife species for its very large seeds. Per Chief Forester's Memo (18815-02) in early 2023, whitebark pine within harvest areas should be retained while applying best management practices to promote survivorship of retention (Murray and others 2021).

Limber pine (*P. flexilis*) is rare in the TSA and occurs only in southeast BC. As a five-needled pine, it is impacted by the same forest health agents as whitebark pine. It occurs at lower elevations, such as along Hwy 1 in Kicking Horse Canyon.

The cutting or damaging of these pines should be strictly avoided. Pine stands, especially those with many cone-bearing trees and in good health, are good candidates for wildlife tree reserves, Old Growth Management Areas, and Wildlife Habitat Areas for grizzly bears. In harvest areas, the light thinning of competing trees can promote pine survivorship by reducing competition and providing seed regeneration habitat.

5.3 INSECTS

Western balsam bark beetle IBB (*Dryocoetes confusus*)

Western balsam bark beetle has been chronically causing mortality over many years. In 2022 a similar amount of area and severity of attack was observed with 11,798 ha mapped in primarily Trace and Light Severity. IBB attack was 11,052 ha and 11,985 in 2021 and 202 respectively. Area of attack is scattered throughout the TSA, National Parks and Provincial Parks. There are significant areas of subalpine fir leading forest stands in the TSA that are susceptible to western balsam bark beetle. Direct control action on that insect is very difficult due to its attack dynamics and the scattered distribution of the stands. Licencees may want to consider not exacerbating IBB by leaving potential attack material such as downed green Sub-alpine fir slash or stubbing Bl trees for wildlife purposes, or at very least minimizing this activity where possible.

Douglas-fir beetle IBD (*Dendroctonus pseudotsugae*)

IBD incidence had been building for the last few years but has dropped slightly in 2022 to 599 ha compared to 709 ha in 2021 and 374 ha in 2020 with most of the attack in Light followed by Trace and Moderate Severity. The AOS areas of noted 2022 IBD attack include: several polygons around Golden Game and Smith Ck in north, and in Glacier and Kootenay National Parks. Management of blowdown and other significant debris is a key component of IBD management.

There are 58,933 ha of susceptible (>20 rating) forest types to Douglas-fir beetle in the Golden TSA outside of the National Parks based on a 2015 BMU analysis. Most of the susceptible area is in the 2 lower classes of 20-40 and 40 -60. The Douglas-fir beetle has the potential to significantly impact the Golden TSA timber supply. Therefore, the management of Douglas-fir beetle and Douglas-fir leading stands remain a high priority. **Trap tree and/ or funnel trap programs and monitoring post-harvest slash and monitoring blowdown in recently harvested blocks and removing or burning any slash are recommended beneficial practices to minimize future losses.** Additional good practice includes harvesting fired damaged trees and adjacent stressed trees to reduce IBD population increases. This may be even more important for small tenure holders such as Woodlots.

Previous years' analysis has shown minimal harvest of IBD attack to date. **Licencee response in suppression BMUs should be targeting harvest of at least 50% of the previous year's attack within 1 to 2 years.**

Spruce beetle IBS (*Dendroctonus rufipennis*)

Spruce beetle has decrease significantly in 2022 to 348 ha compared to 1,977 hectares in 2020 and 2,218 ha in 2021. The 2022 attack is primarily in Light and Moderate severity class. The main area with significant IBS outbreak areas outside of Glacier National Park and Hamber Provincial Park is in Upper Wood Arm in inoperable/ OGMA areas in 2021 and Glacier National Park, Kootenay National Park, Upper Wood Arm valley in 2022.

The infested THLB area has been relatively small in area in the THLB and only a very small amount of that area has been harvested or planned to harvest to date. No detailed flights were undertaken in 2020 for IBS in Golden TSA.

Rapid harvest response to any IBS outbreaks on operable THLB area is critical to reduce losses and IBS populations. Previous analysis has shown minimal harvest of IBS attack to date. **Given the current low amount of attack in operable areas, harvesting and keeping IBS populations low should be targeted through immediate harvesting, in less than 1 to 2 years.**

Spruce blowdown when identified is a high priority for treatment / harvest. The Bark Beetle Guidebook will guide treatments. Link is as follows:

<http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm>

There are 123,514 ha of susceptible (>20 rating) forest types to Spruce beetle in the Golden TSA outside of the National Parks based on a 2015 BMU analysis. The 24 BMUs have greater than 2,500 ha of susceptible Sx area. The TSA is very susceptible to IBS with the high amount of spruce covered area in moderate or higher susceptibility. Most of the susceptible area is within the 20-40 and 40-60 susceptibility classes.

Mountain pine beetle IBM (*Dendroctonus ponderosae*)

Mountain pine beetle decreased to essentially no area detected with only a single spot mapped. This is down from 445 ha in 2020 to 229 ha in 2021. It is recommended that Licencees harvest IBM attacked polygons within 2 years or less of discovery especially if Moderate, Severe or Very Severe attack noted to reduce non-recoverable losses.

There are only 4077 hectares of susceptible area within Golden TSA outside of the National Parks and 2564 of these hectares are within just the 4 BMUs – Blaeberry, West Bench, Chatter/ Prattle and Moberly.

> 500 hectares of susceptible (33+) Lodgepole Pine in ascending order of area from top to bottom.

5.4 MAMMALS

Voles

Voles are a reoccurring issue in the Golden TSA. Some areas have experienced extensive damage eg. Glenogle, Beaverfoot, and Blaeberry areas have experienced annual damage whereas other areas appear to be on a four-year cycle. Vole research treatments have included various types of repellents, guards and feeding station establishment consisting of a sunflower mix in areas where annual populations reside eg. Glenogle and Redburn Valley. No recent Vole issues have been reported to this District by the Licencees.

Other things to consider when harvesting in known vole areas are:

- using alternative silvicultural systems – green-tree retention (Douglas-fir, spruce) wherever possible, avoid contiguous clearcut units,
- enhance habitat for predators and predation – increase the number of debris piles will increase small carnivores, increase the number of snags and shrub trees will increase birds of prey,
- avoid the use of seeding of pasture grasses – use alternative shrub species (alder, willow) for erosion control,
- tree species selection/planting regime – plant spruce, subalpine fir, or larch where possible – all are relatively unpalatable to voles compared with lodgepole pine and Douglas-fir, plant more trees per ha to accommodate expected damage, use larger stock where possible, nursery seedlings with reduced fertilization regime and tree guards,
- provide a diversionary food source.

Bear

Bear damage is not easily identified by the overview survey. 72 ha were observed in 2022 compared to 0 ha in 2021 and 48 ha in 2020. Mortality often appears to be on younger (saplings and poles) single trees rather than widespread areas. Bear damage has been identified at the free growing survey stage and in a number of blocks where Stand Development Monitoring (SDM) plots have been established in the other TSAs in Selkirk District. To be detected on the AOS it would be significant damage within an opening or strata. Potential solutions to manage animal damage and in particular bear damage might include species diversity at time of planting and perhaps higher planting density as well. Rapidly growing, vigorous trees in moderately to lightly stocked stands are preferred by bears. Stands that have been juvenile spaced and or pruned appear to have a greater incidence of bear damage than stands that have not been spaced and or pruned.

5.5 ABIOTIC FOREST HEALTH FACTORS

Windthrow NW

Overall, damage because of wind can cause significant forest losses. Windthrow was not observed in 2022 and was mapped in 2021 at 93 ha and 10 ha in 2020. Two main areas were noted in 2021: Upper Blaeberry River (2 polygons) and several polygons within Glacier National Park. The geography of the area consists of many narrow valleys that drain cold air from higher elevations and flow into the Columbia River drainage: this concentrates air flows and can create turbulence pockets both of which can result in increased wind speeds. Strategies for managing windthrow risk include considering dominant wind patterns when establishing the boundaries for harvest areas, and, in rare cases where there are high values at risk and forested areas that are not overly decadent, feathering the edges of harvest blocks by selectively removing trees and retaining the more wind-firm stems. Since management strategies cannot account for unpredictable storm winds, aerial overview survey data will identify new patches of windthrow and can be evaluated for salvage potential. Whenever reasonable, windthrown timber should be salvaged within a short time from discovery so that bark beetle infestation levels are minimized.

Fire/ Post Fire Mortality NB/ NBP

Fire damage was up significantly in 2021 to 1,520 ha compared to only 137 ha in 2020. No fire damaged area was observed for 2022. Fire damaged areas should be considered for immediate salvage where economically feasible to capture volume before non-recoverable losses are incurred and assist with regeneration through reforestation activities post-harvest.

Hot Droughts ND

The frequency and intensity of drought combined with higher summer temperatures appears to be increasing in the southern interior of BC. No drought damage was observed in 2022 however a significant amount was in 2021, 1,526 ha, and was scattered throughout the TSA. As a result, trees become stressed, especially young regeneration stands on thin soils / rocky knobs/ ridges and overstocked (high density) mature stands. 2020 weather was not as hot and dry, and no area was noted for drought. Drought mortality may not become evident until the year following ~~as well~~. Impacted trees often don't die until a year or two post hot drought. The hot droughts of 2003 and 2007 are implicated in the timing of deaths of Armillaria infected regeneration on the Knappen Creek Stump Removal Trial. In a report to the Chief Forester, Axelson and Ebata (2015) predict the following impacts:

- Bark beetles of various species populations will increase.
- Plantation pests such as spruce weevil or lodgepole pine terminal weevil will increase.
- Defoliator activity could increase. Decline syndromes already being experienced in aspen and birch, they will continue or will become accelerated.
- Root diseases impacts will accelerate.

6 Management Objectives for Priority Forest Health Agents

6.1 Integrated Forest Health Management objectives

The following principle for management objective commonly known as “Integrated Forest Health Management” will be followed for all the priority forest health agents in the Golden TSA:

1. Know the land base and resource management objectives;

2. Manage from an ecological perspective;
3. Don't make the situation worse;
4. Practice adaptive management.

The Integrated Forest Health Management is a system that, in the context of specific resource management objectives and knowledge of the associated environment and the biology of the forest health agent and host species, applies all suitable techniques and methods to maintain forest health agent populations at levels below those causing unacceptable damage or mitigates such damage.

6.2 Management objectives for bark beetles (IBD, IBS and IBM)

The following are the management objectives to be implemented for the three main bark beetles in the Golden TSA: spruce bark beetle, Douglas-fir beetle and mountain pine beetle. Any reference to “bark beetles” in the following management objective refers to the three bark beetles listed above.

1. **Sanitation and salvage harvesting of beetle killed areas where economically feasible, especially Moderate or higher severity IBD, IBS and IBM attacked polygons and larger Light attack polygons identified by the Aerial Overview Survey or other surveys. Limit the amount of unsalvageable losses due to bark beetles. Target harvesting a minimum of 80% of the area to maintain BMU Targeted strategy within 24 months of the AOS flight.**
2. Prioritize the forest management to higher hazard forest stands by harvesting or reducing the susceptibility of stands to bark beetles.
3. Limit the amount of non-recoverable losses due to bark beetles;

Definitions:

Sanitation harvesting: harvesting operations specifically designed to maximize the extraction of currently infested or infected stands in order to reduce the damage caused by forest pests and to prevent their spread, e.g. bark beetles.

Salvage Harvesting: harvesting operations primarily designed to recover timber damaged or degraded by fire, an old insect attack, wind, or disease before the potential wood products become un-merchantable. Control of forest health factors such as bark beetles is incidental and is not the primary objective of salvage logging.

6.3 Harvesting Treatments

Harvesting is to be considered the preferred treatment for all infestations where it is operationally feasible. Treatment may include a single harvest regime or combination of harvest regimes ranging from large cut blocks, to single tree selection or small patch where appropriate.

The treatment goal is to remove as much, if not all of the current attack prior to the next beetle flight period. Within the Suppression Zone action plans must contemplate harvest before the next flight period. If this is not achievable, or the likelihood of pre-flight harvest is low, then these areas should be tabled as opportunities for other Licencees by at least April 1st of the following year.

Direct single tree treatments are not to be considered an alternative for harvest where the recovery of otherwise lost timber values and sanitation of beetles, i.e. removal of trees with brood can be attained. Where resources are insufficient to address the removal of all infestations prior to the next beetle flight, consideration must be given to minimizing block sizes and/or harvesting only those portions of the block that are infested this should be considered a short-term strategy until resources permit the removal of logical openings.

It is imperative the operational planning requirements are scheduled accordingly and where necessary to meet tight time frames. If necessary, expedited approvals should be requested and are appropriate where infestations are identified post-flight and where harvest is planned to take place prior to the next beetle flight.

Licencees should consider a small-scale sanitation program as required to meet overall objectives. Sanitation is defined as the removal of infested material prior to beetle flight. Sanitation is to be used, where necessary, to balance resource allocations to optimize the effectiveness of harvesting and single tree treatment strategies and maximize the recovery of otherwise lost timber values.

Sanitation should also be considered where landscape level disturbances and impacts dictate a light footprint approach and where a minimum of one truck load (40 m³) of operable timber can be recovered, within reasonable skid distance (400 metres) of established logging truck access; the objective is to remove all infested trees prior to the next beetle flight. Only under exceptional circumstances where the methods cannot be applied should these sites be baited and held over flight.

If it is determined that harvesting prior to the next beetle flight is impossible, then consideration should be given to expanding the harvest area to include the area baited, as well as sufficient susceptible host.

6.4 Hauling and Milling Guidelines

The following guidelines should be considered when areas surrounding the mill site are in or near urban areas, or in areas not yet affected by bark beetles.

In recognition of the potential for bark beetles to fly from milling facilities into adjacent areas the following guidelines apply typically from April 1 to August 15 for IBD, May 1 to June 30 for IBS and July 1 to August 31 for IBM.

- Manage -spring break up inventories of infested timber for priority processing prior to the above-noted period;
- Keep mill inventories and deliveries of bark beetle infested wood at a minimal operational level to meet business needs;
- Mill profile requirements permitting, prioritize processing beetle- infested sources over uninfested sources.
- Establish funnel traps (especially for IBD) in and around log yards, log decks and log booms to assist in monitoring bark beetle flight and to serve as a control measure. Traps should be monitored at least weekly and contents destroyed.

In recognition of the potential for bark beetles to fly from infested cut blocks (standing trees or decks) to adjacent timber, the following guidelines apply:

- In Salvage BMU's, no special considerations
- In Proactive, Targeted and Reactive BMU's:
 - For infested cut blocks that are not harvested/hailed prior to beetle flight, consider baiting to minimize spread. Licensees should, where practical, plan operations that avoid leaving decks of infested timber on site.
 - Communication of business needs/expectation for awareness between licensee and DSE prior to spring break-up/next beetle flight is required.

In recognition of the potential for bark beetles to fly from trucks during transport the following guidelines apply:

- Inform truck drivers when they are hauling green attack loads and that the beetle flight period typically extends from April 1 to August 15 for IBD, May 1 to June 30 for IBS and July 1 to August 31 for IBM.
- Inform truck drivers that extended delays along the way can result in bark beetles flying from the load into the adjacent forest land base.
- When practical, hauling of beetle infested logs should be as direct as possible from the cutting area to the mill.

6.5 Pheromone Placement

Pheromone placement is to occur in **infested stands only**, where beetle control activities cannot be implemented until after the next flight and in mop up operations around harvested and treated infestations. In the case of larger blocks with isolated concentrations of attack, only the infested portions of the block should be baited.

The use of pheromone baits must always be followed by actions to remove or eradicate the concentrated beetle populations. All pheromone placement plans should be shared at operational beetle planning meetings, including scheduling follow-up treatments and responsibilities.

Pheromone placement can be implemented throughout the spectrum of treatment strategies including fall and burn. Pheromones should not be placed in operable areas where population levels are extremely high and increasing, or in inoperable areas where population levels are endemic and declining.

The responsibility to carry out follow-up treatments to remove or eradicate concentrated beetle populations resulting from baiting lies solely with the placement agency (Section 41 of the Forest Planning and Practices Regulation (FPPR)). Follow-up actions must be carried out prior to the subsequent beetle flight unless specifically exempted by the District Manager (Section 91 of the FPPR).

Licensees, excluding TSL holders not operating under a cutting permit authority, should consider pheromone bait placement in unharvested portions of beetle infested blocks prior to biological beetle flight times where due to unforeseen circumstance the Licensee will not be able to complete harvest prior to the beetle flight.

All pheromone placement activities must be carried out in a manner which allows for future identification and location of baited trees. Baited trees must be marked conspicuously in the field using flagging, and the placement agency must be identified at each bait site. Maps identifying all baited areas should be provided to the District by September 15th each year. Detailed guidance and protocols on the use of pheromones is provided in “Strategies and Tactics for Managing the Mountain Pine Beetle”, developed for the B.C. Forest Service by Lorraine Maclauchlan and J. E. Brooks (http://www.for.gov.bc.ca/ftp/HFP/external/!publish/MPB_booklet/).

7 ROLES AND RESPONSIBILITIES

Detailed bark beetle surveys are carried out to determine the nature and extent of bark beetle infestations within the area of the plan. Specific areas requiring surveys are identified from aerial overview maps and previously known infestations.

If significant risks to forest resources are identified from surveys, actions to reduce risks are identified and reported within bark beetle survey reports and shared with the appropriate licensee. The responsibility to carry out these actions or measures is the responsibility of the licensee.

1. Responsibilities are assigned in this matrix according to funding source. Although there are allowances for some activities under the appraisal system, the responsibilities assigned include the implementation and funding of these activities.
2. If a Forest Licensee must carry out activities within the operating area of another Forest Licensee, the responsibility for bark beetle management activities post-harvest are to be negotiated in advance.
3. Where special management areas have been identified such as areas of interest for the Protected Areas Strategy, the responsibilities identified in this matrix may be amended to address specific management guidelines for these areas.

DSE Forest Health Responsibility Matrix

DISTRICT RESPONSIBILITIES	REGIONAL RESPONSIBILITIES
Prepare an annual TSA Forest Health Strategy	Conduct annual aerial overview surveys and provide digital data to Districts to produce overview maps and to distribute to DSE clients.
Info sharing at TSA Steering Committee meetings and directly to Forest Licensees and other clients	Produce and distribute the Provincial annual forest health overview surveys
Conduct detailed aerial and ground surveys within the TSA where deemed appropriate	Conduct defoliator monitoring & aerial treatments for defoliators (ex. spruce budworm Bt spraying)
Produce maps from the aerial surveys and provide ground survey information and maps to Licensees and clients	Provide overwinter mortality estimates of bark beetles
Within Selkirk Resource District (DSE), Forest Licensees have a responsibility to track, monitor and treat forest health factors. The following table covers the responsibilities for Licensees and the Ministry of Forests.	

ACTIVITY	MoF	LICENSEES
Monitor and evaluate forest health activities (Utilize the best current information to detect and manage forest health factors)	X	
Conduct treatment of defoliator outbreaks (MoF regional responsibility)	X	
Develop annual reports of bark beetle activities for the Province	X	
Conduct bark beetle treatments when required by the Forest Health Strategy	X	X
Maintain and share records of collected survey information	X	
Conduct ground surveys when required to verify incidence and severity of forest health pests	X	X
Conduct aerial overview forest health surveys and report on results (MoF region)	X	
Conduct detailed aerial surveys focusing on suppression beetle management units	X	
Submission of survey and treatment data to MoF		X

8.0 BMU STRATEGY - IBM, IBS AND IBD

No changes have been made to the BMU strategies for the 3 bark beetles for many years, there has been a Provincial update to the naming convention. All BMUs for IBD and IBS are currently listed as Targeted. IBM strategies are a mix of Targeted or No Action (in lower hazard BMUs).

. The updated Strategy options and descriptions are as follows:

1. Proactive	The use of proactive management tactics and is applied where beetle populations are in the endemic population phase. The key goal of the Proactive strategy is to prevent beetle populations from expanding to unmanageable levels.
2. Targeted	The use of aggressive pest reduction tactics on beetle populations that are in the incipient population phase and is applied where pest populations are building but can still be effectively reduced before more widespread infestation occurs.
3. Reactive	The use of tactics in response to pest populations that are in the epidemic population phase. The goal of the Reactive strategy is to reduce and mitigate widespread bark beetle-caused host tree mortality.
4. Salvage	Focus on the harvesting of mostly dead or dying trees and stands to minimize timber value losses in widespread infestations and is applied where management efforts would be ineffective in reducing beetle populations and subsequent levels of damage. The Salvage strategy is most suited for beetle populations that are nearing the end of the epidemic phase or in the post-epidemic phase. The goal is to recover timber value, to regenerate impacted areas and to reduce fire risk to promote future more resilient forests.
5. No Action	<p>The No Action strategy is applied to designated areas where:</p> <ul style="list-style-type: none"> • Natural disturbances are left unmanaged • Management efforts would be ineffective in substantially reducing beetle populations and impacts • There is no short-term possibility of salvaging dead timber • Access cannot be put in place before substantial merchantable degradation of the dead material (economically constrained areas) • Non-timber values or other management constraints such as wilderness areas, Parks or ecological reserves, culturally significant areas, supersedes that of timber or wood products <p>Areas designated as no action should be large enough to allow for the full range of ecosystem processes through time.</p>

Table 5: BMU Strategy by beetle: IBD, IBS, IBM for 2020/2021 for Golden TSA

BMU	BMU Name	Bark Beetle		
		IBM	IBS	IBD
G01	Upper Wood	No Action	Targeted	Targeted
G02	Molson/Dainard	No Action	Targeted	Targeted
G03	Lower Wood	No Action	Targeted	Targeted
G04	Tsar	No Action	Targeted	Targeted
G06	Kinbasket	No Action	Targeted	Targeted
G07	Sullivan	Targeted	Targeted	Targeted

G08	Foster/Garrett	Targeted	Targeted	Targeted
G09	Chatter/Prattle	Targeted	Targeted	Targeted
G10	Bush River	Targeted	Targeted	Targeted
G11	Goosegrass	No Action	Targeted	Targeted
G12	Windy/Austerity	No Action	Targeted	Targeted
G13	Bachelor	Targeted	Targeted	Targeted
G14	Ventego	No Action	Targeted	Targeted
G15	Esplanade	No Action	Targeted	Targeted
G16	Blackwater Ridge	Targeted	Targeted	Targeted
G17	Hope/Goodfellow	Targeted	Targeted	Targeted
G18	Valenciennes	Targeted	Targeted	Targeted
G19	Bluewater/Waitabit	Targeted	Targeted	Targeted
G20	Moberly	Targeted	Targeted	Targeted
G21	Blaeberry	Targeted	Targeted	Targeted
G22	Quartz	Targeted	Targeted	Targeted
G23	West Bench	Targeted	Targeted	Targeted
G24	Canyon	No Action	Targeted	Targeted
G25	Mount Seven	Targeted	Targeted	Targeted
G26	Kickinghorse/Beaverfoot	Targeted	Targeted	Targeted
G27	Ice/Moose	No Action	Targeted	Targeted
G28	Kootenay	Targeted	Targeted	Targeted
G29	Swan	No Action	Targeted	Targeted

9 Recommended activities to manage IBS, IBD and IBM

9.1 Douglas-fir beetle

The overall strategy for IBD management is that of suppression/monitor using one or a combination of the following:

1. Sanitation harvesting;
2. Clean harvesting practises;
3. Trap trees;
4. Anti-aggregation pheromones (MCH);
5. Funnel trapping.

9.1.1 Harvesting

Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and stress factors such as nearby windthrow, fire damage for example and/ or infestation is critical to meeting suppression strategy objectives and reducing non-recoverable losses. A combination of sanitation and salvage harvesting for Douglas-fir beetle suppression should be carried out in areas of current-attack in order to reduce the existing population and inhibit the infestation expansion. Failure to address these losses continues to impact future timber supply determinations negatively.

Trap trees are highly recommended as an effective tool to reduce overall beetle population levels in any IBD areas or Douglas-fir stands and complete a post-harvest mop-up where necessary. Baited funnel traps and MCH anti-aggregant may be used where conditions are appropriate.

9.1.2 Pheromone Use

Pheromone use is planned for use with IBD funnel trapping projects is covered by the Southern Interior Region Pest Management Plan. No Planned funnel trapping by MoF in Golden for 2023-24.

http://www.for.gov.bc.ca/rsi/ForestHealth/PDF/PMP_2013-2017_FH_Southern_Interior_Feb_19_2013.pdf.

9.1.3 Single tree treatment and other treatments

No planned single tree treatments currently.

9.1.4 Detailed Flight and Ground Surveys

The current plan for 2023-24 continue to monitor Forest Health issues through the Aerial Overview Survey.

9.2 Spruce beetle

The overall strategy for IBS management is that of suppression/monitor using one or a combination of the following:

1. Clean harvesting practices;
2. Trap trees.

9.2.1 Harvesting

Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and/ or infestation is critical to meeting suppression strategy objectives and reducing non-recoverable losses. A combination of sanitation and salvage harvesting for Spruce beetle suppression should be carried out in areas of current attack in order to reduce the existing population and inhibit the infestation expansion. Failure to address these losses continues to impact future timber supply determinations negatively.

Trap trees are highly recommended as an effective tool to reduce overall beetle population levels in any IBS areas or Spruce stands and complete a post-harvest mop-up where necessary.

9.2.2 Pheromone Use

No planned use of pheromones is planned at this time for IBS management.

9.2.3 Single tree treatment and other treatments

No planned single tree treatments currently.

9.2.4 Detailed Flight and Ground Surveys

The current plan for 2023-24 continue to monitor Forest Health issues through the Aerial Overview Survey. No ground surveys currently planned.

9.3 Mountain pine beetle

9.3.1 Harvesting

Harvesting is the most efficient short-term method of managing IBM populations with the intent to prevent timber loss. Timber harvesting in infested (1st priority) and red/grey attack (2nd priority) and un-infested stands (3rd priority) with high hazard and/ or infestation is critical to reducing non-recoverable losses. Failure to address these losses will impact future timber supply determinations negatively. In order to reduce mid-term timber supply impacts harvesting should be targeted at infested stands with significant hazard where feasible.

9.3.2 Pheromone Use

None planned at this time.

9.3.3 Single tree treatment and other treatments

No planned single tree treatments currently.

9.3.4 Detailed Flight and Ground Surveys

None planned at this time as the susceptible area is too small.

10 Priority Activities in BMUs

The following projects are planned:

- Ongoing discussions with Licencees regarding active IBS, IBD and IBM populations and infestations in their operating areas and targeting these areas and any fire damaged or windthrow areas for immediate harvest.
- Encouraging Forest Licencees to consider their own funnel trap and trap tree programs.

11 2023-24 Fiscal Year Tactical Plan

The tactical plan will be to continue to monitor forest health agents through the overview survey.

Forest Licencees have been encouraged to consider their own funnel trapping programs and trap tree programs for IBD. The focus will continue TSA Licencees meetings to address primarily IBD & IBS impacted areas through harvesting to reduce non-recoverable losses and attempt to limit the spread of the various bark beetles. No planned single tree treatments currently.

12 Stocking Standards

Forest health concerns can be a factor in species selection and other aspects of stocking standards. Significant concerns in Golden might relate more to drought for some species currently listed in DCO stocking standards such as Sub-alpine fir at lower elevations where it was not previously listed by Chief Forester Standards.

Licencees and prescribing foresters need to be cognizant of climate change and how this can impact future timber supply through stocking recommendations and forest health issues that may have greater, lesser or different impacts in the future as a result of climate change. With the effects of climate change and the unforeseen impacts that this will have on forest health, it will be important to recognize changing environmental conditions and predict the effect that this will have on the management of forest ecosystems. Forest managers will need to assess the suitability of other non-native species as well as how current species will respond to changing climatic conditions.

An additional consideration to professionals completing Free Growing (FG) declarations is the age at which plantations can undergo FG evaluation. The average FG declaration age is 9 years in the South Area. However, Armillaria root disease, the primary agent of mortality in a substantial number of plantations, does not typically spread until 12-16 years. Thus, FG evaluations prior to 16 years of age risk underestimating stand mortality.

13 Non-Recoverable Losses

Non-recoverable losses (NRLs), or unsalvaged losses, are the amount of volume lost annually to damaging agents that is not harvested. This represents losses above and beyond those already accounted for in existing growth and yield models, often as a result of unpredictable events. These losses can be both incremental losses (e.g. defoliation, defect) and mortality. NRLs are generally subtracted from yield projections.

Table 6: 1999-2019 THLB volume killed, and not harvested and total killed volume harvested by selected Forest Health factors.

Annual Volume Killed on the THLB and Not Harvested as of 2019 -- Golden TSA								Volume Killed and Harvested	
Year	IBM	Fire	IBB	Wind Throw	IBS	IBD	Totals*	m ³	% of Total Killed
1999-2009	533,336	12,942	17,318	2,631	468	4,260	569,280	278,470	33%
2010	26,128	1,914	357	6,386	0	535	28,934	7,007	19%
2011	18,405	253	137	877	0	104	18,899	3,990	17%
2012	11,338	77	587	6,486	1,332	0	15,418	3,360	18%
2013	7,993	0	885	250	0	0	9,853	2,226	18%
2014	10,392	776	4,071	0	0	0	17,378	563	3%
2015	13,536	0	3,026	0	166	241	17,387	705	4%
2016	8,396	0	1,000	0	1,029	1,053	11,478	424	4%
2017	9,578	6,040	1,287	624	2,266	3,692	23,959	825	3%
2018	1,888	32,491	6,839	0	161	0	41,594	4,658	10%
2019	608	0	4,705	0	8,772	1,002	15,087	-	0%
Totals	641,598	54,493	40,212	17,254	14,194	10,887	769,267	302,228	28%

*Includes Flooding & Drought

The estimated annual forest volume killed by selected Forest Health Factor and not harvested in the Timber Harvesting Land Base (TSA only), as well as the amount of that killed volume that has been harvested for 1999 to 2019 (Table 6). Over the 21 years reported in this table the volume lost by the significant FH factors represents about **7.4%** of the AAC for that time period. The 21-year average annual of Volume Killed and harvested is 28% and 2008 was the last year that the TSA met or exceeded this value. The years 2014 to 2019 had very low harvest recovery rates of only 0-10%. Ideally Licencees should target more of the beetle attacked AOS polygons for harvest and within a faster timeframe to reduce losses and beetle population growth which contribute to more future timber losses. While there is often a lag between losses and harvesting and some damaged timber is easier to harvest than others, the last 6 years show a low harvest response to date. Given the rise of IBD and IBS **Forest Licencees are encouraged to target the damaged stands for immediate harvest (maximum completion in 2 years)**. The lower NRLs in 2019 are due to no fires recorded causing significant volume losses.

There is no 2020 to 2022 update to this table as it was not supplied at the time of this report preparation.

The historical Golden TSA AAC (excludes Area based tenures –Woodlots) from 1999 to present is listed in the table below.

Golden TSA Historical AAC	
Year	Volume m3
1999	540,000
2000-2003	530,000
2004-Present	485,000
23 Year Total	11,390,000

14 Conclusion

This Forest Health Strategy provides strategic direction for the licensees and MoF in the Selkirk Natural Resource District – Golden TSA. 2021 and 2022 significant concerns are: Spruce Beetle, Fire damage, Douglas-fir Beetle, Western Balsam Bark Beetle and Western Hemlock Looper and areas affected by these FH agents should be considered for targeted harvesting where possible. Prompt action can mitigate any future losses. Hemlock Looper appears to be on the rise and is worth being cognizant about. Specific practices conducted by each licensee should fall within the strategic direction provided within this document. There are significant concerns on the spread and ongoing non-recoverable losses because of the 4 bark beetles – Spruce Beetle, Douglas-fir Beetle, Western Balsam Beetle and Mountain Pine Beetle and fire damaged stands and the necessity to address these through harvest and other active management tools to reduce NRLs in the present and future. A potential concern could be woodborers as in the southern TSAs within Selkirk and Rocky Mountain Districts they appear to be primary mortality agents instead of secondary possibly due to the Heat dome and extended droughts. Currently no known area for woodborers in Golden at this time.

Periodic review of the Forest Health Strategy will allow adaptive management principles to be used. The plan is to review it on an annual basis will ensure forest managers regularly turn their minds to other potential sources of damage or risk to the forest.

The active co-operation of licensees and MoF staff working together to promote and manage healthy forests through diversity, early detection of forest health issues, and direct action as required, will ensure a sound and sustainable industry.

15 Information Links and Reference Material

Report: 2022 Overview of Forest Health Conditions in Southern British Columbia

<https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/aerial-overview-surveys/summary-reports>

Provincial Forest Health Strategy 2019-2022

https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/fh-strategies/final-2019-22_bc_pfhs.pdf

Provincial Bark Beetle Management Technical Implementation Guidelines (formerly Bark Beetle strategy)

<https://www.for.gov.bc.ca/hfp/health/fhdata/bbstrategy.htm>

Spatial Data:

Bark Beetle Hazard Ratings https://www.for.gov.bc.ca/rsi/foresthealth/hazard_rating.htm

2022 and earlier Annual Overview Surveys. (fixed wing based aerial mapping of all visible forest pests).

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

2021 and earlier Detailed Mapping (Helicopter based aerial mapping of Beetle Management Units with a Douglas-fir beetle strategy of suppression). Available upon request from District Forest Health Staff or at following FTP location:

<https://www.for.gov.bc.ca/ftp/DAB/external!/publish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/>

2019-21 Maps of IBD, IBS and IBM for the area are available on the FTP site at

<https://www.for.gov.bc.ca/ftp/DAB/external/!publish/Forest%20Health/Detailed%20and%20Aerial%20Overview%20flight%20data/2018%20data/AerialOverviewSurvey%202016-2018%20IBM%20IBD%20NW%20NF%20GEOrefPDF%20maps/>

Additional maps and data are available on the Branch FTP site at
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/

Murray, M.P.; Berg, J.; Huggard, D.J. **Harvest Retention Survivorship of Endangered Whitebark Pine Trees.** *Forests* 2021, 12, 654. <https://doi.org/10.3390/f12060654>.



Black army cutworm pheromone trapping to monitor populations.