

Integrated Stewardship Strategy for the Stuart TSBs (A, B, C) in the Prince George TSA

Situation Analysis

Version 1.2

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Project 419-37

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Executive Summary

This Integrated Stewardship Strategy (ISS) project aims to **facilitate a respectful and collaborative planning process that supports the delivery of defined stewardship outcomes - which in turn improves business certainty for licensees operating within Stuart TSBs in the Prince George TSA (formerly the Fort St James District).**

This Situation Analysis is the first of nine documents to make up the ISS. It describes the status of the resources within the Stuart TSBs and the issues that affect their sustainable use.

The Stuart TSBs is home or traditional territory to twelve First Nations including the: Nak' azdli Band, Yekooche First Nation, Tl'azt'en Nation, Takla Lake First Nation, Lake Babine Nation, Lheidli T'enneh, Tahltan Central Government, Halfway River First Nation, West Moberly First Nation, Tsay Keh Dene, Nadleh Whut'en First Nation, and the McLeod Lake Indian Band.

Twelve forest licensees currently operate within the Stuart TSBs, including Apollo Forest Products Ltd., BC Timber Sales, CONIFEX, Canadian Forest Products Ltd, Carrier Lumber Ltd., Consortium No. 6, Lakeland Mills Ltd, Sinclair Group, Stuart Lake Lumber, Ta Da Chun, and Winton Global. Each licensee has a defined, albeit unofficial, operating area. These areas may be subject to change in the near future as the dead pine salvage period draws to a close as the green timber for the mid-term timber supply is not evenly distributed throughout the supply block. Licensees in the area include

The First Nations, licensees, interest groups, and public stakeholders will play a vital role ensuring that all relevant and recent information is compiled for use in the planned analyses. In particular, we welcome First Nations' active participation to provide traditional knowledge to help develop more robust and appropriate management scenarios that will be examined in future phases of this project.

While the timber supply review accounted for many factors in determining the AAC, exploring alternative land use options was outside its scope. In recent years, government agencies and licensees operating within the Stuart TSBs have developed an array of strategies and plans, including:

- Legal objectives set by government
- Provincial timber management goals and objectives
- Fort St. James Land and Resource Management Plan
- Federal Recovery Strategy for Woodland Caribou, Southern Mountain population
- Sustainable Forest Management Plan
- Several consecutive Silviculture Strategies
- BC Mountain Pine Beetle model (BCMPBv12)
- Provincial Stewardship/Timber Harvest Land Base Stabilization
- Future Forest Products and Fibre Use Strategy
- Multiple Resource Value Assessment
- Forest Health Strategy
- Ecosystem Restoration
- Whitebark Pine Tactical Recovery Plan
- Fire and Fuel Management

In the Prince George TSA the MPB infestation began in 2002, peaked in 2004 through 2007, and had finished by 2013. The extensive impact of the mountain pine beetle on the TSA's pine forests leaves a very uneven distribution of green timber for the mid-term. A large proportion of the mid-term timber for the entire TSA will be available in the northwest end of the Stuart TSBs. While this dependency on a large proportion of the cut coming from one geographical area has enormous operational and logistical challenges, it also has potential to adversely affect the full range of non-timber values if not managed

carefully. This ISS has been initiated to ensure that all values are managed appropriately during this intensive harvest mid-term period in the Stuart TSBs.

The Prince George TSA AAC of 9.3 million m³/year was initially uplifted to 12.2 million m³/year in 2002 to facilitate the salvage of beetle-killed pine. It was further increased in 2004 to 14.9 million m³/year as the outbreak worsened, and was then reduced in 2011 to the current level of 12.5 million m³/year. The current AAC is still a 34% uplift from the pre-beetle infestation level, and has a specific partition assigned to target dead pine and limit green timber harvesting.

According to the BCMPBv12 model projections, approximately 68.3 million m³ or 67% of the pine volume has been killed in the Stuart TSBs. Overall in the Prince George TSA the total figure killed by 2020 is projected to be 196 million m³. There will be a significant fall down in timber supply in the Prince George TSA following this salvage period in short term when harvest levels are estimated to drop from the current 12.5 million m³/year to 6.4 million m³/year. Mitigation strategies being considered in the current TSR may help to alleviate this falldown throughout the mid-term.

This salvage period continues to pose significant challenges to forest licensees who must:

- quickly respond to volatile market prices,
- address the many and significant forest health issues impacting these forests,
- consider biodiversity, wildlife, other resource values and users,
- introduce new harvest methods and equipment (i.e., cable) as salvage operations extend into steeper terrain, and
- carefully monitor and prioritize dead pine stands as they deteriorate beyond minimum harvest criteria and maximum haul distances.

Applying the 2015 TSR “shelf life” curve provides an estimate that the dead pine will continue to retain some commercial value for up to 20 years from when it was attacked (i.e., 2017 to 2028). This is based on the timber having primary value as sawlogs, then pulp, and finally as biomass for energy. The salvage period strategy with the increased AAC is to harvest the dead pine stands now and save green timber for after the salvage period comes to an end (i.e., the mid-term harvest period). By 2028, the harvest is expected to have shifted almost completely to non-pine leading stands.

MPB-killed pine stands that are not salvaged in time and that have become economically inoperable will require assessments to determine whether to rehabilitate or leave them to regenerate naturally - since some stands may have sufficient advanced regeneration.

MPB is not the only forest health impact to these forests. Significant tree mortality is currently observed with “balsam decline” as older trees die off, likely due to a combination of factors, gall rust affecting regenerating pine stands and the ever-increasing risk of fire as the dead wood dries.

One of the primary considerations for this project is to ensure that wildlife and biodiversity values are maintained while optimizing timber harvesting opportunities during the critical salvage period. This will be exacerbated throughout the mid-term as a large proportion of the TSA cut will be concentrated within the Stuart TSBs.

Over 940,000 hectares of the Stuart TSBs, 41% of that forested, has been designated as parks and protected areas and removed from the timber harvesting land base. These areas provide significant ecological and recreational value and contribute towards wildlife and biodiversity objectives.

Parks, ungulate winter ranges and wildlife habitat areas contribute to maintaining biological diversity. However, more focused consideration is applied through the establishment of landscape- and stand-level reserves through non-spatial old growth retention, wildlife trees, and riparian areas. Other biodiversity considerations include coarse woody debris management and patch size distribution.

Risks to wildlife, biodiversity, and other resource uses must also be identified and understood to mitigate adverse, unintentional impacts to these values. Examples of these risks include increased sedimentation from riparian disturbance and road surface siltation, increased use of pesticides, road density, loss of sufficient closed canopy or interior forest condition habitat, and increased access providing advantages for predators and hunters.

Specific changes in seasonal weather have been modelled and are available by region. Climate change adaptation strategies are being developed for the Province but specific silvicultural treatments for the Stuart TSBs are not available at this time.

Other key values identified in this document include First Nations interests and cultural heritage, visual quality, recreation, guide outfitters, trappers, watershed health. Historically, mining has played a major role in developing this area. This has also helped to support new infrastructure such as camps and the new rail line. Other specific issues considered are road density and access issues, herbicide use, and deciduous utilization.

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List of Acronyms

AAC	Allowable Annual Cut
BCMPB	BC Mountain Pine Beetle Model
BCTS	BC Timber Sales
BEC	Biogeoclimatic Ecosystem Classification
FLNR	BC Ministry of Forests, Lands and Natural Resource Operations
FLTC	Forest Licence To Cut
FPPR	Forest Planning and Practices Regulation
FRPA	Forest and Range Practices Act
HEWR	High Elevation Winter Range
ISS	Integrated Stewardship Strategy
LRMP	Land and Resource Management Plan
MoE	BC Ministry of Environment
MPB	Mountain Pine Beetle
MRVA	Multiple Resource Value Assessment
OBAC	Omineca Beetle Action Coalition
RESULTS	Reporting Silviculture Updates and Land status Tracking System
SERNbc	Society for Ecosystem Restoration in North-Central BC
SFMP	Sustainable Forest Management Plan
THLB	Timber Harvesting Land Base
TSA	Timber Supply Area
TSB	Timber Supply Block
TSR	Timber Supply Review
UWR	Ungulate Winter Range
WHA	Wildlife Habitat Area

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Revision History

Version	Date	Notes/Revisions
0.1 (1.0)	December 5, 2015	First version distributed for review and comment.
1.1	May 25, 2016	Revised sections 2.2, 2.3, 2.6, 2.11, and 3; more significant changes were made to sections 7; 8.2, and 11.1.2.
1.2	March 31, 2018	Updated document title from "Integrated Silviculture Strategy" to "Integrated Stewardship Strategy". Updated Provincial Timber Management Goals and Objectives (2017) in section 2.1.

1 Introduction

The British Columbia Ministry of Forests, Lands and Natural Resource Operations (FLNR) has initiated an Integrated Stewardship Strategy (ISS) for the Stuart Timber Supply Blocks (TSB) within the Prince George TSA. The ISS is an evolving planning process that aims to provide context for management decisions necessary to achieve forest level objectives. It integrates other planning processes that have historically been separate or disjointed, such as:

- wildfire management planning,
- forest health,
- wildlife habitat planning,
- biodiversity habitat planning,
- cumulative effects, and
- silviculture strategies.

Aligning these plans and strategies within a common process will focus landbase investments, improve planning outcomes, and enhance communications with stakeholders and First Nations – resulting in increased efficiency and effectiveness to stewardship planning relative to status quo.

1.1 Integrated Stewardship Strategy Objectives

In support of government objectives to mitigate forest health impacts on mid-term timber supply, this ISS project aims to:

Facilitate a respectful and collaborative planning process that supports the delivery of defined stewardship outcomes - which in turn improves business certainty for licensees operating within Stuart TSBs.

This improved certainty will be achieved through the creation of:

1. A common understanding among participants of the goals, values, issues, and challenges facing the Stuart TSBs.
2. A well designed Landscape Reserve Strategy that realigns existing land-use designations and constraints to increase or minimize impacts to the timber harvesting land base (THLB) while addressing as many stewardship issues as possible. This includes First Nation's interest and will ultimately help indicate the areas of the landbase that are currently suitable for harvesting by licensees.
3. A Silviculture Strategy that provides clear direction on how to achieve improved timber and habitat outcomes in the future through investments in silviculture.
4. A coordinated Harvest Strategy that identifies approaches to harvest scheduling aimed at addressing common interests (MBP salvage, equitable access to green timber, landscape level fuel breaks, etc.).
5. A plan for monitoring and evaluating progress and effectiveness towards meeting key goals and objectives that support future management decisions in the Stuart TSBs.

These objectives are meant to align with Provincial Timber Management Goals and Objectives (FLNR 2017), the Chief Forester's *Provincial Stewardship Optimization/Timber Harvesting Land Base (THLB) Stabilization Project* (FLNR 2015) and FLNR staff.

1.2 Context

The situation analysis is the first of seven documents developed through the ISS process:

1. **Situation Analysis** – describes in general terms the situation for the unit – this could be in the form of a PowerPoint presentation with associated notes or a compendium document.
2. **Integrated Strategies** - describes the development of the overall (preferred) strategy to be explored through forest-level modelling. Tactics are grouped into three broad categories:
 - a. **Landscape-Level Reserve Tactics** – review and analyze existing and proposed management zonation and develop strategy options that provide for the sustainable management of non-timber values.
 - b. **Landscape-Level Harvest Tactics** – review and analyze current and planned timber harvesting plans, infrastructure, and capabilities in the context of the distribution of MPB-killed pine salvage opportunities and the landscape reserve strategy. This must consider the current salvage period and the transition into the mid-term timber supply.
 - c. **Silviculture Tactics** –provides treatment options, associated targets, timeframes and benefits to minimize the impact of the MPB infestation over the mid-term timber supply.
3. **Data Package** - describes the information that is material to the analysis including the model used, data inputs and assumptions.
4. **Analysis Report** –provides modeling outputs and rationale for choosing a preferred scenario.
5. **Tactical Plan** – direction for the implementation of the preferred scenario.
6. **Final Report** – summary of all project work completed.
7. **Monitoring Plan** – direction on monitoring the implementation of the ISS; establishing a list appropriate performance indicators, developing monitoring responsibilities and timeframe and a reporting format and schedule.

This particular document aims to provide brief summaries of the current situation for a very wide range of forest resource values and issues of concern that pertain to the Stuart TSBs. Ultimately this reference is not expected to provide answers but rather invite questions and stimulate ideas for the next phases of the ISS project.

In some cases the authors have extracted or paraphrased sections from existing material and referenced the appropriate sources for the reader to explore further. This list of topics was limited to those being considered - at this time - for the project as other topics may be currently outside of the project scope.

1.3 Project Area

The project area (Stuart TSBs) is situated in north-central British Columbia (Figure 1) and covers 3.174 million hectares. This area represents the former Fort St. James Forest District; comprised of TSBs A, B, and C of the Prince George TSA. It also lies within the newly-formed Stuart Nechako Natural Resource District administered from the FLNR office located in Fort St. James. Because of this recent change in district name, most documents, maps and websites still refer to the project area as the Fort St. James Forest District.

The Stuart TSBs form an elongated area running in a northwest to southeast direction, bordered by the Skeena Mountains to the West and the Omineca mountains to the East.

Forests are mostly comprised of lodgepole pine and spruce, with balsam at higher elevations and scattered patches of aspen. There are some areas of Douglas-fir - particularly along the shores of Stuart Lake. A history of frequent wildfires has left a mosaic of forest ages. The majority of the stands are young, but there is some old-growth along the lakeshore. Old and mature balsam stands are found in the northern portion of the district. An ecological reserve at Takla Lake consists of Douglas-fir at the northern-most tip of the species' range.

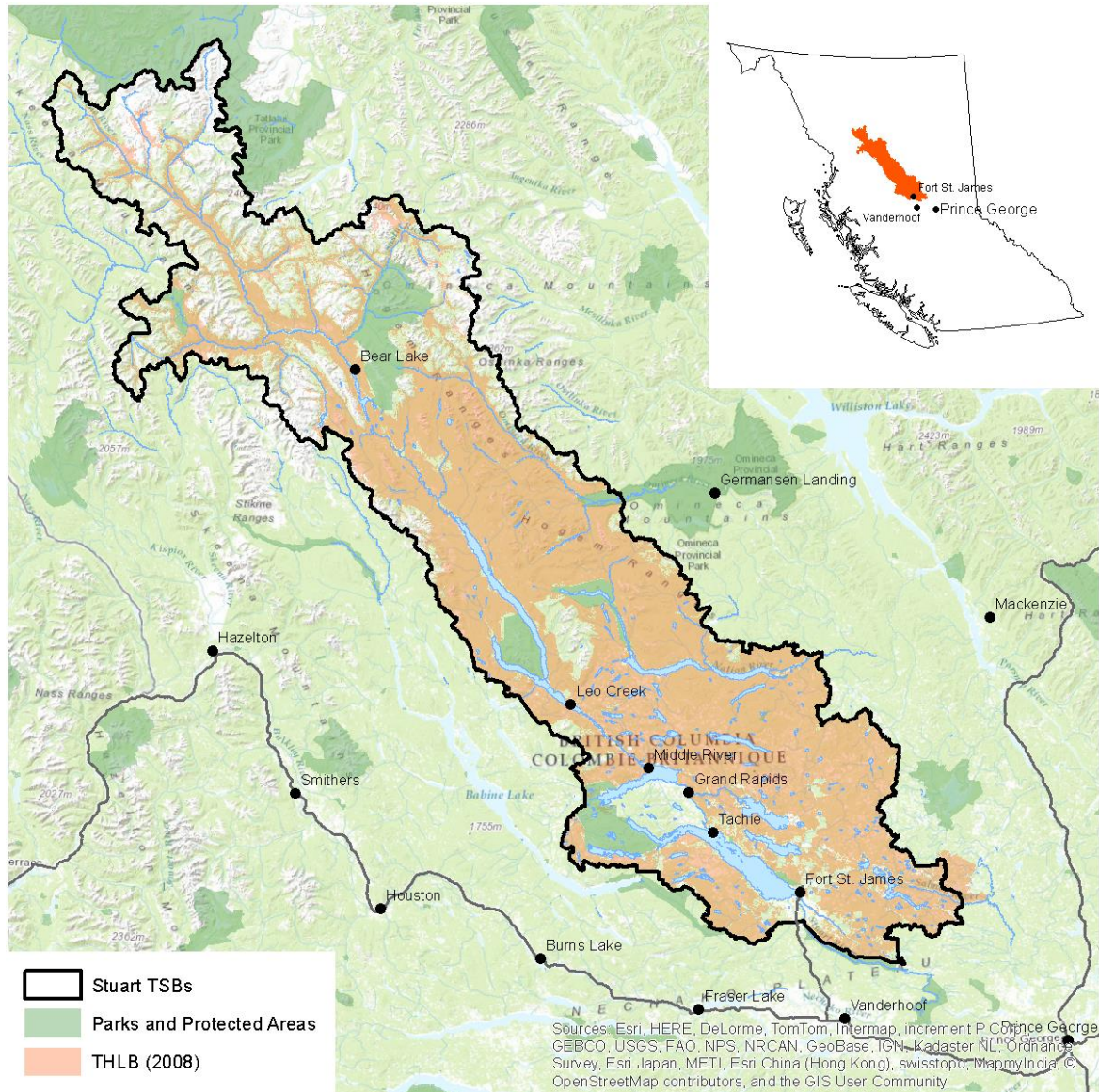


Figure 1 Project Area - Stuart TSBs within the Prince George TSA

Source: *Mid-term Mitigation Timber Supply Analysis, Prince George TSA, November 17, 2011*

Approximately 4,500 people live within the Stuart TSBs; the majority within the municipality of Fort St James.

Source: *District of Fort St James municipal website (<http://fortstjames.ca/first-nations/>)*

2 Summary of Current Plans and Strategies

The subsections below provide a brief summary of the strategies and plans that may pertain to this project. Others are specifically identified in other sections of this document (e.g., climate change adaptation).

2.1 Provincial Timber Management Goals and Objectives

Provincial Timber Management Goals and Objectives (FLNRO 2017) set high-level provincial timber management goals, objectives and targets to provide context and guidance for planning across management units - including specific direction to ISS projects. These timber management goals are intended to be aligned with the Vision for B.C. Provincial Forests, which includes:

- Managing forests to meet present needs without compromising the ability of future generations to meet their needs;
- Providing stewardship of forests based on an ethic of respect for the land;
- Maintaining and restoring proper ecosystem function and promoting ecological resilience for influences such as climate change;
- Balancing economic, social, spiritual, ecological and recreation values of forests to meet the needs of peoples and communities, including First Nations; and
- Conserving biological diversity, soil, water, fish, wildlife, scenic diversity and other forest resources.

The 5 main timber management goals are summarized below while context and much more detail is available in the source document.

2.1.1 Timber volume flow over time

Timber volume flow over time describes what has traditionally been the focus of sustainable forest management. The provincial aim is not a strict even flow regime, but rather predictable and reliable flows to support economic and social objectives. Timber flow will be managed in an integrated manner with other key forest values.

Goal	Promote resilient and diverse forest ecosystems to provide a sustainable flow of economically valuable timber that generates public revenue, and supports robust communities and healthy economies for a vigorous, efficient and world-competitive timber processing industry.
Objectives	<ol style="list-style-type: none"> 1) Manage timber in an adaptive manner to address the dynamic nature of natural processes and the inherent uncertainty of managing over long timeframes. 2) Achieve forecasted long-term harvest flows through the application of timber management activities, including harvest practices and silviculture investments. 3) Use available data to continuously improve timber flows, verify assumptions, and reduce uncertainty. 4) Promote and support the innovative utilization of economically available fibre.
Targets	<ul style="list-style-type: none"> • Based on a 22-million hectare timber harvesting land base (THLB), produce: a mid-term timber supply of at least 57 million m³/year and a long-term timber supply of at least 65 million m³/year. • Local targets should incorporate assumptions and outcomes from the most recent TSR and associated forward-looking strategies available in individual management units.

2.1.2 Timber quality

Timber quality is defined by species, log sizes and grades, end use, and economic value. In order to minimize risks and maintain future options for different products, a diverse portfolio of timber quality is desirable.

Goal	Maintain a diversity of timber-related economic opportunities through time.
Objectives	<ol style="list-style-type: none"> 1) Proportions of high-value tree species within each management unit will be maintained at no less than pre-harvest levels. 2) Restock new forests with trees that will produce high-quality fibre (including sawlogs) as the primary product objective. 3) Ensure a proportion of the growing stock will produce future logs of premium grade.
Targets	<ul style="list-style-type: none"> • To produce a minimum of 10 per cent premium grades annually from B.C.'s forests, both now and in the future. • Local targets should incorporate assumptions and outcomes from the most recent TSR and associated forward-looking strategies available in individual management units.

2.1.3 Tree Species Composition

Tree species composition is an important overall forest resource consideration as it influences timber values, health, resilience, and non-timber values. Tree species diversity is a fundamental climate change adaptation strategy. Tree species composition overlaps with other timber management goals such as timber quality and stand productivity.

Goal	Maintain or enhance timber and non-timber values, forest health, and resilience through the management of tree species composition.
Objectives	<ol style="list-style-type: none"> 1) Where it is ecologically feasible, reliable and productive, use a resilient mix of species at both the stand and landscape scales to reduce long-term forest risks and maintain future options. 2) Promote reforestation of species compositions that reduce vulnerability from climate change and forest health impacts on timber and other forest values. 3) Reduce the occurrence of species where future risks (ecological and economic) are disproportionately high compared with other species. 4) Plant trees that are well adapted to the climate of the areas in which they are planted, contain adequate genetic diversity, and form part of diverse forest ecosystems across the landscape.
Targets	<ul style="list-style-type: none"> • At least 80% of harvested areas are planted with more than one species. • The change in pre- and post-harvest tree species composition in the last five reporting periods is within +/- 2 percentage points. The pre-harvest species composition is measured using HBS volumes, and the post-harvest tree species composition is measured using RESULTS forest cover inventory label stems/ha at the time of free growing. • Initial tree species targets for each management unit will be set using the process outlined in the Species Monitoring Report data package. • Additional local targets should incorporate assumptions and outcomes from the most recent TSR and associated forward-looking strategies available in individual management units.

2.1.4 Stand productivity and growing stock

Management of stand productivity and growing stock focuses on trends in standing timber (all ages) over the management unit through time. This encompasses the health, genetics, density, and stocking of various stands so that they can productively utilize site resources, balanced against the various risks that can threaten the growing stock through its life span.

Goal	Maintain or improve the productivity of the growing stock in provincial forests.
Objectives	<ol style="list-style-type: none"> 1) After significant and sudden changes to growing stock from natural disturbances and salvage harvesting, cost-effective management options with timely management unit analysis and planning will be developed for the consideration of government. 2) Target full site occupancy of growing space after making effective allowances for other values and risks. 3) The proportion of high-risk species¹ across a management unit will not be increased, and, where future risks for such species are disproportionately high compared with other species, they will be gradually reduced. 4) Decisions at the stand level will not be made solely on the basis of return-on-investment data, but will consider stand-level risks and management unit objectives and targets. 5) Tree seed selected for improved growth or pest tolerance is used, where available. 6) Risks to productivity and growing stock (including risks from insects, disease, fire, and wind-throw) will be reduced across the forest within the context of climate change and other long-term influences.
Targets	<ul style="list-style-type: none"> • Free-growing stems per hectare exceed 75% of the target stocking 80% of the time. • The average planting regeneration delay is less than two years on harvested areas. • By 2020, 75% of all trees planted will be grown from selected seed with an average genetic gain of at least 20%. • Local targets should incorporate assumptions and outcomes from the most recent TSR and associated forward-looking strategies available in individual management units.

2.1.5 Inherent site capacity

From a timber perspective, inherent site capacity is about the biophysical attributes of the land as they relate to timber productivity. While the focus for this goal is timber, site capacity is important for all values. Site capacity is mostly influenced by soil attributes, hydrological flows and balances, and associated processes such as decomposition and nutrient cycling.

Goal	Maintain the inherent site capacity in provincial forested ecosystems.
Objectives	<ol style="list-style-type: none"> 1) The permanent footprint of roads, trails, and landings will not exceed what is necessary for logical and efficient natural resource management. 2) Access construction and maintenance will maintain natural drainage patterns and flows, and will not contribute to slope failures or chronic erosion over the long term. 3) Harvesting, silviculture and other management activities will not result in significant soil compaction and/or erosion on growing sites, temporary trails, and work areas that will be reforested. 4) Harvesting, silviculture and other management activities will be conducted in a manner to provide for the maintenance or recovery of proper nutrient cycling and soil nutrition.
Targets	<ul style="list-style-type: none"> • The area-weighted permanent access structures per cent reported to RESULTS in the last five reporting periods is less than 5%. • Local targets should incorporate assumptions and outcomes from the most recent TSR and associated forward-looking strategies available in individual management units.

Source: FLNRO 2017 - Provincial Timber Management Goals and Objectives (see References)

2.2 Fort St James Land and Resource Management Plan

The Fort St. James Land and Resource Management Plan (LRMP) process began in October 1992 and the plan was approved by the BC Provincial Government in March 1999. Over these past 16 years, it has never been updated to address emerging values and the dramatic changes across the landscape due to the MPB attack.

¹ High-risk species – Species with a high risk of mortality during its development stages due to a range of biophysical influences, including climate change (e.g., lodgepole pine in some provincial ecosystems as identified through vulnerability analyses or district forest health strategies).

The LRMP was based on the principles of integrated resource management and sustainability, and serves to guide ongoing resource management activities and planning for forest development.

The Fort St. James Land and Resource Management Plan provides management direction that reflects a local vision for how the landbase should be managed. It increases certainty for resource development industries, while stating what considerations need to be made for other resource values in development planning. It provides guidance on management for environmental resource values, lowering risk to caribou, grizzly and fisheries. It is a world-class example of local participation in Land Resource Management Planning, providing direction for integrated resource management.

Source: Fort St James LRMP Summary page 9

The LRMP made recommendations regarding scenic areas within the Fort St James District, which resulted in 144 being established on September 20, 2005, under Section 7 of the Government Actions Regulation of the *Forest and Range Practices Act*.

The LRMP divided the Stuart TSBs into 36 Resource Management Zones (RMZs) that fall into five categories:

Settlement/Agriculture RMZ

This category represents < 1% of the LRMP landbase, and designates lands within the zone are that are currently used or proposed for farming, and/or are used or proposed for settlement in an Official Community Plan, Crown Land Plan, or LRMP. Management on these lands integrates Crown lands with the historic pattern of settlement and agriculture in the planning area, and management of natural resource values and resource development is compatible with this.

Resource Development RMZ

Representing 32% of the landbase, these are lands with existing or future potential for intensive resource development. These are managed with consideration of other resource values and within the guidelines of specific zone objectives and strategies. Management on these lands emphasizes the development of resources such as mineral extraction and timber harvesting, while minimizing impacts on other resources through a variety of integrate resource management strategies. Access is relatively unrestricted, with the exception of any land that may need special management considerations.

Multi-Value RMZ

Representing 45% of the landbase, these lands are managed to integrate a wide range of resource values. Access within these zones is relatively unrestricted, with the exception of specific areas that are recommended for special management considerations.

Special Management RMZ

Representing 16% of the landbase, these lands are managed for a wide array of resources, but in general indicate the need for more sensitive resource management. Resource development (including roaded access development) may proceed as long as impacts on other resource values are minimized and resource values are maintained. There are two special management zones in place for specific wildlife habitat protection which do not allow harvesting; these are the Sustut River and Jake Creek. Sustut river is a reserve along the upper Sustut River approximately 250 m wide on either side of the river to protect fisheries habitat. The Jake Creek zone is a subzone within the Squingula resource management zone which is a valley with particularly high moose and bear values.

Protected Area RMZ

Representing 6% of the landbase, Protected Areas are established in perpetuity so that the ecological systems they encompass can continue to evolve with a minimum of intervention. The Protected Area System comprises a family of Protected Areas. The system, rather than individual areas, provides for the diversity of ecosystems, special features and outdoor recreation opportunities and experiences sought.

2.3 Federal Recovery Strategy for Northern Caribou

The Stuart TSBs overlap the herd range of several northern caribou herds that generally utilize low elevation forests with abundant ground lichens, and/or higher elevation, windswept alpine areas, and subalpine forests. Northern caribou herds found within the Stuart TSBs include the Takla, while the Wolverine, and Chase caribou herd range overlaps into the eastern edge of the Stuart TSBs, and the Spatsizi caribou herd range overlaps into the northern edge of the Stuart TSBs.

In 2002, Council on the Status of Endangered Wildlife in Canada (COSEWIC) designated northern caribou in north-central BC as threatened which means that those herds may become endangered facing imminent extirpation or extinction unless corrective management actions are undertaken. Threats to caribou include:

- habitat loss,
- predation (through altered predator-prey dynamics),
- human disturbance, and
- in some places, small population effects.

In 2008, caribou experts and Stuart TSBs Stakeholders wrote a “Recovery Action Plan for Northern Caribou herds in North-Central BC” (McNay et al., 2006). It provides recovery recommendations for the Wolverine, Chase and the Takla (Fort St. James) herds. While this document was not a formal Recovery Strategy and was not endorsed by the Provincial Government, it is considered to be the best summary of available information.

Under the Federal Species at Risk Act (SARA) a Recovery Strategy must be prepared for a threatened species, which includes identification of Critical Habitat (Section 37 of SARA). Critical habitat is defined as habitat necessary for a species survival or recovery and includes Core and Matrix Habitat. Core habitat is occupied by caribou, and Matrix habitat is the surrounding areas that influences predator – prey dynamics. The ultimate objective of caribou management is to create or maintain habitat conditions that allow caribou to be naturally self-sustaining. In June 2014, Environment Canada finalized a “Recovery Strategy for the Woodland Caribou, Southern Mountain Population in Canada” (Environment Canada, 2014), which applied to the Takla, Wolverine and Chase caribou herds. As required by SARA, the recovery plan specifies when the Ministry of Environment must complete an action plan under the recovery strategy, which is stated as December 2017. An Action Plan details how the objectives of the recovery strategy will be achieved; this is completed through a coordinated approach, including involvement with the provincial government, First Nations and stakeholders. The Province of BC has the primary responsibility for managing caribou within BC, however, under Section 34 and 61 of the SARA the Federal government may invoke a safety net clause if it is perceived that the provincial government is not undertaking efforts to recover the species.

2.4 Sustainable Forest Management Plan

To promote responsible forestry practices, some forest companies have achieved forest management certification through independent third-party auditors (Table 1). Requirements under the SFI standard include measures to protect water quality, biodiversity, wildlife habitat, species at risk and forests with

exceptional conservation value while CSA SFM standards take environmental, social, and economic factors into account - in part, by facilitating public advisory groups. Both standards require the development of a Sustainable Forest Management Plan that describes commitments made, through a set of management and operational principles, to conduct business in a manner that protects the environment while ensuring sustainable development of forests. These plans are typically available for public review.

Table 1 Forest Management Certification

	Certification Standard Achieved and Maintained	Licensees
CSA	Canadian Standards Association Z809-08 Sustainable Forest Management Standard	Canfor
SFI	Sustainable Forestry Initiative 2010-2014 Forest Management Standard	Conifex
SFI	Sustainable Forestry Initiative 2015-2019 Forest Management Standard	BCTS

2.5 Silviculture Strategies

2.5.1 Type 1 Silviculture Strategy - 2000

The Prince George TSA Type 1 Silviculture Strategy for the Prince George TSA identified five key issues to address through treatment options (Table 2).

Table 2 Treatment options from the Type 1 Silviculture Strategy

Issue	Treatment Option
Potential gaps in Mid-Term Timber Supply	<ul style="list-style-type: none"> Thin and fertilize moderately repressed 40-70 year-old pine stands (currently in the THLB) Survey and reclassify old Intermediate utilization (IU) harvest units Fertilize thrifty juvenile stands on 10-year cycle Pre-commercial thin to set up mid-term commercial thin treatments Fertilize thrifty pole-sized stands on 10-year cycle
Address backlog Stands	<ul style="list-style-type: none"> Backlog surveys Backlog reforestation Treat backlog impeded stands Enhance structure of aspen Stands Enhance intermediate utilization sites
Forest Health	<ul style="list-style-type: none"> Reduce risk of Western Gall Rust losses
Lodgepole Pine repression	<ul style="list-style-type: none"> Survey over-stocked fire-origin pine stands to facilitate future treatment decisions.
Timber Quality	<ul style="list-style-type: none"> Minimal consideration given, other strategies above would suffice, program of pruning 170 ha year suggested.

2.5.2 Type 1 Silviculture Strategy Update - 2003

In 2003, an update to the 2000 Type 1 silviculture strategy for the Prince George TSA was undertaken to incorporate changes relating to TSR II (September 2001), the subsequent revised AAC (June 2002), Mountain pine beetle impacts, and the change in funding structure from FRBC to FIA. The 2002 AAC determination provided a 3 million m³ uplift to facilitate MPB control and salvage operations, and the Type 1 Update recognized a number of new key points:

- a gap was becoming apparent in the mid-term timber supply;
- the mountain pine beetle infestation is forcing large scale operational changes;

- older partially harvested sites should be completely harvested and replaced with more productive stands;
- consider pre commercial thinning pine stands to reduce age to operability;
- early and late term fertilization of medium and good sites on 10 year intervals to bring stands to operability sooner to fill the mid-tem supply gap;
- consider reducing the green-up age;
- investigate harvesting opportunities with in special management zones such as RMZs and caribou habitat;
- the new deciduous AAC partition will allow more areas to be converted to coniferous;
- monitor beetle killed stands that exceed their shelf life for reforestation needs; and
- many over-stocked pine stands previously excluded from the THLB will be added back in and scheduled for rehabilitation and planting, thinning, or for an early harvest as pulpwood.

2.5.3 Type 2 Silviculture Strategy - 2008

A Type 2 Silviculture Strategy completed for the Prince George TSA utilized the latest inventory data with the following objectives:

1. mitigate the effects of the MPB epidemic on the timber supply through incremental silviculture,
2. manage the fire risk to timber supply caused by the MPB epidemic,
3. initiate a review of basic silviculture practices in the context of the MPB epidemic and future risks of pests and diseases, and
4. keep all options open for the future.

The Type 2 exercise focused on the following strategies for timber and habitat:

Timber	<ol style="list-style-type: none"> 1) Develop a comprehensive TSA Fertilization Strategy 2) Fertilize mature spruce-leading stands to generate short-term volume gains and larger piece sizes 3) Fertilize immature spruce-leading stands 4) Non-recoverable Losses Reforestation Strategy 5) Backlog NSR treatments 6) Backlog Impeded Stand treatments 7) Repressed pine stands 8) Review of Basic Silviculture strategies <ol style="list-style-type: none"> a) Revise stocking standards b) Plant more mixed species stands c) Utilize improved seed stock
Habitat	<ol style="list-style-type: none"> 1) Underplant un-salvaged areas where no reforestation responsibilities exist. Priority areas include: <ol style="list-style-type: none"> a) Sensitive watersheds linked to high value fish streams and temperature sensitive streams. b) Upland planting to speed hydrologic green-up in strategically identified watersheds, and sensitive watersheds. 2) Underplant in riparian and enhanced riparian areas <ol style="list-style-type: none"> a) Identify key areas for enhancement of riparian features through silviculture treatments. b) Review the riparian reserves and inventory for opportunity areas in consideration of other resource values and non-timber constraints. 3) Maximize diversity of stock used in under planting. 4) Selected (wildlife) species habitat strategy <ol style="list-style-type: none"> a) Incremental silviculture treatments can be specifically developed to speed the recovery of habitat elements in short supply. b) Review the selected species habitat and inventory for opportunity areas in consideration of other resource values. 5) Mitigate the loss of older forest stand structures. <ol style="list-style-type: none"> a) Thin mid-seral and mature forest stands to speed the recovery of old growth structure. b) Focus on non-pine leading OGMA and WTP areas

6) Rehabilitate roads to manage access for species and ecosystems sensitive to access.

2.5.4 Type 4 Silviculture Strategy - 2014

A Type 4 Silviculture Strategy was recently completed for the Prince George TSA, which provided:

1. a fully rationalized plan to guide the expenditure of public silviculture funds to improve the future timber supply and habitat supply; and
2. silviculture regimes and associated standards that may potentially be adopted in forest stewardship plans as required standards for basic silviculture operations.

The Type 4 strategy recognized MPB impacts on timber and non-timber resources, and clearly stated the implications of the uneven distribution of dead pine throughout the TSA. For instance, the former Vanderhoof District, having a very high percentage of pine, suffered a significant AAC reduction in the mid-term. This significant loss, combined with the harvest history in the Prince George District (i.e., concentrated closer in to town); means that the mid-term timber supply will depend heavily on stands harvested from the Stuart TSBs.

The Type 4 strategy listed specific short-, mid- and long-term working targets regarding salvage, fertilization, and continued surveys and monitoring. It emphasized treatments designed to maximize the mid-term supply through late rotation fertilization at first, followed by fertilization of progressively younger stands, and rehabilitation of dead stands with no merchantable volume. Treatments would be accompanied by a comprehensive surveying and sampling program to better predict site index and yields.

2.6 BC Mountain Pine Beetle Model

FLNR developed a BC Mountain Pine Beetle model (BCMPB) to project the annual volume of mature pine killed by MPB. Data from a series of annual aerial overview surveys are used to calibrate the BCMPB.

The FLNR (Forest Analysis and Inventory Branch) recommends using MPB mortality data generated through BCMPBv12 modeling and updated in the latest vegetation resources inventory. These data indicate that approximately 68.3 million m³ of pine within the THLB is dead due to MPB. This mortality represents 26% of the total volume and 67% of the pine volume on the THLB.

The current data summary (BCMPBv12) from the vegetation resources inventory indicates that about 67% or about 68.3 million m³ of the pine volume on the THLB is currently dead (as defined in 2002) had been killed by 2014 (Figure 2). As the infestation recedes, the BCMPB model predicts just an additional 1% mortality by 2020.

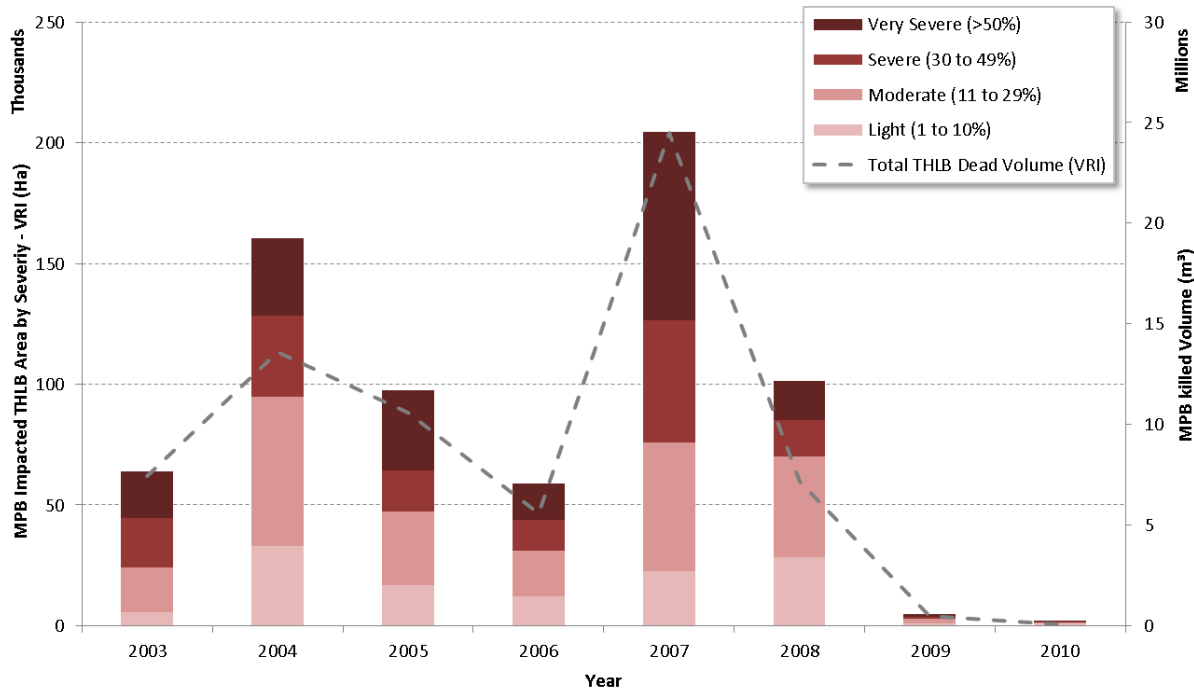


Figure 2 Severity of MPB impact by area (left) and total dead volume (right) by year of attack

2.7 Future Forest Products and Fibre Use Strategy

The Omineca Beetle Action Coalition (OBAC) was formed in 2005 with the purpose of working “to ensure sustainable development and resiliency for the OBAC region”. OBAC has worked with its member communities, First Nations, all levels of government, industry and sector representatives, academic institutions and allied partner organizations to develop a regional diversification plan to build resilient communities during and after the mountain pine beetle epidemic. Through its Future Forest Products and Fibre Use Strategy (Timberline 2008), the OBAC recommended long-term strategies designed to mitigate the social and economic impacts of the MPB epidemic. They stated six overall objectives:

1. Increase community benefits from forest resources.
2. Diversify and strengthen the forest sector.
3. Form stronger working partnerships and communication among First Nations, local communities, government, and the forest sector.
4. Increase the ability to train and retain the required work force.
5. Create a climate of ownership and pride in the region’s forest resources.
6. Ensure the forest is managed to meet future needs and opportunities.

OBAC developed four recommendations to promote change in the management of the region’s forests, the beneficial use of forest resources and community resiliency:

1. Increase the benefits that communities can rely upon from forest resources and forestry.
2. Ensure that the forest sector remains a strong economic contributor to the region.
3. Recognize the pine beetle killed stands as a valuable asset which should be used to full potential before their commercial value is depleted.

4. Increase awareness and understanding of the long-term viability of the forest sector.

Specific actions required to enact the OBAC report vision included:

1. Provide all communities in the region with a more direct role in forest management and in the benefits derived from the region's forests.
2. Incorporate community resilience considerations into major forest management decision making.
3. Improve and enhance transportation infrastructure and services.
4. Provide more equitable and diverse access for existing and new users of fibre.
5. Increase the range of products generated from the region's forest resources. Start by determining which high value and locally wealth-generating products are best suited for production from this region's assets.
6. Ensure that dead pine stands are managed in a manner which addresses both their economic and environmental utility.
7. Create a positive and competitive business climate for bio-energy development through an integrated policy, regulatory, tenure, and pricing environment.
8. Provide information to the public on the strength and importance of the forest sector and the collective efforts to grow future opportunities.
9. Grow the forests that we will need in the future with focused, large scale investments in a targeted reforestation program.

Ten years later, it is evident that much of the OBAC report vision has been realized, including:

1. Solid relationships now exist between licensees, manufacturing companies, First Nations, the Town of Fort St. James, and the Provincial Government.
2. There is an increased level of local management.
3. The forest sector has diversified.
4. A bioenergy plant is nearing completion in Fort St. James.
5. There has been a full realization of the MPB-killed pine value and the opportunity it represents.

2.8 Multiple Resource Value Assessment

The goal of sustainable forest management is to achieve a balance between environmental, social and economic objectives. Multiple resource value assessments (MRVA) show the results of stand and landscape-level monitoring carried out under the Forest and Range Evaluation Program (FREP). These reports provide resource professionals and decision makers with information about the environmental component of this 'balance' so that they can assess actual outcomes compared to expectations.

The Forest and Range Practices Act (FRPA) lists eleven resource values essential to sustainable forest management in the province: biodiversity, cultural heritage, fish/riparian and watershed, forage and associated plant communities, recreation, resource features, soils, timber, visual quality, water, and wildlife. MRVA reports summarize the conditions of these values through available field assessments. These assessments are generally conducted on or near recently harvested cut blocks and therefore are only evaluating the impact of industrial activity and not the condition of the value overall (i.e., they do not take into account protected areas and reserves). Most of the information gathered is focused on the

ecological state of the values which provides useful information to resource managers and professionals on the outcomes of their plans and practices. This information is also valuable for communicating resource management outcomes to First Nations, stakeholders, and the public, and providing a foundation for refining government's expectations for sustainable resource management in specific areas of the Province.

Source: FLNR, Fort St James District MRVA December 2013

The extraction and development of natural resources, along with natural factors (e.g., insects, wind, and floods), influence and impact the ecological conditions of a management unit. The goal of effectiveness evaluations is to assess these impacts on public natural resource values (i.e., status, trends, and causal factors). These evaluations do not assess compliance with legal requirements but do help resource managers:

1. assess whether the impacts of resource development result in sustainable resource management,
2. provide transparency and accountability for the management of public resources,
3. support the decision-making balance between environmental, social, and economic factors, and
4. inform the ongoing improvement of resource management practices, policies, and legislation.

The MRVA for the Stuart TSBs produced a summary of key findings and, in some cases, identified performance trends (Figure 3) to provide excellent baseline data for comparing performance against strategies developed from this and other future projects.

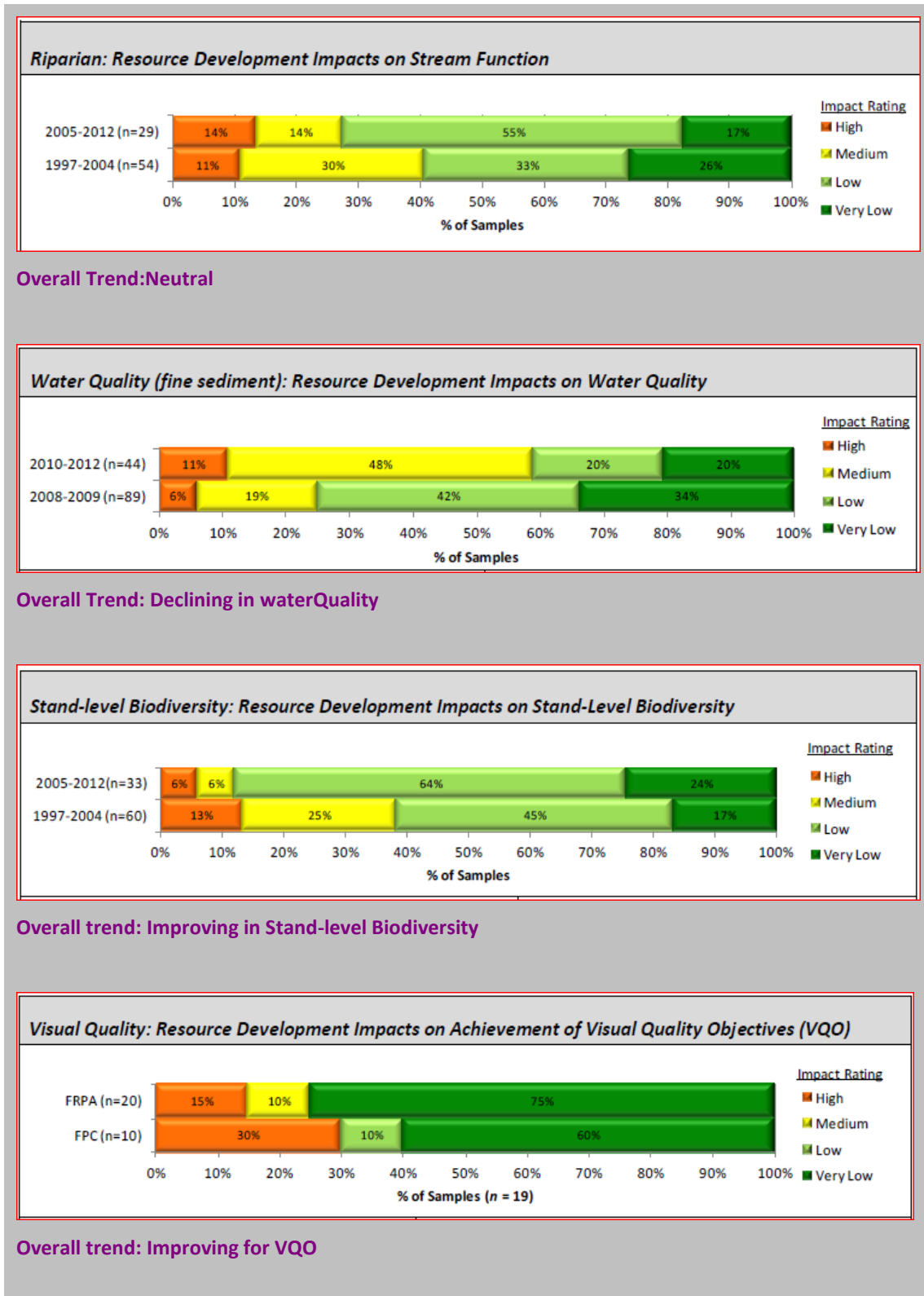


Figure 3 MRVA Performance and Trends - Stuart TSBs

Source: Fort St. James MRVA Report, December 2013

2.9 Provincial Stewardship/Timber Harvesting Land Base Stabilization

The FLNR's Forest Competitiveness Initiative recently produced guidelines for implementing Provincial Stewardship/THLB Stabilization Projects. The intent of these projects is to optimize the stewardship of Provincial forest and natural resources while realizing the full operational potential of the timber harvesting land base. While these projects, often referred to as co-location, do not change existing land use plans or legislation, they explore the best possible combination of overlapping the many constraints on timber harvesting. The key objective of the process is optimizing the placement of spatial constraints that results in an overall increase in THLB.

2.10 Forest Health Strategy

The Omineca Region's (including Stuart TSBs) Forest Health Strategy (FLNR 2013) was prepared consistent with the Provincial Forest Health Strategy and Forest Health Implementation Strategy goals and objectives. This strategy is a key source of information for identifying and prioritizing the existing forest health issues and factors that exist within the Stuart TSBs (Table 3).

Table 3 Ranking of Forest Health Factors in the Stuart TSBs

Very High	High	Medium	Low	Very Low
	Two-year Budworm	Spruce beetle	Tomentosus Root Disease	Large Aspen Tortrix
	Western Balsam Bark Beetle	Mountain Pine Beetle	Lodgepole Pine Dwarf Mistletoe	Serpentine Leaf Miner – aspen
	Douglas-Fir Beetle	Engraver beetles (Ips Pini)	White Pine Weevil	Birch Leaf Miner
	Stalactiform Blister Rust	Warren's Root Collar Weevil	Venturia	Forest tenet Caterpillar
	Western Gall Rust		Red band Needle Blight - <i>Dathistroma</i>	Black Army Cutworm
	Comandra Blister Rust			

2.11 Ecosystem Restoration

Ecosystem Restoration is defined as the process of assisting with the recovery of an ecosystem that has been degraded, damaged, or destroyed by re-establishing its structural characteristics, species composition, and ecological processes. The vision of the Provincial ecosystem restoration program is to restore identified ecosystems to an ecologically appropriate condition, creating a resilient landscape that supports the economic, social, and cultural interests of British Columbia. The province has produced a draft strategic plan (Ministry of Forests and Range 2009) with goals, strategic priorities, and methods to help guide the program.

The Society for Ecosystem Restoration in North-Central BC (SERNbc) is a group of individuals and agencies interested in collaborating to help restore vulnerable and degraded ecosystems in the Omineca Region of Northern BC. Members include representatives from government agencies such as Forest Stewardship, Environment, and BC Parks; organizations like the Fish and Wildlife Federation, B.C. Trappers Association, the Guide Outfitters Association, and Cattlemen; as well as private citizens. The purpose of the society is to:

1. identify, treat, and monitor vulnerable and degraded ecosystems in the Omineca Region to achieve a desired future condition that will sustain ecological services and human socio-economic needs,

2. coordinate ecosystem restoration activities in the Omineca Region and foster collaboration amongst stakeholders,
3. acquire technical information on ecosystem restoration and disseminate it to members and stakeholders, and
4. inform public and land managers on current ecological vulnerabilities as understood through the implementation of ecosystem restoration.

SERNbc receives its funding through the Provincial Habitat Conservation Trust Foundation, the anglers, hunters, trappers, and guides who contribute to the Trust, and other sources. They recently completed a strategic plan to provide guidance to the society overall and to support funding applications (e.g., identifying and assigning priorities to proposed projects). In addition they have identified four sites for treatment within the Stuart TSBs:

1. Monk's Bay –The objectives of the project would be to create more open canopy conditions, reduce aspen occupation, improve grass and shrub cover, maintain Douglas-fir stands, and support deer and elk populations. This project has not been implemented and is at the conceptual stage only
2. Ruby Rock - Numerous monitoring and treatment activities occurring in Ruby Rock Provincial Park, promoting unique structural components including open grown meadows, Douglas fir timber types and variable stage treed ecosystems. A burn was planned for 2015, but has not yet been carried out.
3. Kwanika Creek - A range burn was planned to promote forage for the local range permit holder, but it has not been completed.
4. Stuart River – A burn is planned to reduce tree ingress into open grassy meadows.

2.12 Whitebark Pine

Due to various forest health factors, (white pine blister rust, pine beetle, others) whitebark pine has declined across its range and is now listed as a species at risk (section 7.1.1). The Omineca region of BC contains the most northern stands of whitebark pine, and some of those small stands are within the Stuart TSBs (Figure 4). Maintaining these stands will be important for the recovery of the species, for facilitating future migration north with a changing climate, and for maintaining biodiversity - particularly supporting species that rely on whitebark pine so closely. A tactical plan was prepared to provide some guidance for its recovery within the Omineca Region (BVRC 2013), that includes three parts:

- 1) current baseline maps showing known locations of whitebark pine stands,
- 2) management options, and
- 3) a summary of potential restoration priorities by forest district.

The Ministry also developed a bulletin that provides general recommendations on how to conserve whitebark pine within THLB in harvesting and silviculture operations:

Logging in high-elevation spruce-fir and lodgepole pine stands can cause unintended damage to and removal of whitebark pine. Removing whitebark pine trees reduces the seed supply, which is an important, sometimes essential, food source for wildlife and necessary for regeneration. In particular, Clark's nutcracker not only utilize seed as a food source, their habit of caching seed in the ground is the primary means by which whitebark pine regenerates. Harvesting may also remove trees that could be genetically

resistant to blister-rust. Retaining stands and individual trees, and promoting natural regeneration of whitebark pine will help conserve this species and the ecosystem services it provides.

Minor amendments to forest stewardship plans at the landscape level, and harvesting and site plans at the stand level, could also help conserve this species. For example, adjustments to cutblock boundaries and locating wildlife tree patches in areas with whitebark pine could protect small stands and individual trees. Identifying whitebark pine as an acceptable species in stocking standards for appropriate sites would also preclude the need to plant another species adjacent to naturally regenerated whitebark pine seedlings and larger residual trees.

Source: *Whitebark Pine Bulletin, BC FLNR, Ministry of Environment, ISSUE 01 December 2011*

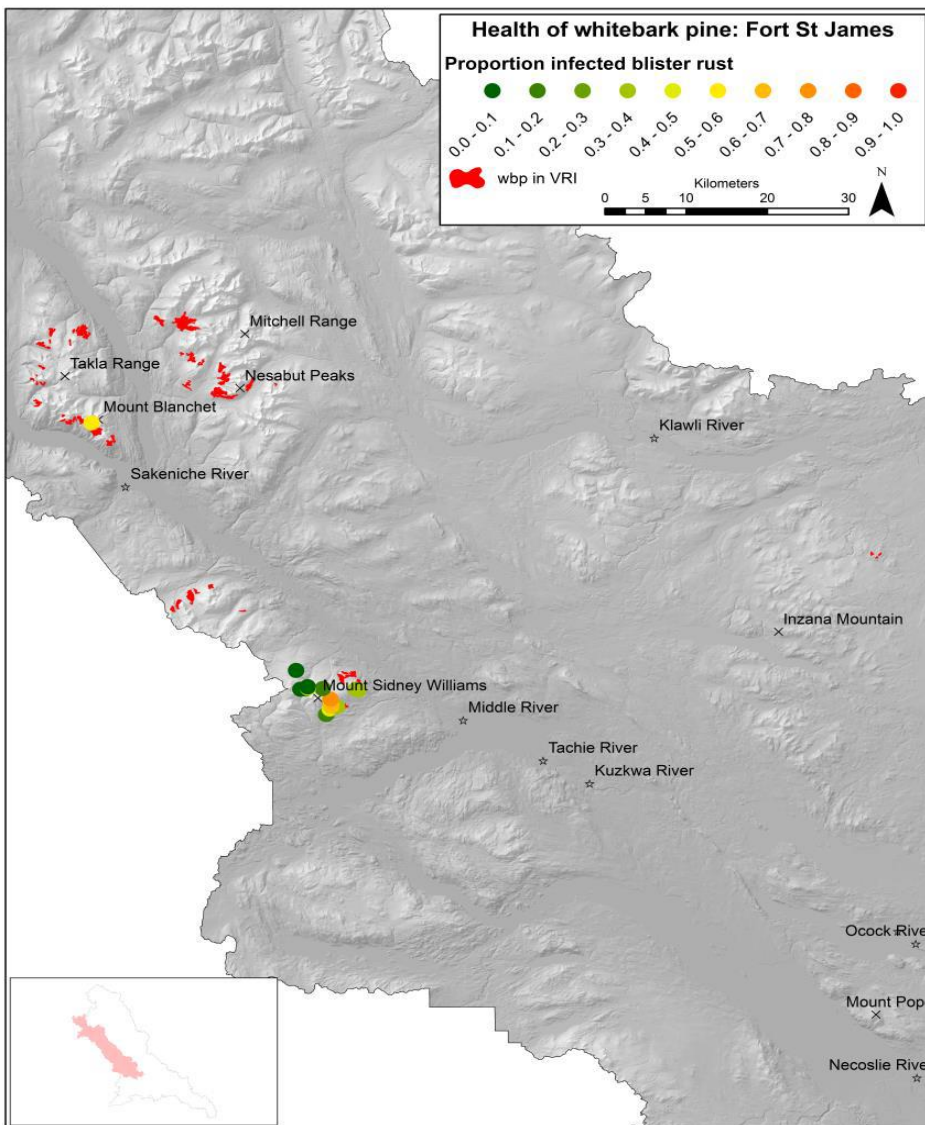


Figure 4 Location of Whitebark Pine in the Stuart TSBs

Source: *A TACTICAL PLAN FOR THE RECOVERY OF WHITEBARK PINE IN THE OMINECA REGION Bulkley Valley Research Centre March 2013.*

2.13 Fire and Fuel Management

It is likely that a large portion of the MPB-impacted land base will remain unsalvaged and contain increased fuel loads. This can result in very aggressive fire behaviour and high fire intensity due to the increased amount of dry standing and surface fuels.

The BC Wildland Fire Management Strategy (MFR 2010) provides direction for a proactive provincial wildland fire management program aimed to:

1. Reduce fire hazards and risks (particularly in and around communities and other high-value areas).
2. Carefully use controlled burning where the benefits are clearly defined and the risks can be cost-effectively managed.
3. Monitor and manage, rather than suppress, fires that are of minimal risk to communities, infrastructure or resource values.
4. Implement land, natural resource and community planning that incorporates management of wildland fire at all appropriate scales.
5. Develop a high level of public awareness and support for wildland fire management.

Fire Management Plans are tools used by land managers and response staff to identify values at risk in developing a fire analysis that describes general control objectives and strategies. Priority is given to protecting values ranked as follows: human life and safety, property, high environmental values, and resource values. A Fire Management Plan has not yet been developed for the Stuart TSBs.

The community of Fort St. James completed a Draft Community Wildfire Protection Plan in 2013 which identifies areas at risk from wildfire in and around the Community.

Note 1 - Looking for a copy of the final CWPP; a newspaper article suggested it was completed.

Note 2 - John sent us two key documents: Fire Management Strategic and Tactical Plans for VanJam (Vanderhoof and FSJ) 2015; need to incorporate here.

3 First Nations and Cultural Heritage

Fort St. James has been home to the Dakelh First Nations people since long before the arrival of Simon Fraser and the Hudson's Bay Company. Nak'azdli, Yekooche, Binche, Tl'azt'en, Middle River and Takla Lake First Nations in the area comprise approximately 25% of the Carrier Sekani Tribal Council. Twenty one Dakelh pictographs can be found on the north shore of Stuart Lake and are accessible only by water. Many First Nations residents still practice in their cultural traditions. The language of the Dakelh is part of the Athapaskan language group.

Cultural heritage resources and other areas of importance to First Nations are continually being noted and documented throughout the PGTSA. Frequently, though not always, these areas are accounted for through riparian habitat, wildlife areas or other removals from the THLB including buffered trails and archaeological sites. The magnitude of this assumption may change as the extent of cultural heritage and other First Nation areas of importance and their impact on timber harvest activities become better understood.

This section names and provides a brief description of the 12 First Nations that reside within the Stuart TSBs, claim traditional territories, and have social and economic interests in the area. Many of these First Nations traditional territories overlap within the Stuart TSBs.

3.1 Nak'azdli Band

The Nak'azdli form one of several local groups that make up the Carrier or Dakelh which means "on water travel people", "or people who go around by boat") and are members of the Athapaskan language group. The English translation of Nak'azdli is "when arrows were flying".

Nak'azdli is located on Necoslie I.R. No. 1, situated on the south-eastern coast of Stuart Lake in Fort St. James; 60 km (37 m) North of Vanderhoof or 153 km (94 m) from Prince George (closest city).

The main traditional activity of the Nak'azdli was/is fishing (primarily salmon from the Stuart watershed). The Nak'azdli people were semi-nomadic; seasonal movements throughout the traditional territory were dictated by the availability of their primary food sources.

Traditional territory for hunting and fishing is passed through clan based family groupings referred to as Keyohs. Nak'azdli peoples participate in the balhats (potlatch) system which is organized by matrilineal clans.

The Nak'azdli Band is part of the Carrier Sekani Tribal Council.

Source: <https://nakazdli.wordpress.com/about-us/>

3.2 Yekooche First Nation

The Yekooche Band traditional territory is located about 85 km northwest of Fort St James British Columbia. It comprises 4 reserves on a total of roughly 180 hectares. Most of the band members live in Reserve #3 (Yekooche) located along the northwest arm of Stuart Lake, where Nancut Creek drains Cunningham Lake into Stuart Lake. Currently the Yekooche First Nation is not affiliated with any other tribal councils or treaty groups.

Yekooche First Nation currently has about 227 members with approximately 120 living in the village and the rest living in Fort St. James, Prince George and in other areas.

The traditional language of the Yekoochet'en is Carrier which is somewhat similar to French. The name Carrier is believed to have derived from an old tradition which dictated that when a husband died, his wife carried his ashes for a year. The arrival of the fur trade and the Hudson's Bay Company added more French influences to the language.

Ye Koo Che in Carrier translates to the location of the community as "Ye Koo" refers to Cunningham Lake and "Che" refers to the end or tail of Nankut Creek.

Today, the Yekoochet'en are actively involved in protecting what remains of their land and have entered the treaty-making process as a means of preparing themselves for the future. Believing in their role as "stewards" of the land within their traditional territories they hope to fulfill a greater role in conservation and safeguarding of their culture and way of life while developing through working partnerships some of the economic opportunities which have been denied them in the past.

Source: <http://www.yekooche.com/nativeheritage.htm>

3.3 Tl'azt'en Nation

The Tl'azt'en Nation, or "people by the edge of the bay", is a First Nations community situated in north-central British Columbia, Canada. We know ourselves as Dakelh (we travel by water) but Europeans called us "Carriers". Our language, Dakelh, is part of the Athapaskan language group.

Prior to European contact, Tl'azt'en's traditional territory covered a vast area along Stuart Lake running up the Tache River almost to Takla Lake to the north. The population of Tl'azt'en Nation today is around 1750. Of these, approximately 600 live in one of the main communities of Tache, Binche and Dzitl'ainli, and K'uzche. Tache, the largest of the communities, is situated 65 km northwest of Fort St. James at the mouth of the Tache River on Stuart Lake. Binche is 25 km Northwest from Fort St. James and at the mouth of the Binche River which drains Binche Lake into Stuart Lake. Dzitl'ainli is on Leo Creek Road alongside Trembleur Lake. K'uzche is on the Tache River.

Our people still live off the land and we hunt for moose, deer, bear, caribou, mountain goat, and small fur-bearing animals. We set nets for salmon, whitefish, trout, kokanee, spring salmon, and ling cod. We still go to our camp grounds in the summer time and gather food for our winter storage.

The Tl'azt'en Nation is a member of the Carrier Sekani Tribal Council.

Source: <http://www.tlaztennation.ca/index.php/about-us/>

3.4 Takla Lake First Nation

The Takla Lake First Nation is one of several local groups that make up the Carrier people; members of the Athapaskan language family (Nedut'en dialect). Traditionally, the Takla Lake First Nation was semi-nomadic moving seasonally throughout their traditional territory in response to the availability of their primary food sources. Takla Lake is part of Tsay Key Nay, a partnership between Tsay Keh Dene, Kwadacha and Takla Lake.

The traditional territory of the Takla Lake First Nation is located in North Central British Columbia, and totals approximately 27,250 square kilometres. The territory is a rich environment of lakes, rivers, forests and mountains, bordered on the west by the Skeena Mountains and on the east by the Rocky Mountains. Our Nation is an amalgamation of the North Takla Band and the Fort Connelly Band, a union which occurred in 1959. Our traditional lands are the geographic area occupied by our ancestors for community, social, economic and spiritual purposes. Carrier and Sekani place names exist for every physical feature and place that we occupied. Each name reflects the significance of the feature or site

and today provides us with historical information to the rich history and extensive knowledge of our land and our resources.

Takla Lake First Nation's main community is at Takla Landing, which lies 320 km north of Prince George, B.C. This picturesque community, home to approximately 250 residents, is situated on the eastern shore of Takla Lake. The community, which was isolated until the 1950's when forestry pushed into the area, is now accessible through Fort St. James on paved and unpaved forestry road. Alternatively, there is summer access to Takla Landing via Germansen Landing, on rough, unpaved road. Currently Takla Lake First Nation has 18 Reserves. The main community of Takla Landing lies within IR #7 and 7A.

Source: <http://www.taklafn.ca/>

Takla Lake First Nation interests include: cultural rediscovery, economic prosperity, cumulative effects of resource activity on traditional culture, water quality, caribou populations, and the Wolverine Lake and Jack Fish areas.

Their concerns raised through TSR consultation included: UWR, management and protection of water, soil erosion, surface runoff flow control and stream temperature increases, future state of forest health, damage to fish and wildlife populations, impacts to aboriginal rights and title, consultation, financial assistance for their land use plan, access to digital maps from FLNR, independent environmental assessment, and employment.

The Takla Lake First Nation belongs to the Carrier Sekani Tribal Council.

3.5 Lake Babine Nation

Lake Babine Nation is third largest Aboriginal Band in British Columbia. Lake Babine Administration Office is situated 142 miles West of Prince George, with a total registered membership of over 2,438 [based on 2014 population]. The Nation has 27 reserve lands and three (3) communities, which are inhabited year round, and two that are inhabited year round from time to time. Prior to 1957, Lake Babine was two separate Bands, the Old Fort Band and the Fort Babine Band, both situated on the Babine Lake. At the time, approximately 12 communities were inhabited year round. On June 12, 1957, Department of Indian Affairs amalgamated the two Bands to form what is now known as the Lake Babine Nation

Source: <http://www.lakebabine.com/>

3.6 Lheidli T'enneh

The Lheidli T'enneh Band (Klate-lee—Ten-eh) also known as the Lheidli T'enneh First Nation and historically known as the Fort George Indian Band is the First Nations band government for the Lheidli T'enneh, a subgroup of the Dakelh people whose traditional territory includes the City of Prince George, British Columbia. The name means "The People from the confluence of the two rivers" in the Carrier language referring to how the Nechako River enters the Fraser River at Prince George.

The Lheidli T'enneh are Carrier people. Their traditional language, now spoken only by a few people, is a dialect of the Carrier language.

Source: <http://www.lheidli.ca/>

3.7 Tahltan Central Government

The Tahltan are Athapaskan speaking people centered in the area around the upper Stikine River believed to trace their origins to a meeting between people from the north (Tagish) and those from the

head of the Nass River to the south, who settled at Tahltan. Those people were later joined by others from the east and the three groups together became the Tahltan tribe. The Tahltan are organised into two phratries, Raven and Wolf, each with three clans or family groups. Succession and inheritance follow a matrilineal decent system. The Tahltan were semi-nomadic, following a yearly cycle which primarily involved fishing, hunting (principally caribou and moose), and trapping.

Tahltan First Nation's traditional territory is within the northern portion of the Stuart TSBs and is primarily in parks, high elevation mountainous terrain with very limited access. Their traditional territory also covers area within the Mackenzie, Kalum, Skeena, and Fort Nelson Districts.

The Tahltan First Nation has not brought forward any specific resource management interests to the Ministry at this time.

Source: <http://tahltn.org/>

3.8 Halfway River First Nation

Halfway River First Nation is an Athapaskan speaking people belonging to the Beaver/Cree culture group. The Halfway River First Nation is a member of the Treaty 8 Tribal Association, which also includes Doig River First Nations, Prophet River First Nation, Saulteau First Nations, and West Moberly First Nations. The Treaty 8 Tribal Association is an incorporated organization under the BC Societies Act, since 1982.

Halfway River First Nation's non-disputed traditional territory encompasses 2 Natural Resource Districts: Peace and Mackenzie, while their asserted traditional territory also encompasses: Fort St James.

The Halfway River First Nation's specific resource management and conservation interests are not known at this time.

Source: <http://hrfn.ca/>

3.9 West Moberly First Nations

West Moberly First Nations (plural) is an Athapaskan speaking group, belonging to the Beaver and Cree culture group. West Moberly linguistic groups include Beaver and Cree. Formerly part of the Hudson Hope Band, West Moberly First Nations signed onto Treaty No. 8 in 1914, and in 1977 split into West Moberly Lake and Halfway River.

West Moberly's asserted traditional territory encompasses 3 Natural Resource Districts: Fort St James, Prince George and Mackenzie. Their non-disputed territory is located in the mid eastern portion of the Stuart TSBs, while their non-disputed traditional territory encompasses the Peace and Mackenzie Districts.

Concerns raised through TSR consultation include UWR's and landscape connectivity, Peace caribou herds and interest in establishment of Fisheries Sensitive Watersheds.

Source: <http://www.westmo.org/>

3.10 Tsay Keh Dene

The main community for the Tsay Keh Dene (formerly known as the Ingenika Band) is located at the northern end of the Williston Reservoir. They speak Tsek'ene and, as a nomadic people, Tsay Keh Dene members inhabit the valleys of mountainous areas of the rivers (Omineca, Meslinka, Ingenika, Finlay, and Parsnip). The Thutade Lake area also holds high cultural value to the people of Tsay Keh Dene.

The Tsay Keh Dene territory is situated mostly within the Mackenzie TSA but extends Westward into the Stuart TSBs.

Tsay Keh Dene interests include cultural rediscovery, economic prosperity, cumulative effects of resource activities on traditional culture, water quality, caribou populations, and increased access for hunters. Concerns raised through TSR consultation include: Ungulate Winter Range (UWR) and landscape connectivity, decline in caribou populations, high and low elevation caribou and wildlife corridors, and road maintenance to northern communities.

Source: <http://www.tsaykeh.com/>

3.11 Nadleh Whut'en First Nation

The Nadleh Whut'en is part of the Dakelh (Carrier) people. Carrier is a translation of the Sekani name for Dakelh people, Aghele. This term is said to be derived from the fact that when a Dakelh man died and had been cremated, his widow would pack around his bones and ashes during the period of mourning. The reason that the English term comes from the Sekani name is that the first Europeans to enter Dakelh territory, members of the Northwest Company party led by Alexander Mackenzie in 1793, passed through Sekani territory before they entered Dakelh territory and so learned about Dakelh people from the Sekani. Furthermore, Sekani people played an important role in the early period of contact between the fur traders and Dakelh people because some Sekani people could speak both Dakelh and Cree and served as interpreters between the fur traders and Dakelh people (Yinka Dene Language Institute).

Nadleh Whut'en means 'people who live where the salmon return', signifying the connection we have with our land. We continue to strive for our ancestors, current and future generations.

The Nadleh Whut'en First Nation is a member of the Carrier Sekani Tribal Council.

Source: <http://www.nadleh.ca/>

3.12 McLeod Lake Indian Band

McLeod Lake Indian Band members are an Athapaskan-speaking people within the Tse'khene group of Aboriginal peoples that include bands at Fort Ware (Kwadacha) and Ingenika (Tseh Keh Dene). The English translation of Tse'khene is "people of the rock". They were a nomadic hunting people who inhabited the basins of the Parsnip and Finlay Rivers and the valley of the Peace River.

The McLeod Lake Indian Band traditional territory lies within the southern portion of the Stuart TSBs extending into the Prince George, Fort St. James, and Dawson Creek Districts. McLeod Lake Indian Band interests include: rebuilding of traditional culture, economic prosperity/a successful local economy, cumulative effects of resource activity on traditional culture, and impacts of resource activity on water and water quality. Maintenance of fisher populations was a key concern raised through TSR consultation.

Source: <http://www.mlib.ca/new/>

4 Forest Licensees

AAC apportionment and commitments to licensees are assigned at TSA level and are not specified within each TSB.

Operating areas are a non-legal agreement between licensees and FLNR. Within the Stuart TSBs, operating areas have been allocated to fourteen forest licensees (Figure 5). For some licensees, their entire license commitment is allocated within their operating area while others are distributed throughout the Prince George TSA.

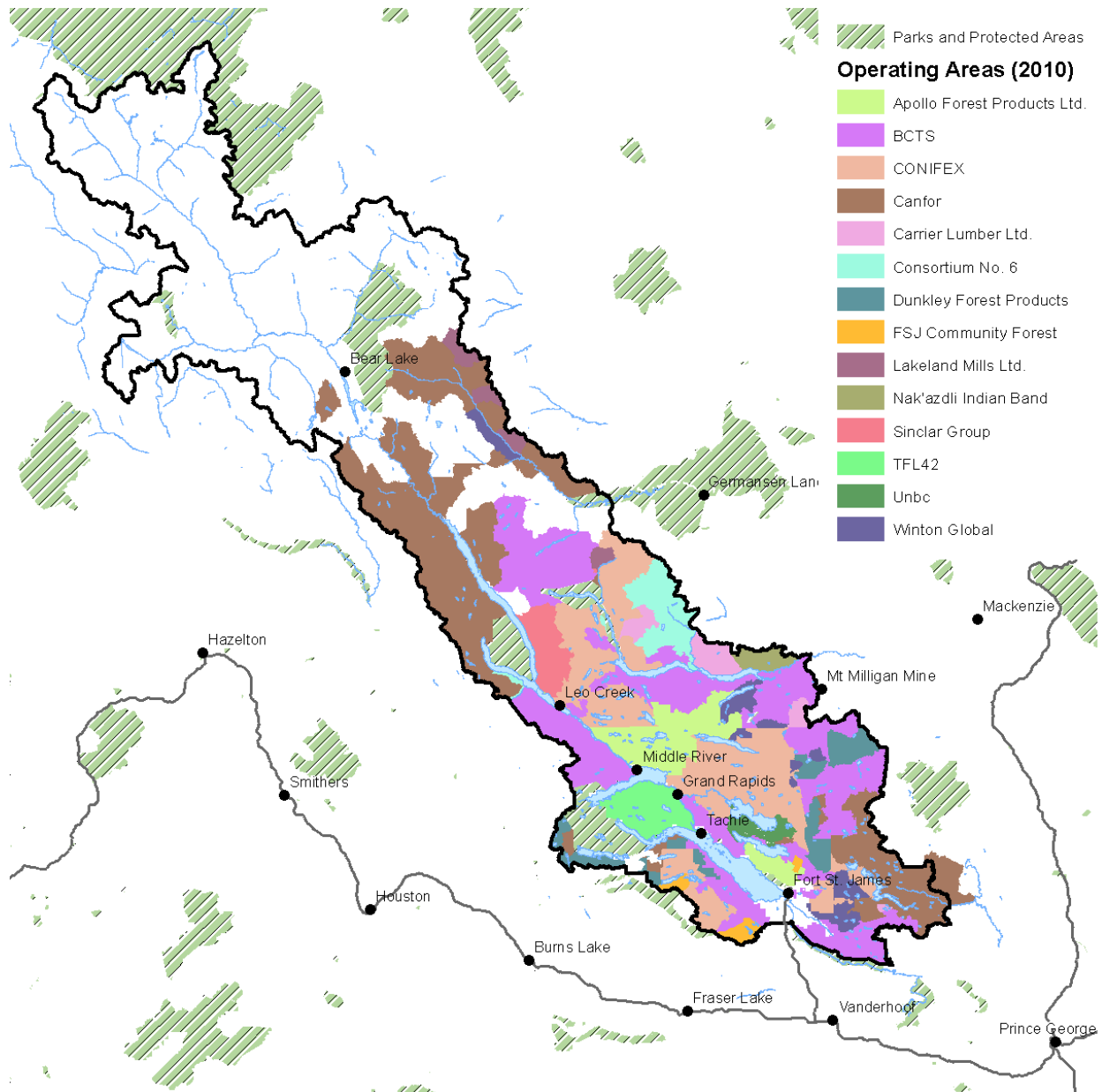


Figure 5 Licensee Operating Areas (2010)

Source: District of Fort St. James FTP site, external/publish

4.1 Replaceable Forest Licensees

At present, eight forest licensees operate within the Stuart TSBs through replaceable forest licensees:

1. Apollo Forest Products Ltd.
2. Canadian Forest Products Ltd.
3. Carrier Lumber Ltd.
4. Conifex Inc.
5. Dunkley Forest Products Ltd.
6. Lakeland Mills Ltd.
7. L&M Lumber Ltd.
8. Winton Global Lumber Ltd.

4.2 Non-Replaceable Forest Licensees

There are currently 12 licensees operating within the Stuart TSBs through non-replaceable forest licenses:

1. L&M Lumber Ltd.
2. Renew Resources Inc.
3. Pinnacle Renewable Energy Inc.
4. K&D Logging Ltd.
5. Brave Holdings Ltd.
6. Stellako Custom Wood Ltd.
7. Colborne Lumber Ltd.
8. Nak'al Ko Timber Ltd.
9. Tano T'enneh Ltd. Partnership
10. Saik'uz First Nation
11. Stelat'en Duchun Forstry Ltd.
12. Nadleh Whuten First Nation

BC Timber Sales

BC Timber Sales (BCTS) has a mandate to provide the cost and price benchmarks for timber harvested from public land by auctioning blocks through timber sale licenses. This semi-autonomous program within FLNR has an AAC allocation of 2.5 million m³/year within the Prince George TSA. BCTS's operations within the Stuart TSBs are administered and managed through its Stuart-Nechako Business Area.

BCTS is currently certified to the ISO 14001: 2004 Environmental Management System (EMS) Standard and, as part of the Provincial Sustainable Forestry Initiative single certificate initiative, BC Timber Sale's Prince George Business Area is certified under the 2015 - 2019 Sustainable Forestry Initiative Standard.

4.3 Area-Based Tenures

Area-based tenures within the Stuart TSBs are awarded their own AAC based on defined area and management regimes. While these tenures are managed separately from the TSA and Stuart TSBs (i.e., not within the scope of this project), they are affected by many similar issues and regulatory regimes.

Community Forests

The Fort St James Community Forest Corporation holds community forest agreement K1D with an AAC of 23,895 m³/yr.

Tanizul Timber Ltd. holds a Community Forest Agreement K4B (formerly TFL 42) with an AAC of 152,672 m³/year.

Woodlots

Within the Stuart TSB, 38 woodlots comprise approximately 28,800 hectares.

First Nation Woodland Licence

The Nak'azdli First Nation holds Woodland Licence N1T with an non-replaceable AAC of 30,000 m³/year.

Three new First Nation Woodland Licences are nearly finalized within the Stuart TSBs. These include area-based tenures for the Yekooke, Nak'azdli and Tl'azten First Nations.

University of Northern British Columbia

The John Prince Research Forest encompasses 13,032 ha of crown land in North Central BC, 30 km North of Fort St. James. The forest is situated between Tezzeron (Chuzghun) and Pinchi (Tesgha) lakes in the traditional territory of the Tl'azt'en First Nation. The research forest was established in 1999 as a result of many years of planning by the University of Northern British Columbia and the Tl'azt'en First Nation. This research forest is unique in North America in that it is the only research forest that is jointly managed by a University and a First Nation community. The purpose of the forest is to promote inter-disciplinary research while providing education and employment opportunities for the local community.

The majority of the forested landbase consists of Spruce and Douglas Fir leading stands (62%). Lodgepole Pine and Balsam contribute an additional 12 %each. Hardwoods consisting of Cottonwood Trembling Aspen and Paper Birch make up the remainder (14%). Total standing volume of timber on the JPRF is approximately 1.8 million cubic meters.

Source: <http://researchforest.unbc.ca/jprf/jprf.htm>

5 Timber Supply

5.1 Vegetation Resource Inventory

The Vegetation Resource Inventory Management System (VRIMS) is used to update the Provincial Forest Inventory. In this process, new harvest and free-growing data are extracted from the Reporting Silviculture Updates and Land status Tracking System (RESULTS), verified and integrated into the Vegetation Resource Inventory.

While the vegetation inventory available for the Stuart TSBs has been acquired over several decades (Figure 6), most projects throughout the area defined as the THLB have been conducted fairly recently - albeit prior to impacts from MPB, spruce and balsam beetle infestations.

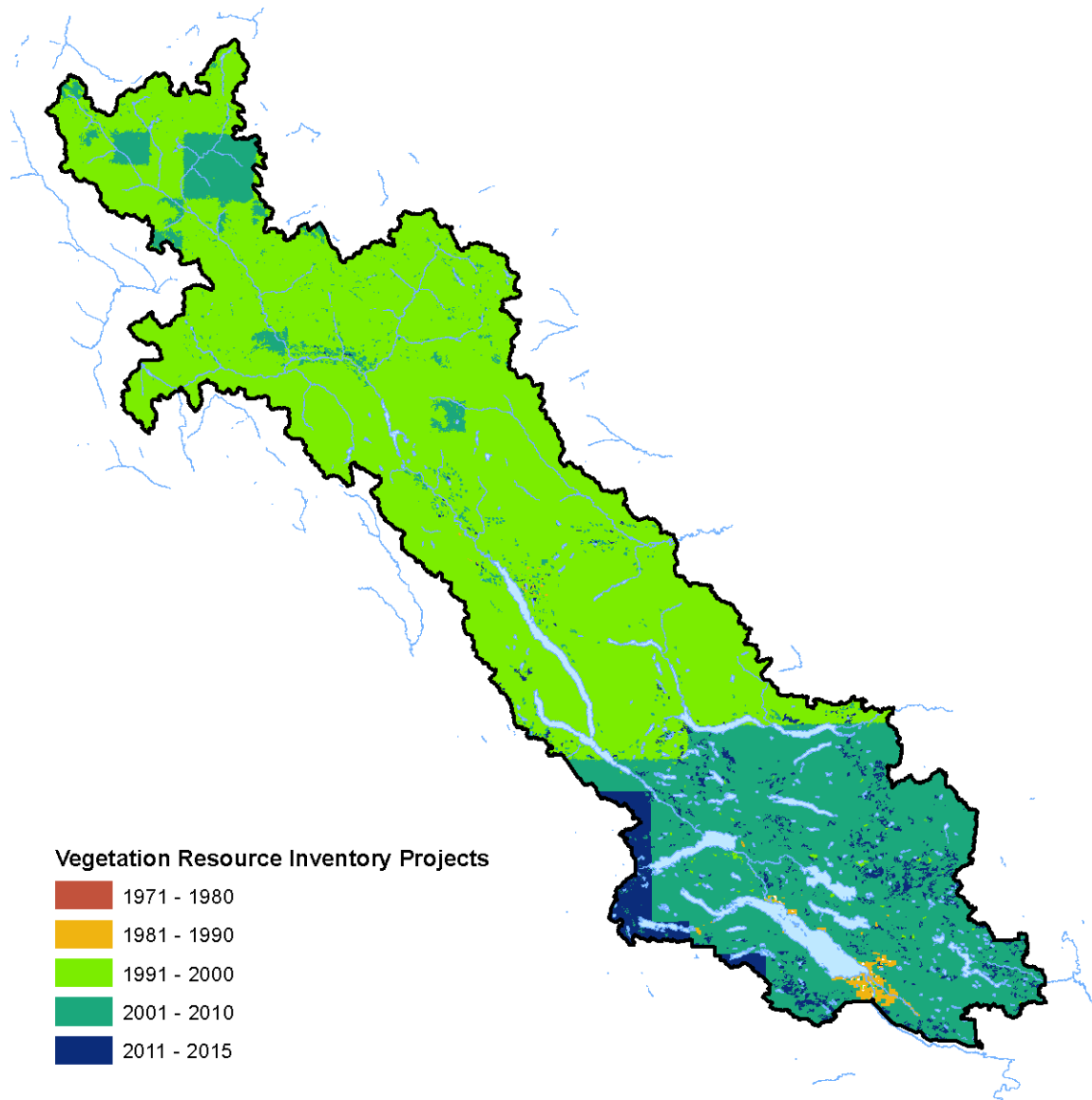


Figure 6 VRI Photo Interpretation Projects

5.2 Timber Profile

Forests of the Stuart TSBs are mostly lodgepole pine, spruce and a relatively significant amount of balsam at higher elevations (Figure 7, Figure 8, Figure 9). There are also scattered patches of aspen a few stands, particularly along the shores of Stuart Lake, with Douglas-fir. A history of frequent wildfires has left a mosaic of forest ages.

Timber harvesting to date has concentrated on the southern portion of the Stuart TSBs, in areas around the larger lakes, and along valley bottoms in old age class spruce, with increasing emphasis on lodgepole pine-dominated stands. Historical lack of access, mountainous terrain and a predominance of less preferred tree species, such as balsam, have limited harvesting in the north.

Source: Fort St James LRMP, 1999

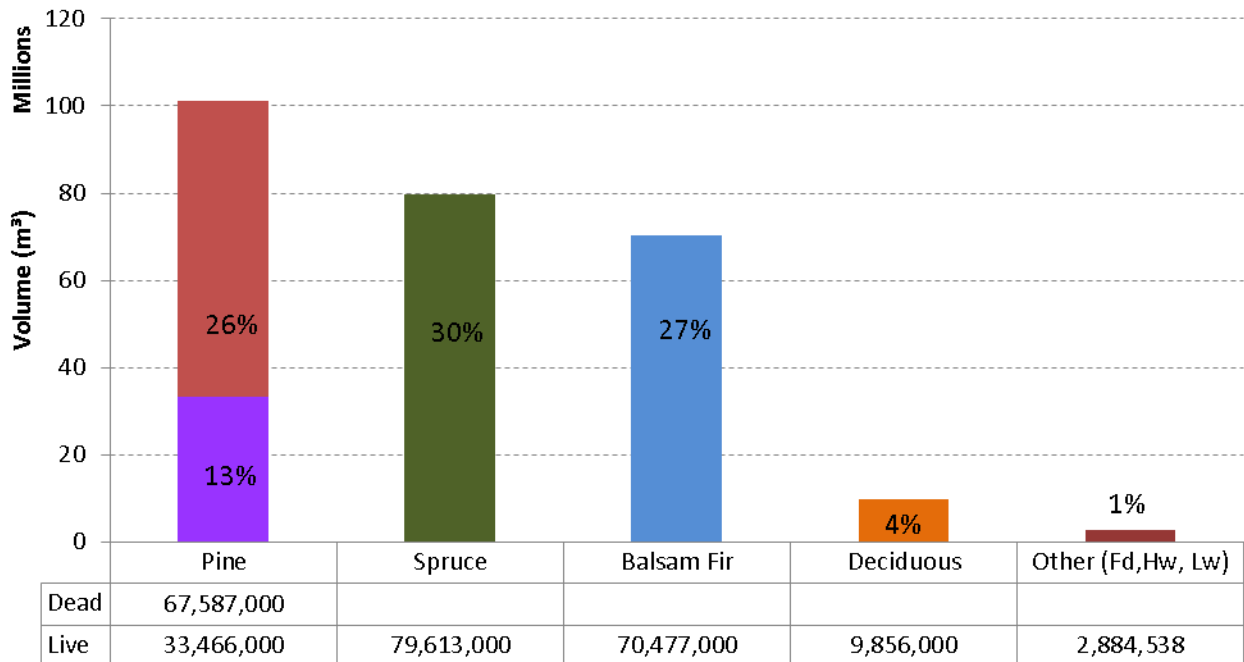


Figure 7 Total volume by species within the THLB for Stuart TSBs

Source: Forsite - VRI 2014

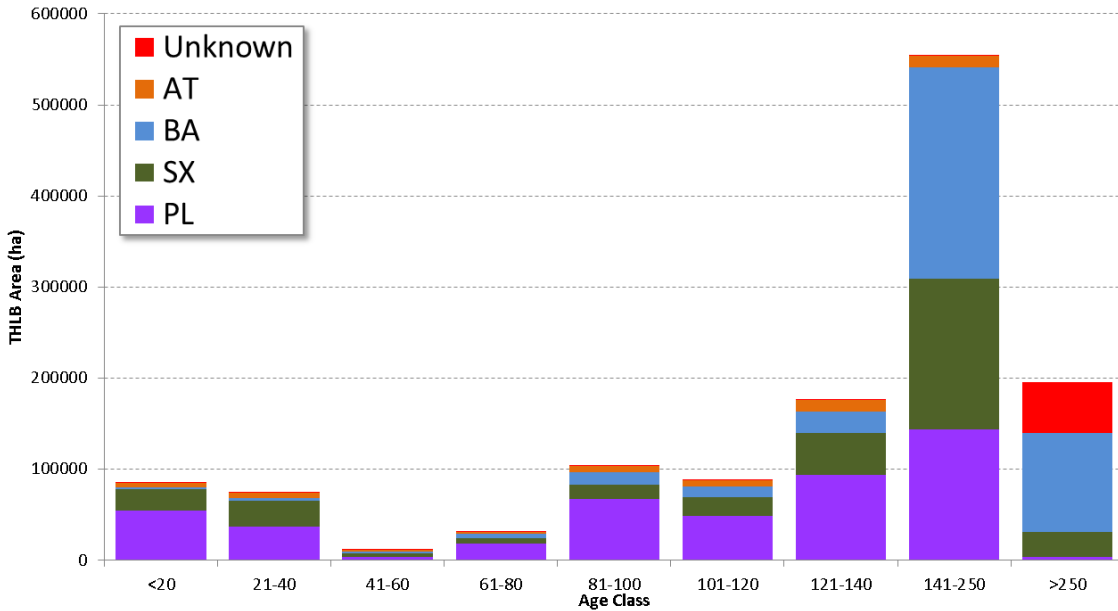


Figure 8 Area distribution by age class and species within the THLB for Stuart TSBs

Source: Forsite - VRI 2014

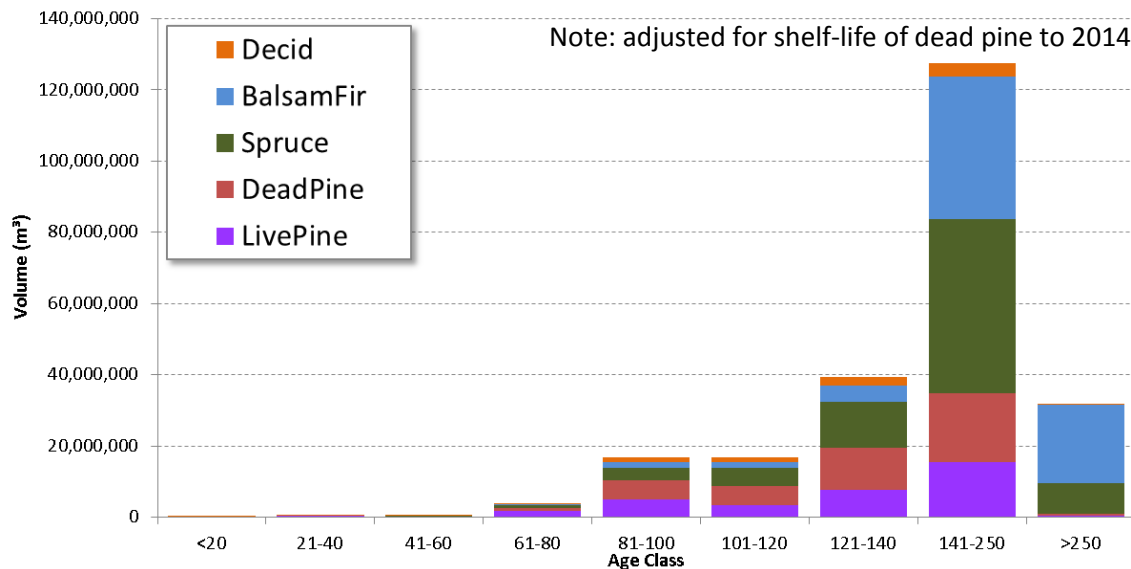


Figure 9 Volume distribution by age class and species within the THLB for Stuart TSBs

Source: Forsite - VRI 2014

5.3 Allowable Annual Cut

5.3.1 Past and Current AAC

In response to the MPB epidemic the AAC was increased in 2002 from 9.3 million m³/year to 12.2 million m³/year, and then increased further to 14.9 million m³/year in 2004. These increases were specifically intended to facilitate the salvage of dead pine while it retained commercial value. In January 2011 the AAC was reduced to 12.5 million m³/year, still higher than the “green” AAC prior to the beetle outbreak.

Through the Chief Forester's direction, specific AAC partitions were also implemented to continue the focus on dead pine salvage, as:

The chief forester has determined that about 3.7 million cubic metres of the total AAC will be for non-pine species. Harvest levels will be limited to 875,000 cubic metres for spruce-leading stands, 23,000 cubic metres for cedar-leading stands and 160,000 cubic metres for deciduous-leading stands in the Prince George and Fort St. James forest districts. The other 2.64 million cubic metres is for the incidental harvest of non-pine timber in stands dominated by pine.

Significant implications are expected with this AAC uplift and partition:

1. The harvesting pattern will be different than in the past. Often, roads will have to extend beyond operable green timber to reach the dead pine stands. This will likely result in higher average development and road maintenance costs.
2. There is potentially a higher risk to non-timber values in this period of accelerated development. This is a major factor in requiring the development of this ISS.
3. The AAC for the mid-term timber supply depends on the success of the implementation of this partition; saving the green wood for the future.
4. The mid-term timber supply may come with the economic advantage of being already substantially roaded. Roads must be maintained or properly put to bed to maintain the initial development investment.
5. There will be a distinct shift in species composition for both lumber and pulp products both during the pine salvage partition period and immediately afterwards.

5.3.2 Existing Apportionment and License Commitments

The AAC is currently partitioned according to Table 4, apportioned by tenure type according to Table 5, and distributed among licensees as shown in Table 6. Only 61% of the current AAC has been committed to licensees operating within the Prince George TSA.

The three largest licensees operating within the Stuart TSBs are Canfor, Conifex, and BCTS. While operating areas are not a legal instrument, a well-respected agreement exists to define geographical operating areas, as shown previously in Figure 5.

Table 4 Current AAC Partition by partition for the Prince George TSA

Partition	Volume (m3/yr)	Percent
Conventional Stands	8,817,000	70.5%
Deciduous leading Stands	160,000	1.3%
Hemlock Cedar Stands	23,000	0.2%
Non-Pine Species	3,500,000	28.0%
Unapportioned Volume		
	12,500,000	

Table 5 Current AAC apportionment by tenure type for the Prince George Current TSA

Tenure Type	Conventional		Deciduous	
	Volume (m3/yr)	%	Volume (m3/yr)	%
Replaceable Forest Licences	5,695,441	46.2%		
Non-Replaceable Forest Licences	3,507,642	28.4%	120,000	75.0%
First nations Woodlands Licences	450,000	3.6%		
BCTS Forest Licence (Non-Replaceable)	180,000	1.5%		
BCTS Timber Sale Licence	2,280,000	18.5%	40,000	25.0%
Community Forest Agreement	45,000	0.4%		
Forest Service Reserve	181,917	1.5%		
	12,340,000		160,000	

Table 6 Current AAC commitments by licensee and partition for Prince George Current TSA

Licence Type	Licence No.	Licensee	Conventional	Deciduous Leading	Hemlock Cedar
Replaceable Forest Licences	A17482	L&M Lumber Ltd.	49,514		
	A18156	Apollo Forest Products Ltd.	216,746		
	A18157	Canadian Forest Products Ltd.	588,223		
	A18158	Carrier Lumber Ltd.	253,027		
	A18160	Dunkley Lumber Ltd.	47,048		
	A18162	West Fraser Mills Ltd.	240,908		
	A18163	Lakeland Mills Ltd.	249,827		
	A18165	Canadian Forest Products Ltd.	1,104,858		
	A18169	Dunkley Lumber Ltd.	201,978		
	A18171	Winton Global Lumber Ltd.	505,541		
	A40873	Canadian Forest Products Ltd.	1,597,771		
	A77955	Conifex Inc.	440,000		
	A93557	1040804 BC Ltd.	200,000		
		Subtotal	5,695,441	0	0
Non-Replaceable Forest Licences	A55578	L&M Lumber Ltd.	250,000		
	A76218	Renew Resources Inc.	250,000		
	A76219	Renew Resources Inc.	250,000		
	A76400	Pinnacle Renewable Energy Inc.	250,000		
	A77813	K&D Logging Ltd.	250,000		
	A78072	Brave Holdings Ltd.	25,000		
	A86572	Stellako Custom Wood Ltd.	51,200		
	A88972	Colborne Lumber Ltd.		3,000	
	A89464	Nak'al Ko Timber Ltd.	30,000		
	A90812	Tano T'Enneh Ltd. Partnership	101,888		
	A91154	Saik'Uz First Nation	75,000		
	A91518	Stellat'En Duchun Forestry Ltd.	125,000		
	A93154	Nadleh Whuten First Nation	75,000		
	Subtotal	1,733,088	3,000	0	
BCTS - Non-Replaceable	A59071	K&D Logging Ltd.	60,000		
	A64418	Ta-Da-Chun Timber Ltd.	100,000		
	A70349	Xsu-Wii-Ax Forest Products Ltd.	20,000		
	Subtotal	180,000	0	0	
	Total	7,608,529	3,000	0	

Note: Highlighted text denote licences/licensees operating within the Stuart TSBs

Source: Ministry of Forests and Range - Apportionment System, Omineca Natural Resource Region Prince George TSA Report
Effective Date: 2015-10-16

5.3.3 Harvest Performance

Since 2007 the average volume harvested from the Prince George TSA has been approximately 30% below the AAC. This reflects the economic downturn beginning in 2007 that contributed to reduced lumber demand and reduced harvest levels for most major licensees. Harvest shortages from several non-replaceable forest licences awarded to bio-energy proponents also contributed to the undercut.

Source: Prince George TSA Mid-term Mitigation Timber Supply Analysis, Nov 27, 2011

In every AAC determination since 2002 the chief forester has recognized the importance of focusing the majority of harvest on MPB attacked pine forests through AAC partitions. This was done to preserve as much of the green (live) timber as possible over the short-term, that will be critical to preserve as the mid-term timber supply. The volume harvested from the Stuart TSBs (Figure 10) shows that for the last decade licensees operating within the Stuart TSBs have generally complied with this direction by attaining a pine harvest average of 67%, ranging from 63% to 78%.

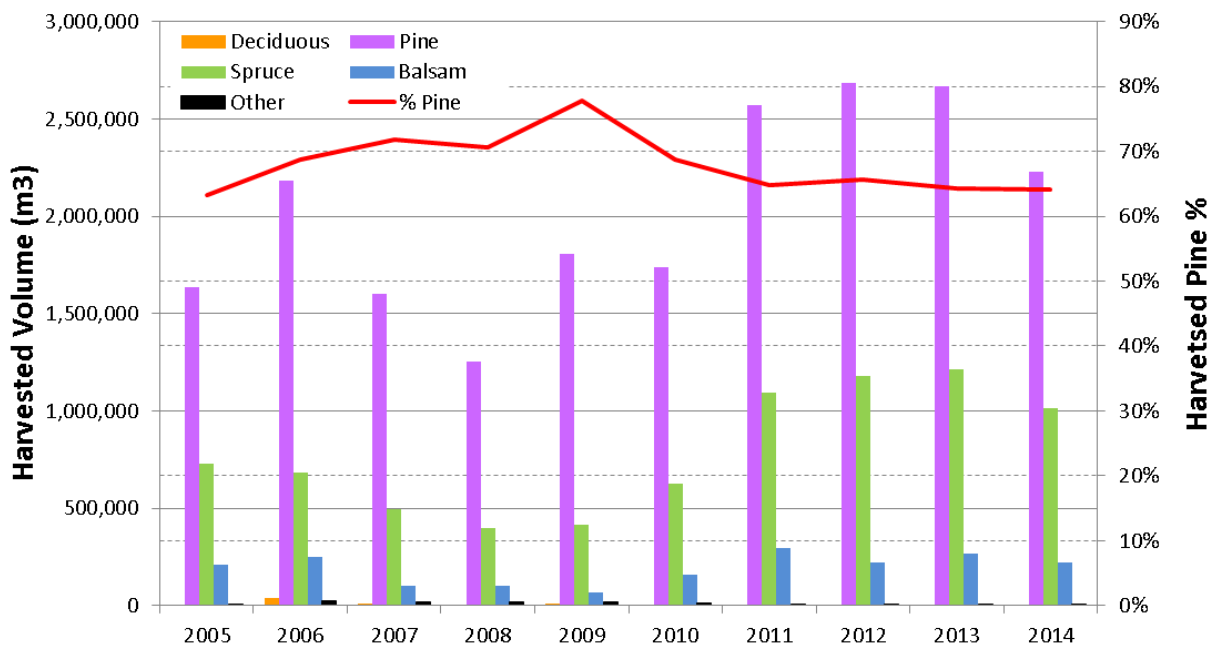


Figure 10 Volume harvested from the Stuart TSBs

Source: FLNR Harvest Billing System (HBS)

Until the pine beetle outbreak and the Chief Forester’s direction to salvage dead pine, the distribution of species harvested in the Prince George TSA had been quite consistent (Figure 11). The harvest shifted towards salvaging pine after the outbreak began in 2002.

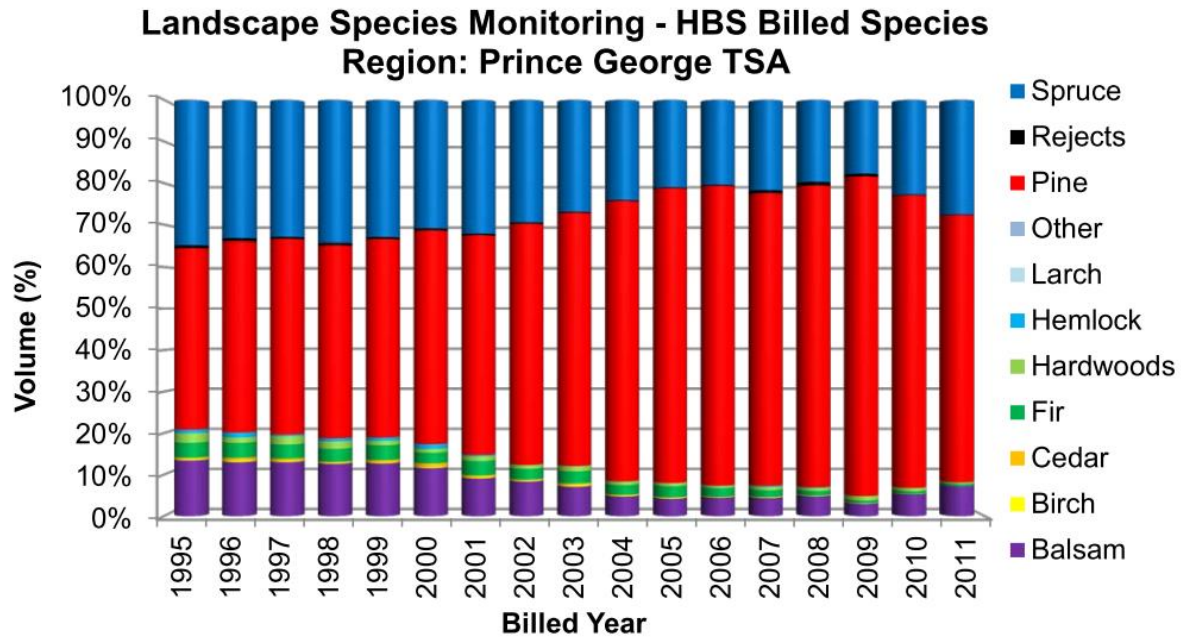


Figure 11 Species Harvested in the Prince George TSA

Source: Species Monitoring Report Stuart TSBs Summary Charts and Graphs May 2012

The base case scenario from the previous TSR (Figure 12) showed that the harvest level over the mid-term would fall to nearly half of the current harvest level uplift and nearly one third of the pre-beetle AAC.

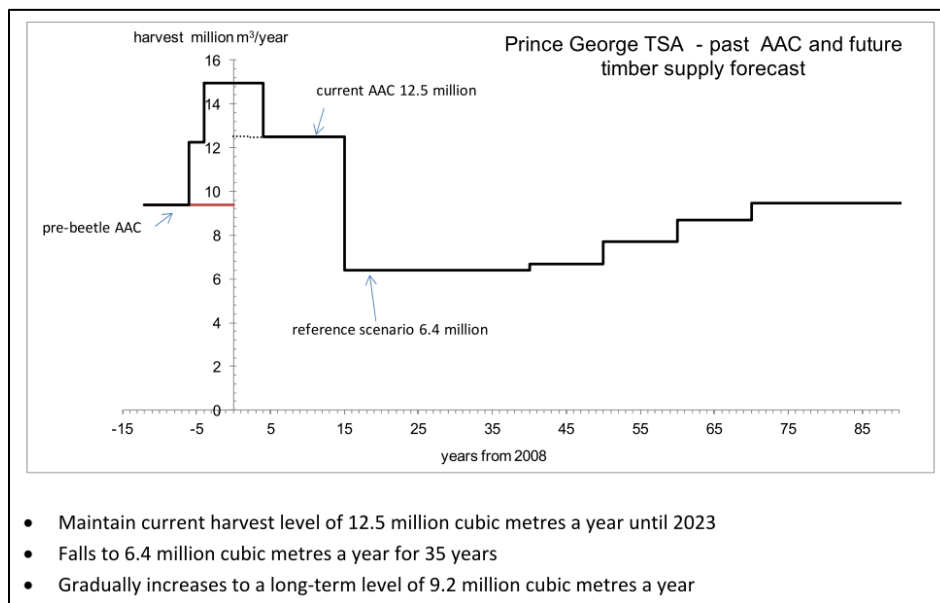


Figure 12 Prince George TSA AAC Forecast Showing Potential Falldown in Cut Level for the Midterm

Many options are being considered to alleviate the potential falldown timber supply though the mid-term, including:

1. Altering the Prince George Old Growth Order, lowering the age definition of old growth

2. Removing the constraints of the Prince George Old Growth Order altogether
3. Relaxing VQOs
4. Intensive silviculture including a very significant fertilization program.

The potential risks to biodiversity and other non-timber values are being weighed against the various options.

5.3.4 Balsam Utilization

Although balsam-leading stands represent 22% of the Crown Forest Land Base area and 19.6% of the total volume, historically (i.e., pre-MPB epidemic) they have represented 1.6% of the harvest profile in the Prince George TSA. The current TSR for the Prince George TSA may incorporate a partition for this profile. Table 7 shows that over three quarters of this volume occurs within the Stuart TSBs (DJA).

Table 7 Area and Volume of Balsam-Leading Stands in the Prince George TSA

Land base	Stands with 80% Balsam or greater		90% Balsam or greater	
	Area	Volume	Area	Volume
CFMLB	707,508	104,558,953	533,496	75,261,218
Inoperable removed	344,671	53,349,913	229,987	33,635,957
District				
DPG	108,190	12,209,568	62,223	6,061,224
DVA	3,312	383,659	896	99,207
DJA	233,170	40,756,685	166,868	27,475,526

Source: Prince George TSA TSR Data Package April 2015

5.3.5 Deciduous Utilization

There are over 125,000 hectares of deciduous-leading stands within the Stuart TSBs and 70% of these stands are located within 100 km of Fort St James. Many lower elevation stands contain a deciduous component. Deciduous species include cottonwood and birch, but the vast majority of the deciduous inventory is aspen.

Although deciduous-leading stands represent a significant component of the timber supply within the Stuart TSBs, it has yet to be utilized to any extent. Past deciduous apportionments were unused but market values are slowly beginning to increase with more product options such as:

1. Oriented Strand Board sheets are now a widely used building material in North America.
2. Aspen is now used by a number of pulp mills for making kraft paper.
3. Poplar species are used in many Asian plywoods as core stock.

From a timber supply and silvicultural perspective there are several advantages to utilizing and managing for deciduous:

1. it regenerates easily from roots,
2. it grows quickly,

3. brushing to eliminate it would not be required, reducing use of pesticides.
4. mixed stands with spruce underneath the deciduous may lessen the incidence of spruce terminal weevil (*Pissodes strobi*), and
5. a large amount exists within current and ongoing development areas and just needs to be added to the existing harvest.

5.4 Forest Health Impacts

5.4.1 Mountain Pine Beetle

Within the Prince George TSA, the Stuart TSBs has been identified as a key source of green timber over the mid-term. It is worth noting that total volume losses due to MPB have actually been greater, in the Stuart TSBs have actually been greater than in the Vanderhoof or Prince George TSBs.

The widespread MPB epidemic poses the following three challenges to timber supply that must be carefully addressed through the course of this project.

MPB Kill in Old Stands

As mentioned in section 2.6, current data from the vegetation resources inventory indicate that about 68.3 million m³ or 67% of the pine volume on the THLB is currently dead. The geographical distribution of dead pine and estimated year of attack within the Stuart TSBs is illustrated in Figure 13.

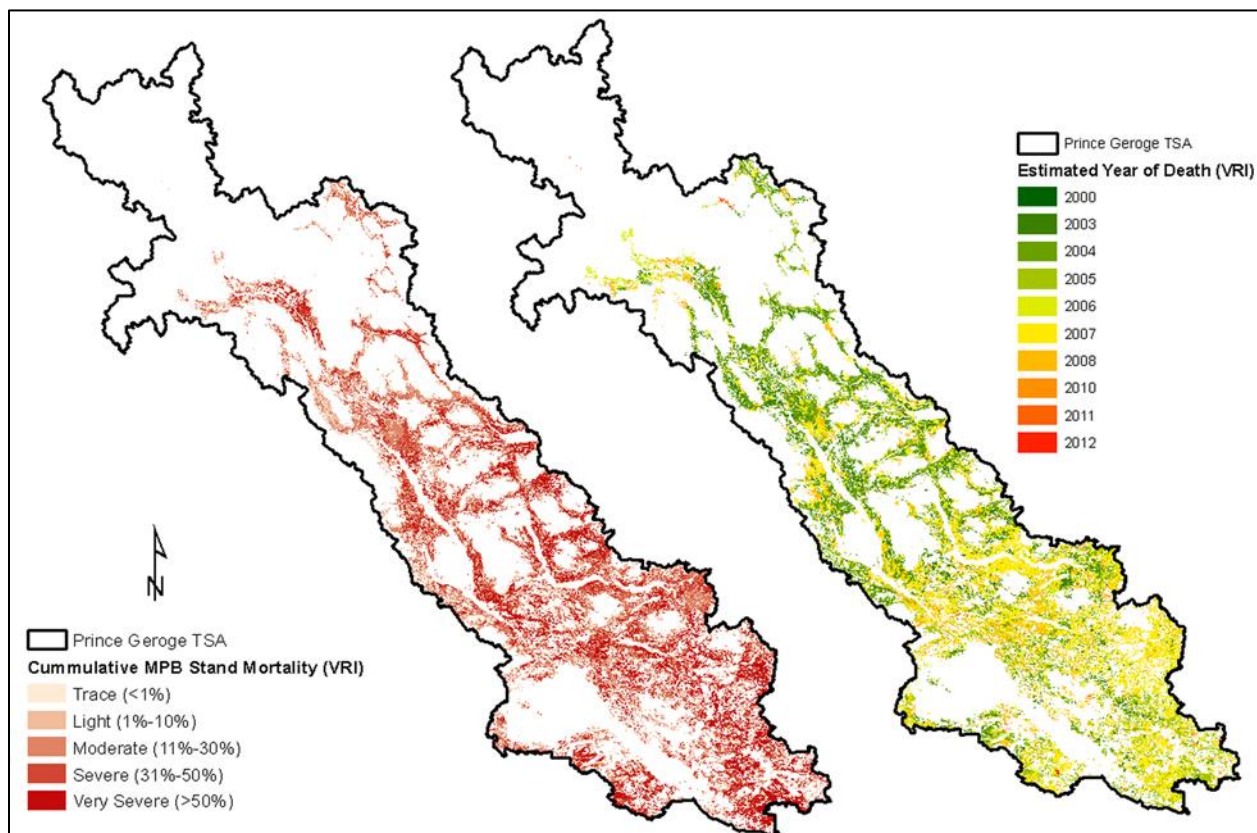


Figure 13 Cumulative Stand Mortality due to MPB and Estimated Year of Death

Source: Forsite 2015 - MPB Summary of vegetation resources inventory for Stuart TSBs

MPB Kill in Young Stands

When calculating mortality due to MPB the BCMPB model only considers stands greater than 60 years old. The MPB mortality in younger stands is not addressed by this model.

To address the MPB impact on stands younger than 60 years, the on-going TSR applied an approach that incorporated mortality estimates sampled in 2008 to all pine-leading stands within each identified age class and each surveyed landscape unit. Within the Stuart TSBs, attack percentages ranged from 0.3% to 42% for a weighted average of 10.7%.

Source: FLNR Prince George TSA - TSR Data Package ,April 2015

Shelf Life

Following attack, wood fibre of the dead forest becomes increasingly dry and more brittle and rot begins to set in at the base of trees. The loss of quality affects the value of the timber and the products that may be produced from the fibre. This negatively impacts both costs and revenues where:

1. Stands already associated with higher costs due to harvesting constraints (e.g., cable harvesting on steep slopes) and/or long haul distances become infeasible as pine volume/value declines.
2. Logging costs rise, since more non-merchantable timber must be left in the woods and harvestable stands get farther away from the mills.
3. Sawmill lumber recoveries drop as wastage due to rot/checks increases.
4. Difficulties in sawmilling expand (e.g., more saw changes, clog-ups, breakage and wood dust).
5. Lumber grade yields decline.

It is generally accepted that the value of the products derived from MPB-impacted stands decreases as recovery shifts from dimension lumber to pulp and secondary products, such as fibre for bioenergy, in the years following death.

Shelf life refers to the length of time since death in which a specific merchantable product can be produced from a dead tree. It is affected by a combination of factors, such as time since death, moisture, temperature, and aspect. Stand merchantability is also dependent on several factors, including stand condition, market, access, and available milling technology. Shelf life is typically applied as the time a stand (or portion of a stand) remains economically viable or merchantable for harvesting a combination of products including peeler, sawlog and pulp.

Many options have been considered for determining shelf life throughout the province. Different methodologies are chosen to best match the TSR analysis needs and reflect operational factors. The current TSR for the Prince George TSA will use an exponential loss curve to represent decreasing value over time since attack (Figure 14). According to this shelf life assumption, the total volume of dead pine in 2014 should be reduced for decay by 37% or 25.1 million m³.

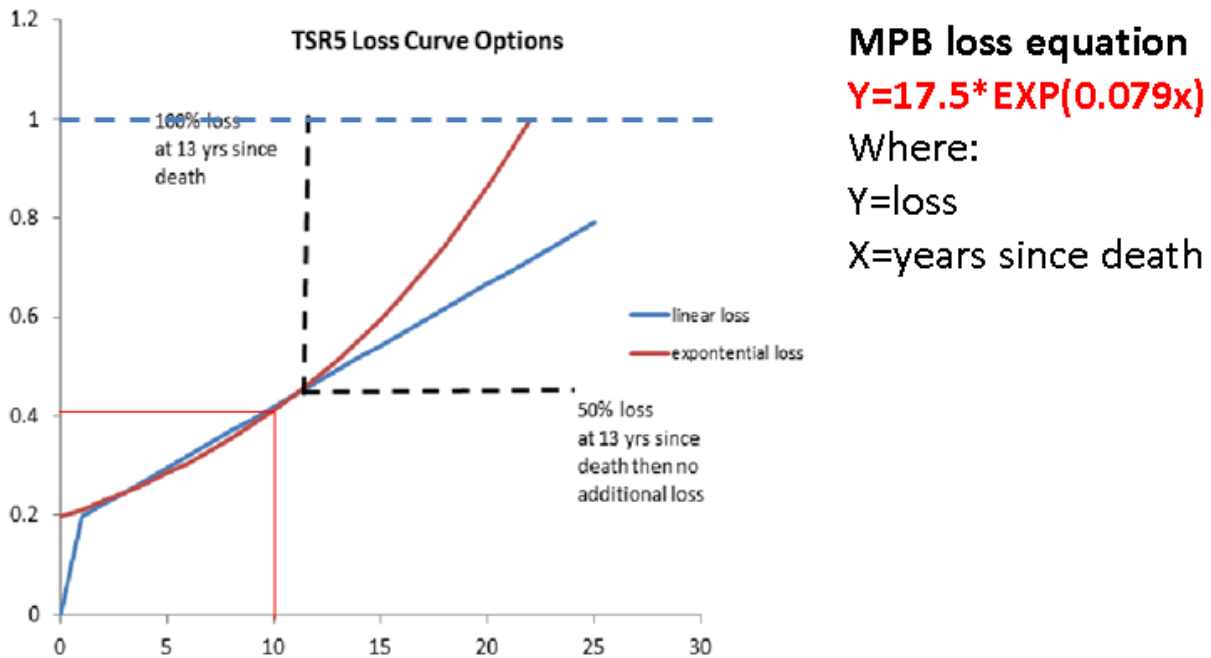


Figure 14 Options considered for ‘shelf life’ (TSR for the Prince George TSA)

Source: FLNR Prince George TSA - TSR Data Package ,April 2015

Secondary Structure

Section 43.1 of the Forest and Range Practices Act Forest Planning and Practices Regulation (FPPR), *Secondary structure retention in mountain pine beetle affected stands* (182/2008), requires forest licensees to protect secondary structure (understory advanced regeneration and non-pine canopy trees) in MPB affected areas. This only applies to TSAs or Tree Farm Licences designated by the Chief Forester in an order made under FPPR Section 43.2(1a). Accordingly, this regulation applies to the Stuart TSBs.

Considerable variation in secondary stand structure exists among different lodgepole pine stands. In their recent study to determine the proportion of Biogeoclimatic Ecosystem Classification (BEC) units considered to be in poor condition and hence likely to recover slowly from a timber supply perspective, Coates and Sachs (2012) reached the following conclusions for pine leading stands:

- Generalizations about secondary structure abundance based solely on pre-beetle pine dominance are too crude since understory, sub-canopy and canopy secondary structure post-beetle can vary widely at any level of pine dominance.
- ESSF and ICH zones pose few problems for recovery while MPB-impacted stands in the SBS zone pose the greatest risk.

Based on 3,823 plots examined, Coates and Sachs (2012) further predicted the natural recovery of pine leading stands, as shown in Table 8:

Table 8 Predicted Natural Recovery of Pine-Leading Stands by BEC

BEC Unit	Suggested % range of predicted natural recovery ⁽¹⁾
SBS	58-68
MS	76-86
SBPS	78-88
IDF	75-85
ESSF	92-100
ICH	90-100
BWBS	80-100
Total	70-80

+/- 5% tolerance used around calculated means except for ICH and BWBS where +/-10% used given low # of plots

Since a large area of MPB attacked pine-leading stands will not be reached during the salvage period, it important to understand the existing regeneration structure within these stands to predict their eventual contribution to timber supply. Stands with good advanced regeneration may be available to contribute to timber supply near the end of the mid-term. Establishing new inventory information for these stands is extremely important but is a considerable challenge.

Regeneration of Unsalvaged Stands

Unsalvaged stands, unless rehabilitated, will regenerate naturally through advanced regeneration (dominated by shade-tolerant species; spruce and balsam) or seed currently on site (dominated by pine within the seed bed or aspen from adjacent stands). Stands that are not salvaged may require an assessment to determine how they are performing and whether additional treatments are required to ensure they are regenerating satisfactorily (or perhaps better).

Pine Seed Availability

In response to the initial years of widespread outbreak in the Province, particularly in the hard-hit Williams Lake and Quesnel Districts, the issue arose of adequate seed supply to reforest pine-leading stands harvested at accelerated rates. Seed collection and supply has increased in response to the MPB epidemic, and the Provincial Seed Planning and Use website now has specific strategies and programs in place to address MPB reforestation seed requirements. Due to the interest in this issue the Tree Improvement Branch of the FLNR has issued the *Mountain Pine Beetle Seed Planning BULLETIN 05, March 2008*. This bulletin begins:

“In response to the mountain pine beetle (MPB) outbreak in the interior of BC, there is a large and ongoing lodgepole pine (Pli) cone collection effort. This is to ensure that those with reforestation obligations have a supply of seed into the future.”

5.4.2 Spruce Beetle

In the wake of the MPB epidemic, a recent outbreak of spruce beetle is has become a serious concern throughout the Omineca Region as spruce trees will be one of the primary sources of fibre through the mid-term harvest period after MPB salvage and AAC uplifts are complete (Figure 12). Over the last two years (Table 11), while the total area of new grey attack has decreased, attack intensity increased (i.e., shift from trace to low; low to medium, etc.), resulting in higher cumulative impacts to spruce-dominated stands.

Table 9 Spruce beetle attack observed in the Stuart TSBs

Year	Trace (<1%)	Low (1-10%)	Medium (11-30%)	Severe (31-50%)	Total Area (hectares)
2014	27,397 (56%)	21,103 (43%)	14 (0%)	0 (0%)	48,514
2015	644 (8%)	3,665 (48%)	3,333 (44%)	17 (0%)	7,659

Note: observations of new grey attack (not cumulative)

Source: FLNR Nov 16, 2015 - Spruce Beetle Overview Flights - Fort St. James Natural Resource District

5.4.3 Balsam Decline

Sub-alpine fir (*Abies lasiocarpa*) decline has been a serious forest health concern in the Stuart TSBs since the early 1990s. Ongoing outbreaks of western balsam bark beetle (*Dryocoetes confusus*) and two-cycle spruce budworm (*Choristoneura biennis*) over the past decade, coupled with various heart rot diseases common to over-mature sub-alpine fir-leading stands, have contributed to extensive stand mortality and significant loss of merchantable volume.

Western balsam bark beetle attacks often coincide with other stress agents, such as Two-year Cycle Budworm, which makes it difficult to accurately record the outbreak pattern and extent of the damage caused. The life cycle of the western bark beetle typically requires two years to complete. Eggs are deposited in chambers within the inner bark where adult beetles over-winter. A phytopathogenic lesion-causing fungus (*Ceratocystis dryocoetidis*), carried on western balsam bark beetles could be responsible for 65% of the mortality associated with an attack. This fungus can invade the phloem causing lesions which can girdle and cause mortality without the additional effect of beetle movement within the tree (Garbutt 1992).

The ongoing TSR for the Prince George TSA addressed losses due to balsam decline through this mortality regression model developed based on inventory age and volume attributes:

$$\text{final volume} = \text{initial volume} * (1 - (-4.55E-02 + (3.21E-04 * \text{initial volume}) + (1.02E-03 * \text{age})))$$

Prince George TSA TSR data package April, 2015

5.4.4 Gall Rust

All pine trees, including those at high elevations, are potential primary hosts to three species of gall rust: Western gall rust, Stalactiform blister rust and Comandra blister rust. The majority of damage resulting from rusts are growth losses and mortality from blisters girdling the stem. Trees of all ages can be attacked however young trees are most susceptible. Damage from rusts can impact lumber quantity and quality. Increased stocking is sometimes recommended to compensate for young trees losses due to gall rusts.

Western gall rust creates irregularly rounded, woody distortions in the tree that grow larger each year until they are attacked by secondary fungi and insects. Signs of infection occur approximately three years after infection distinguished by discoloration of the needles and swelling of the bark. Blisters form from the swelling and spores are released to infect secondary hosts. Infected stems and branches die from attack by secondary organisms.

Western gall rust is the most common rust of young lodgepole pine in the Prince George TSA accounting for approximately 70% of all rust infection. Infection is caused by long distance spread spores that travel hundreds of kilometers. Since western gall rust does not have an alternate host, infection is pine to pine; highest in young stands, with new stem infection largely subsiding by age ten. Main stem galls are generally lethal on young trees, but a portion may persist into late rotation. Western gall rust damage on mature trees is not significant, since most infections occur on branches and branch galls do not result

in serious growth losses (Ziller 1974). As well, this disease seldom kills older trees, but can kill young trees with main stem infections. Heavily infected trees are generally stunted or malformed, predisposing these trees to breakage in high winds or under heavy snow loads (Ziller 1974).

Stalactiform blister rust can be locally abundant, but is not widespread. Alternate hosts include members of the figwort 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 can be tracked in on equipment. Recent research indicates that yellow rattlebox, may be a very prominent alternate host. Significant mortality can occur on sites with moderate to high levels of alternate hosts, particularly if trees are infected at a very young age. Currently, pre- and post-harvest monitoring is occurring.

Comandra blister rust is a very damaging stem rust of lodgepole pine. It girdles and kills young trees rapidly and can occur at very high levels locally. Since spread from the alternate host to pine is by short range spores, infection is highly clustered and generally corresponds to the distribution of the alternate host, Bastard Toadflax (*Geocaulon lividum*). Risk is several times higher within close proximity (a few meters) to the alternate host. Resistance in lodgepole pine is not believed to be common, although screening holds potential. Impact can be serious, especially where stocking is insufficient to compensate for mortality, therefore overstocking is recommended on high risk xeric sites. Species mixes are recommended on mesic and moister sites.

Source: FLNR - Forest Health Strategy for the Prince George TSA, 2011

5.4.5 Unsalvaged Losses

The volume of timber killed or damaged annually by natural causes (e.g., fire, wind, insects, and disease) that is not harvested is referred to as unsalvaged losses.

The ongoing TSR for the Prince George TSA applied estimates of unsalvaged losses that amount to 3.0% during the salvage period and 3.2% thereafter.

Table 10 Estimates of unsalvaged losses applied in the TSR for the Prince George TSA

Prince George TSA TSR Data Package				April 2015
<i>Table 25. Summary of annual insect, wildfire and windthrow losses estimated for the PGTSA</i>				
	Insects (m³)	Fire(m³)	Wind(m³)	Total
Gross volume during salvage period*	312,293	63,314	66,664	382,271
Unrecovered volume during salvage period*	257,040	60,630	51,637	369,307
Unrecovered volume post-pine salvage period**	278,500	111,000	3,670	397,800
*Based on 1999-2013 data.				
** Based on estimates from TSR2.				

5.5 Capacity to Adjust Harvesting Operations to the Stuart TSBs

There are significant operational challenges for the Stuart TSBs to supply the majority of the Prince George TSA AAC for the entire mid-term. The pine-leading forests of the Prince George TSA areas were relatively close to town and located in all directions. In contrast, the long thin shape of the Stuart TSBs will result in very long haul trucking and rail access, and a concentrated use of only a few main transportation networks.

Some key issues to consider with adjusting the majority of the TSA cut and operations to the Stuart TSBs in the short term include:

1. increasing rail haul capacity (i.e., more rail cars and engines, additional reload stations, additional sidings for trains to pass, extended distance);
2. upgraded main haul routes, widening, straightening, paving, safety programs;
3. alternate routes for hauling through towns and communities;
4. building facilities (i.e., for equipment maintenance, crew camps, communications, safety/emergency access);
5. biomass transportation;
6. forest tenure opportunities being sought by First Nations in the Stuart TSBs as well as those from the Vanderhoof and Prince George areas;
7. realignment of licensee operating areas; and
8. pressure to haul wood westward to facilities in Smithers, Houston and Burns Lake.

Sources: Excerpts from OBAC Proposed Interim Action Plan for Future Forest Products and Fibre Strategy and others identified from various sources.

5.6 Operability Criteria

Many site factors play a role in determining the economic feasibility or operability of any stand. These criteria can include: timber value, species, volume, piece size, slopes requiring cable logging, and long haul distances.

Minimum harvest criteria are key assumptions used to define the timber supply and quality for a management unit and is often a source of debate when comparing past harvesting performance with future opportunities. The stand operability criteria applied in the ongoing TSR for the Prince George TSA are shown in Table 11

Table 11 Stand operability criteria used in the ongoing TSR for the Prince George TSA

Leading Species	Minimum Volume	Slope	Elevation	Haul Cycle Time
Pine	<140 m ³ /ha	0-35%	<1492 m	<23 hrs
Non-Pine	<182 m ³ /ha	0-62%	<1492 m	<23 hrs

5.6.1 Minimum Stand Average Volumes

The ongoing TSR for the Prince George TSA uses a minimum stand average volume of 182m³/hectare for both the truck and rail access portions of the TSA. To account for declining volumes in beetle-killed stands a minimum volume of 140 m³/hectare was assumed for pine-leading stands.

5.6.2 Steep Slopes and Elevation

An analysis of cutblocks from past 50 years was used to determine the historic distribution of harvesting in slope and elevation. Slope and elevation class thresholds were derived using the 25-metre resolution digital elevation model that reflect harvest equipment capability and environmental suitability. Safety guidelines for machine operability have also been incorporated into the determination of these thresholds. The analysis indicates that the historic upper threshold for harvesting (for 99.9% of all area harvested in the past 50 years) is 62% slope. For the purposes of defining operability, this value has been used as an upper bound. The elevation analysis indicates that the historic upper threshold for harvesting has been 1492 metres. For the purposes of defining operability this value has been used as an upper bound. To approximate operational practice small areas (< 2.0 hectares) are aggregated with surrounding larger areas from which the operability criteria are adopted.

The MPB-killed pine salvage partition is expected to direct operations to more steep slopes in the near future. The TSR base case scenario limited the harvest to ground-based systems on slopes up to 46%. Steeper slopes could only be accessed with cable logging systems at a higher cost, so the stand value must be proportionately higher to be economically viable. Accordingly, it was assumed that dead pine salvage would not occur on slopes in excess of 35%.

5.6.3 Haul Distances

Timber harvesting in the majority of the Stuart TSBs typically involves high operating costs associated with long haul distances (i.e., trucking and rail). This criterion is a dominant factor in determining a stand's economic operability. Changing costs, most notably fuel and the advancement of shelf-life, will continually affect the operability of stands located along the outer extent of the THLB. The hauling distance issue is being thoroughly analyzed in the ongoing TSR for the Prince George TSA.

A production-weighted cycle time was created to assess historic performance thresholds with respect to haul distance. The cycle time analysis indicates that the historic upper threshold for timber harvesting

has been 22.1 hours. Figure 15 illustrates these haul cycle times spatially. Note that zone 4 is considered inoperable because it is beyond economically viable haul distance.

Note 3 - Let's make a better map; requested data from Kelly Izzard Jan 4

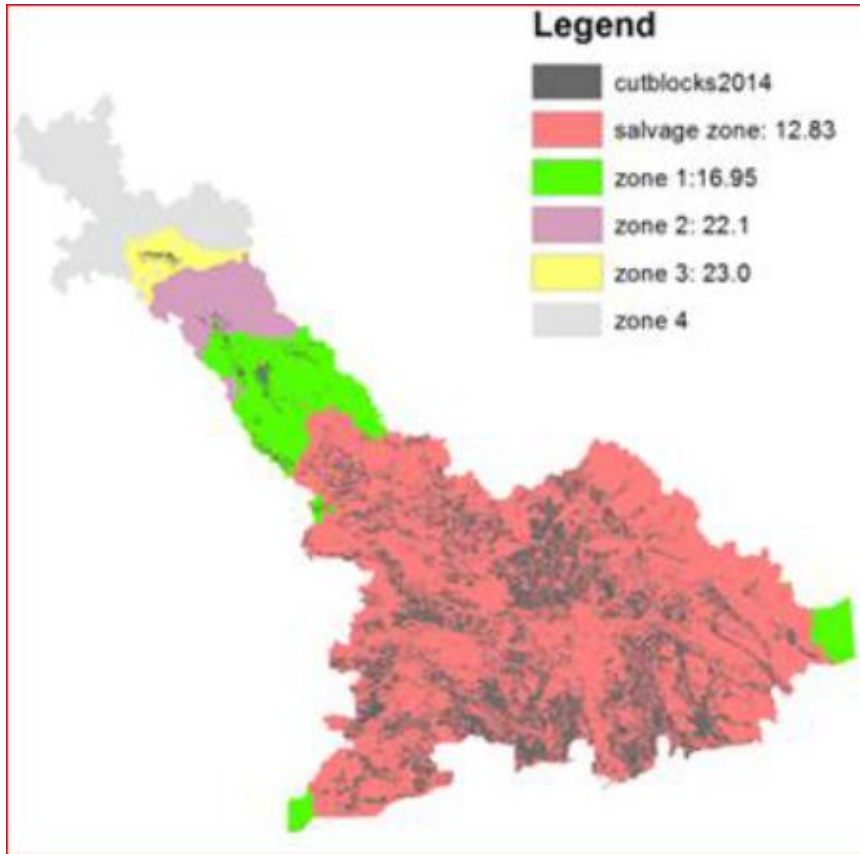


Figure 15 Haul Distance Cycle Times

Source: Prince George TSA TSR Data Package April 2015

6 Timber Quality

High quality logs are a product of long growing periods in naturally grown stands forming consistently sized and straight logs yielding lumber with tight annual growth rings and small branches. Silviculture strategies are typically focused on exploring ways to maintain a desirable profile of products throughout the mid- and long-terms. Various treatment options are considered to manipulate species composition, stand densities, and minimum harvest criteria to influence wood properties such as specific gravity, knot sizes, fiber length, and stiffness. Since strategies to improve timber quality usually involve some compromise to timber quantity, an appropriate balance of these two opposed drivers is required.

To date, Prince George TSA silviculture strategies have focused on achieving timber quantity objectives and have not substantially address the issue of timber quality. With the concerns regarding the mid-term timber supply due to the MPB impact, timber quantity remains the key management issue facing silviculture. The current Land Based Investment Strategy for Prince George – Strategy at a Glance (FLNR) states that:

1. Midterm (21-60yrs): No specific timber quality objectives have been identified in the Type 2 Strategy.
2. Long Term (61+yrs): Though not specified within the Type 2 Strategy, improved quality is anticipated through treatments targeted for timber quantity

The imminent issue concerning timber quality is the inevitable decline in log quality of beetle-killed wood throughout the salvage period (i.e., shelf life - section 5.4.1). Mills must maintain high grade and value outputs to remain competitive and economically viable. A time will come when processing beetle killed trees will not be viable given an ever-declining average quality of log. The beetle-killed pine shelf life is based upon logs having some economic value, but may extend beyond the actual shelf life for viable sawlogs.

7 Fish and Wildlife Habitat

In considering habitat supply, it is important to identify the environmental values potentially at risk from harvesting, roads and forest health impacts.

7.1 Categories of Species and Orders Under FRPA

Under Section 13 of the Government Action Regulation, the Minister responsible for the Wildlife Act may establish, by order, one or more categories identifying species of wildlife as species at risk, regionally important wildlife, or ungulate species.

7.1.1 Species at Risk

Species at risk, as defined by the Federal *Species at Risk Act* means an extirpated, endangered or threatened species or a species of special concern.

In British Columbia, the Ministry of Environment utilizes their red and blue list system:

1. Red listed ecological communities, species and subspecies are those that are extirpated, endangered or threatened in British Columbia.
2. Blue listed ecological communities, and indigenous species and subspecies are those of special concern in British Columbia.

Table 12 to Table 14 list the red and blue listed species for the Stuart TSBs.

Source: Exported from the Ministry of Environment BC Species and Ecosystems Explorer, October 21, 2015

Table 12 Species at Risk for the Stuart TSBs: Vertebrate Animals.

Scientific Name	English Name	BC List
<i>Acipenser transmontanus</i>	White Sturgeon (Nechako River population)	Red
<i>Pelecanus erythrorhynchos</i>	American White Pelican	Red
<i>Euphagus carolinus</i>	Rusty Blackbird	Blue
<i>Glaucidium gnoma swarthi</i>	Northern Pygmy-Owl, swarthi subspecies	Blue
<i>Gulo gulo luscus</i>	Wolverine, luscus subspecies	Blue
<i>Hirundo rustica</i>	Barn Swallow	Blue
<i>Lagopus leucura saxatilis</i>	White-tailed Ptarmigan, saxatilis subspecies	Blue
<i>Oreamnos americanus</i>	Mountain Goat	Blue
<i>Pekania pennanti</i>	Fisher	Blue
<i>Picoides villosus picoideus</i>	Hairy Woodpecker, picoideus subspecies	Blue
<i>Pinicola enucleator carlottae</i>	Pine Grosbeak, carlottae subspecies	Blue
<i>Podiceps nigricollis</i>	Eared Grebe	Blue
<i>Rangifer tarandus pop. 15</i>	Caribou (northern mountain population)	Blue
<i>Salvelinus confluentus</i>	Bull Trout	Blue
<i>Ursus arctos</i>	Grizzly Bear	Blue

Table 13 Species at Risk for the Stuart TSBs: Invertebrate Animals.

Scientific Name	English Name	BC List
<i>Boloria epithore sigridae</i>	Western Meadow Fritillary, sigridae subspecies	Blue
<i>Lymnaea atkaensis</i>	Frigid Lymnaea	Blue
<i>Physella propinqua</i>	Rocky Mountain Physa	Blue
<i>Somatochlora kennedyi</i>	Kennedy's Emerald	Blue
<i>Sphaerium striatinum</i>	Striated Fingernail clam	Blue

Table 14 Species at Risk for the Stuart TSBs: Vascular and Non-Vascular Plants

Scientific Name	English Name	BC List
<i>Carex bicolor</i>	two-coloured sedge	Blue
<i>Chenopodium atrovirens</i>	dark lamb's-quarters	Blue
<i>Pinguicula villosa</i>	hairy butterwort	Blue
<i>Pinus albicaulis</i>	whitebark pine	Blue
<i>Polemonium boreale</i>	northern Jacob's-ladder	Blue
<i>Polemonium elegans</i>	elegant Jacob's-ladder	Blue
<i>Polystichum kruckebergii</i>	Kruckeberg's holly fern	Blue
<i>Stuckenia vaginata</i>	sheathing pondweed	Blue
<i>Woodsia alpina</i>	alpine cliff fern	Blue
<i>Pohlia andalusica</i>		Red
<i>Schistidium confertum</i>		Red

On May 3, 2004 the Ministry of Water, Land and Air Protection established a category of species at risk by order made under the Government Action Regulation of the Forest and Range Practices Act. The category represents species that may be affected by forest or range management and considered endangered, threatened or vulnerable. The order was amended in 2005 and 2006 to add species to category of species at risk. Currently there are 85 species included in this category; however not all the listed species within this category occur within the Stuart TSB. A list of the species is available on the Ministry of Environment website at: <http://www.env.gov.bc.ca/wld/frpa/species.html>

Specific strategies, including silviculture practices, can be employed to reduce the risks to biodiversity, water, fish, wildlife, and habitat (Manning et. al., 2006). These strategies focus on enhancing special habitat like riparian areas and maintaining landscape level biodiversity elements and ecological values. Managing forest health and salvaging MPB will increase road densities across the landscape, which can cause disproportionate impacts to species at risk. Given the vulnerability of forest-dependent species and large areas of MPB impacted timber, increased emphasis on managing these impacts is warranted.

7.1.2 Regionally Important wildlife

Under section 13(2) of the Government Action Regulation the minister responsible for the Wildlife Act by order may establish categories identifying species of wildlife as regionally important wildlife. These species are considered important to a region of British Columbia, rely of habitat that requires special management and may be adversely impacted by forest or range practices. Currently there are no orders establishing the list of regionally important wildlife, but rather this work is ongoing. In 2006 the Omineca Region was part of a pilot project in an effort to identify species for the category of regionally important wildlife. The pilot resulted in the draft list of 28 species; however this list was not finalized by an order under the Government Action Regulation.

7.1.3 Ungulate Species

Under section 13(3) of the Government Action Regulation the minister responsible for the Wildlife Act by order may establish categories identifying ungulate species for which an ungulate winter range is required for the winter survival of the identified species. On May 3, 2004 the Ministry of Water, Land and Air Protection established a category of ungulate species by order. Currently there are 8 ungulate species included in this category; however not all the listed species within this category occur within the Stuart TSB. A list of the species is available on the Ministry of Environment website at:

<http://www.env.gov.bc.ca/wld/frpa/species.html>

7.1.4 Wildlife Habitat Areas

Wildlife Habitat Areas (WHA) are currently established under FRPA for a category of species at risk or regionally important wildlife and have corresponding General Wildlife Measures that provide legal management direction.

WHAs are mapped areas that are necessary to meet the habitat requirements of an identified wildlife element. WHAs designate critical habitats in which activities are managed to limit their impact on the identified wildlife element for which the area was established. The purpose of WHAs is to conserve those habitats considered most limiting to a given identified wildlife element.

There are currently no approved WHAs within the Stuart TSBs; however regional biologists are currently working on several draft WHAs for northern caribou, grizzly bear, fisher and American white pelican.

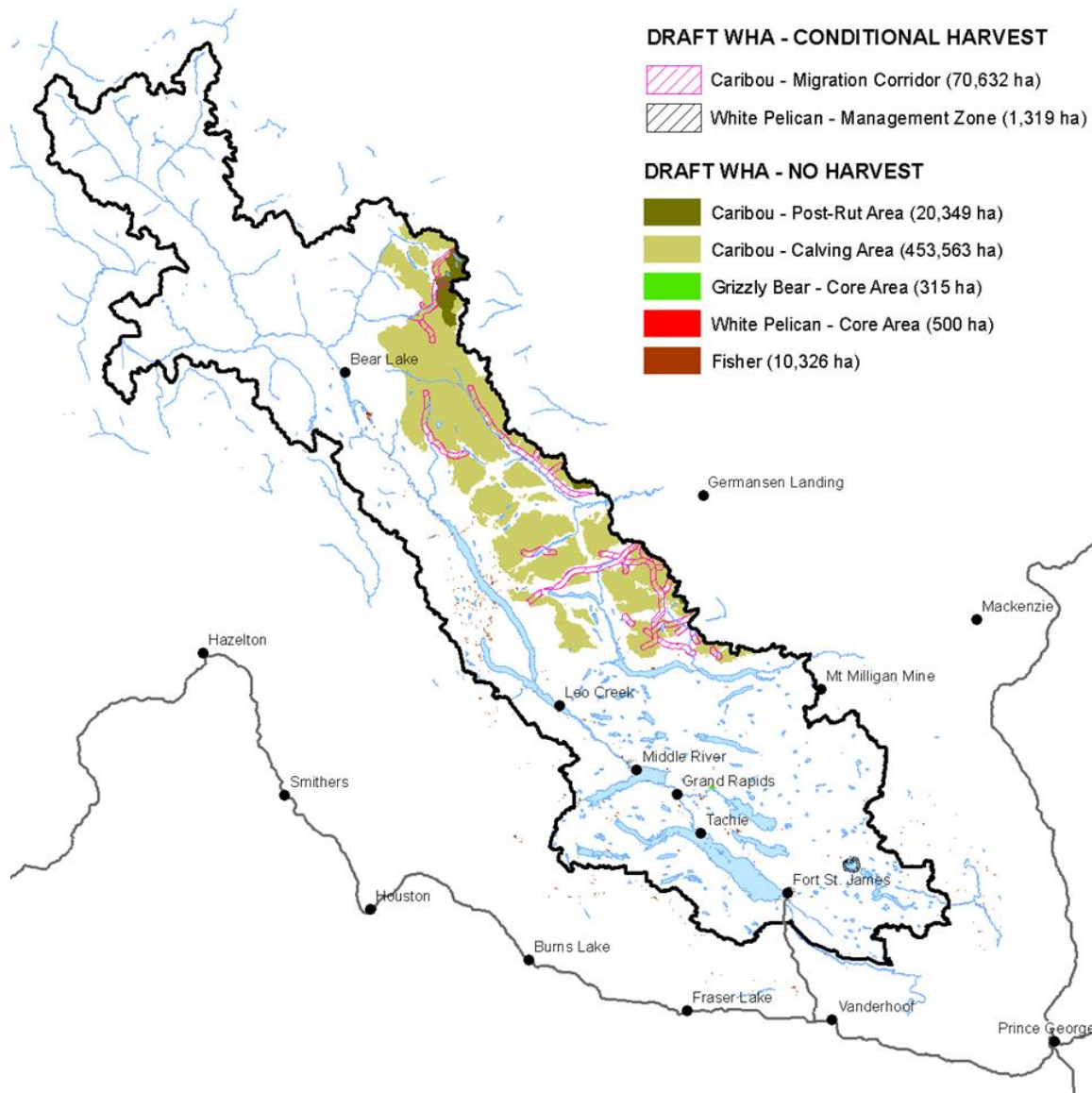


Figure 16 Wildlife Habitat Areas

7.1.5 Ungulate Winter Range

Ungulate Winter Ranges (UWR) are established under the BC Forest and Range Practices Act (FRPA) as areas that contain habitat necessary to meet the winter requirements for an ungulate species and have corresponding General Wildlife Measures/or Objectives that provide legal management direction. UWRs do not address all species management aspects. There are currently several established UWRs for northern caribou, mountain goat and mule deer in the Stuart TSBs with a number of additional ones proposed.

Timber supply impact assessments are based on the spatial overlap of the UWR units with the THLB and associated management direction in the General Wildlife Measures – it is policy that the THLB budget and resultant impacts of UWRs are calculated using TSR 2.

Sections 9 and 12 of the Government Actions Regulation of the Forest and Range Practices Act outline the regulatory authority for establishing UWRs. FLNR may legislate “General Wildlife Measures”

(management rules) to allow the UWR areas to be managed to maintain the winter habitat conditions needed by these animals.

General Wildlife Measures specify what activities are permitted within the UWRs. No “Primary Forest Activities” such as timber harvesting or road building would be permitted. General Wildlife Measures identified within these proposed UWRs may apply to mineral exploration activities if timber cutting or road-building is required. Oil and gas activities that may occur within UWRs are managed separately under the Oil and Gas Activities Act. While General Wildlife Measures will restrict logging, they should not affect First Nation traditional activities such as hunting, trapping, or berry or plant collecting.

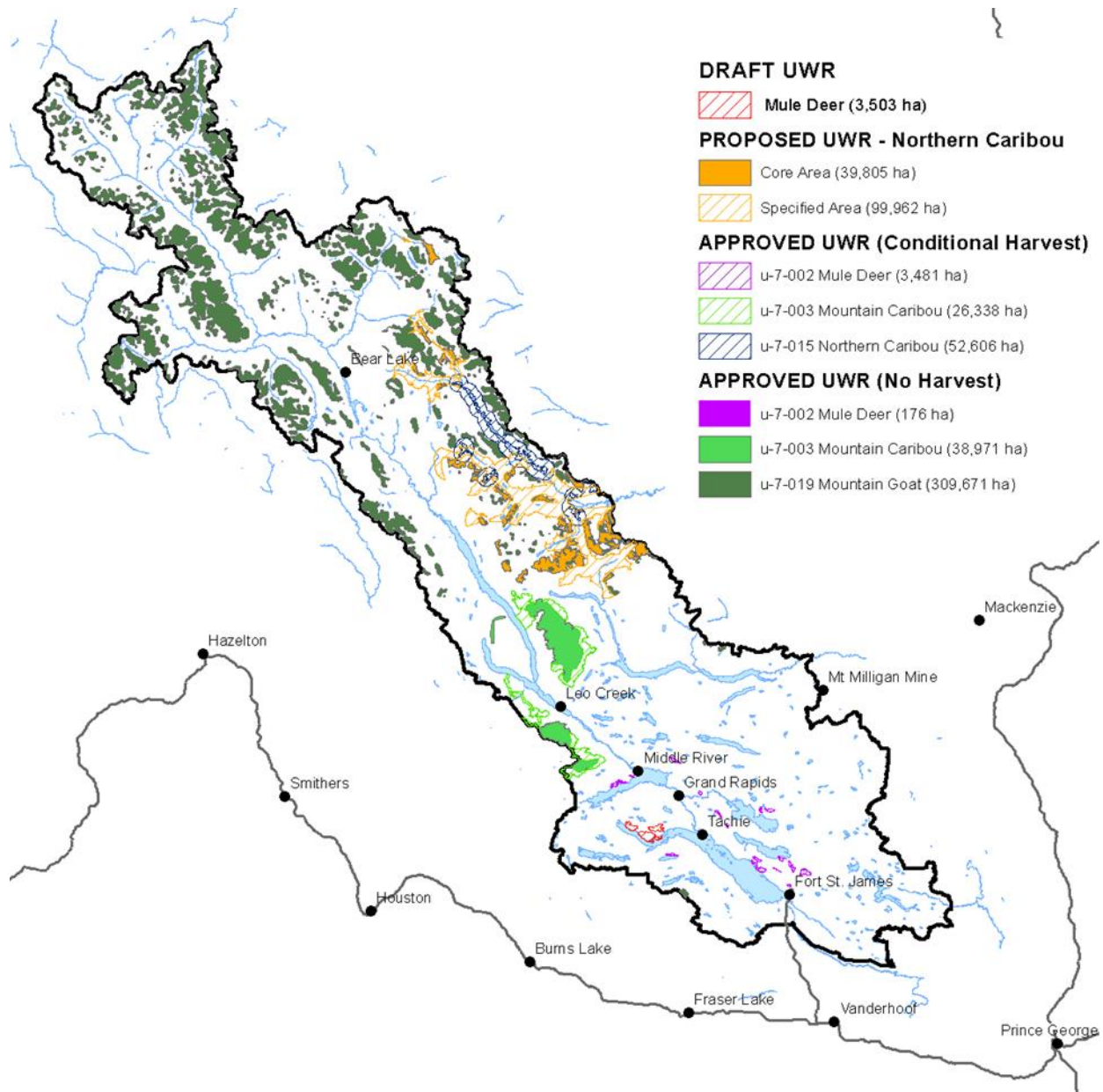


Figure 17 Approved Ungulate Winter Ranges

7.2 Species Information

7.2.1 Grizzly Bear

Grizzly bears are listed within the category of species at risk under the GAR. Grizzly bears are found throughout the Stuart TSBs within seven defined population groups. As of 2012, all of these groups are considered to be viable populations. Some of the 36 area-specific resource management zones established through the Fort St. James LRMP specify objectives for the conservation of grizzly bear habitat. An accounts and measures document (MoE 2004) describes the current general approach to grizzly bear habitat management:

Two objectives in general directions are to maintain or enhance Grizzly Bear habitat and populations, and to minimize conflicts in human–bear interactions. The strategies to achieve the first objective include completing Grizzly Bear habitat mapping in areas of concern; managing for a mosaic of habitat types and characteristics to ensure adequate seasonal foraging sites with adjacent cover; reducing habitat fragmentation by providing FENs or movement corridors; and in high Grizzly Bear habitat suitability areas, undertaking access management planning, establishing management zones around important and valuable habitats, timing development to minimize conflicts, minimizing Grizzly Bear displacement from preferred habitats, creating irregular edges and leaving cover within cutblocks and between cutblocks and roads, and locating roads to avoid valuable Grizzly Bear habitat.

Source: MoE - Accounts and Measures for Managing Identified Wildlife, Grizzly Bear, Ursus arctos

The Damdochax Protected Area and the Upper Jake Creek Special Management Subzone will also provide important habitat for grizzly bears. Regional biologist are working on a draft WHA for grizzly bear on the Kuzkwa River which overlaps significant spring and fall forage habitat.

7.2.2 Bull Trout

Bull trout are listed in the category of species at risk under the GAR. Bull Trout in BC are protected under the provincial Wildlife Act, the provincial Fish Protection Act, and the federal Fisheries Act. This species is more sensitive to habitat disturbances than most other fish species. Stream headwaters and sedimentation related to new road access can have significant impact on populations. Given Bull Trout's preference for cool water systems and their use of smaller headwater systems, a lack of stand retention along S4 streams may be inconsistent with the goal of protecting Bull Trout critical habitat. There are currently no WHAs designated for Bull Trout habitat within the Stuart TSBs.

7.2.3 Northern Caribou

The federal recovery strategy and designated habitat for northern caribou was previously discussed in section 2.3.

Northern caribou are listed within both the category of species at risk and ungulate under the Government Action Regulation. Northern caribou are an eco-type of woodland caribou that generally utilize low elevation forests with abundant ground lichens, and/or higher elevation windswept alpine areas and subalpine forests to survive the winter. These caribou require large areas of relatively undisturbed habitat to enable them to reduce predation by “spacing away” from moose and wolves (Bergerud and Elliot 1986). Northern caribou are particularly affected by the loss of forest cover resulting from the MPB infestation and salvage operations, as this can open up areas that in turn may increase predation.

Implementation of legal management tools is a critical component to recovery management of northern mountain caribou. Two UWRs are currently approved for northern caribou (U-7-003) and (U-7-015). Measures established for specific UWR units range from no-harvest (38,971 hectares) to conditional harvest (78,944 hectares), that require minimum levels of forest cover attributes. A proposed UWR identifies high-elevation winter range habitat for the Wolverine and Chase, herds. Additional WHAs are in draft stage for northern caribou for migration corridors, post rut aggregation areas, and calving for the Wolverine and Chase herds.

The resulting proposal will be based on the habitat mapping and recommendations provided by Wildlife Infometrics Inc. who used existing habitat modeling, new modelling, and caribou GPS and VHF location data to recommend draft WHA polygons (Brumovsky and McNay 2015). The final proposed WHA polygons will consider prioritization, intersects with existing and proposed FRPA habitat designations to minimize impacts to THLB (i.e., calving polygons have significant overlaps with proposed caribou high elevation ungulate winter ranges).

7.2.4 Mountain Goat

Mountain goat are currently listed under the category of ungulate under GAR; although this species has recently been listed as a species at risk in BC it is not included in the category of species at risk under GAR. BC supports about half of the world's population of mountain goats; as such, they are a high priority for conservation management. Mountain goats are provincially blue listed (Table 12). The management goal for mountain goats in British Columbia is to maintain viable, healthy and productive populations of mountain goats throughout their native range in BC. The management objectives include:

1. to effectively maintain suitable, connected mountain goat habitat;
2. to mitigate threats to mountain goats; and
3. to ensure opportunities for non-consumptive and consumptive use of mountain goats are sustainable.

Source: MoE 2010. Management Plan for the Mountain Goat in BC

In the Stuart TSBs, mountain goats occur primarily in high elevation alpine and subalpine habitats; seldom far from cliffs or steep "escape terrain". Winter range habitat is identified by access to nearby good escape terrain, forage availability and winter sun exposure (McNay et. al., 2006). They will move seasonally to access high value forage areas and mineral licks.

Mountain goats are particularly sensitive to industrial disturbance so General Wildlife Measures are sometimes proposed adjacent to mountain goat winter range units that will prescribe measures related to timing of operations, access management and forestry-related helicopter disturbance.

A total of 309,671 hectares of UWRs (U-7-019) and associated general wildlife measures are approved within the Stuart TSBs (Figure 17) to protect and conserve the habitat of mountain goat. These areas were identified through a Bayesian modelling exercise and considering stakeholder inputs (Fillier and Vinnedge 2009). Timber harvesting and road and trail construction is prohibited within all of the designated UWR units.

7.2.5 Fisher

Fisher are listed under the category of species at risk under GAR. Fisher are a forest-dependent carnivore of the Mustelidae (weasel) family that are a Species at Risk under the Identified Wildlife Management Strategy, and a Species of Special Concern (blue-listed) by the BC Conservation Data Centre. The fisher is associated primarily with coniferous and mixed forest habitats and regularly forages

along forest edges and in riparian areas, small wetlands and meadows, and the thick conifer and shrub patches that regenerate in areas opened up by forest fire, windthrow, and some logging practices.

In general, the structural make-up of a forest is more important to fishers than is its age or tree species composition. Important structural features include coarse woody debris, snags, and often multiple layers of overhead vegetation (shrubs, saplings, trees) all of which provide cover for both fishers and their various prey. The species is poorly adapted for travel in deep, soft snow. During winter in BC, fishers may avoid deeper snow areas occupying forests with thick canopies which intercept snow and reduce the amount that reaches the ground, or, in mountainous areas, by using lower-elevation habitats and slopes exposed to sun and wind. Although they commonly hunt for prey in younger or more open habitats, fishers usually rest and den in areas with high structural diversity.

Although much of BC's landscape historically supported viable fisher populations, the distribution and abundance of the species has declined over the last several decades. They are vulnerable to changes in vegetation from forestry and over-harvest by trapping (Weir, and Corbould, 2008). Several aspects of their ecology make them vulnerable to changes from forestry operation, including their use of structural elements found primarily in late-successional forests (Weir, and Almuedo, 2010).

Regional Biologists are working on a draft WHAs for fisher that are based on a Sub Boreal Spruce habitat model. The draft fisher WHAs are comprised of very small core habitat polygons surrounding maternal dens (proposed to be no harvest) and a larger surrounding management zone (where harvesting will be allowed with some minor modifications following best management practices for fisher. The surrounding management zone polygon is projected to have very little impact on Timber Harvesting Landbase.

7.2.6 American White Pelican

American White Pelican are listed under the category of species at risk under the GAR. American White Pelican are provincially red-listed with only one known breeding colony at Stum Lake in White Pelican Provincial Park in the Chilcotin. Within the Stuart TSBs substantial populations of unknown breeding status occur. The goal of wildlife habitat areas, as identified in the , is to protect foraging, loafing and roosting habitat from human disturbance and habitat loss or alteration.

Regional Biologists are working on a draft WHA to protect an important foraging lake for American white pelican based on repeated aerial surveys. The WHA is comprised of a core area (proposed to be no harvest) and a management zone (where harvesting will be permitted, following best management practices and adhering to timing restrictions). The surrounding management zone polygon is projected to have little impact on the Timber Harvesting Landbase.

7.2.7 Moose

Moose are listed under the category of ungulate under the Government Action Regulation. Moose are a regionally significant wildlife species to First Nations, recreational hunters, and guide outfitters. Within the Omineca region, moose are widely distributed and generally considered abundant, but some populations are experiencing decline. It is assumed that moose numbers in the northern Omineca (including Stuart TSBs) are somewhat stable, but trend data is required to better understand current population status.

The focus on recovery of threatened caribou herds will impact moose management in the Omineca region and Stuart TSBs. The objective of caribou recovery is to create or maintain habitat conditions for caribou to be naturally self-sustaining - including low moose and wolf densities. Strategies to maintain low moose densities within and adjacent to northern caribou habitat (core and matrix), include limiting the production of preferred moose browse and, where moose densities are considered to be

unnaturally high, population management to reduce moose numbers by increasing opportunities for hunters.

Since 2005, moose densities in the central portion of the region around Prince George have declined by 50 per cent. Current moose densities in the Omineca remain consistent with healthy populations in other parts of North America. Accordingly, there are currently no moose UWRs established within the Stuart TSBs. Efforts to update estimates of moose populations and densities within caribou herd ranges are required to better inform management options and decisions. A key management goal is to achieve a landbase where both moose and caribou are present but are spatially segregated at densities where populations are sustainable.

Some prescribed burning plans for ecosystem restoration (section 2.11) are aimed to improve moose habitat; with the caveat that these are in areas outside of threatened caribou range.

7.2.8 Mule Deer

Mule deer are listed under the category of ungulate under the Government Action Regulation. Approved UWRs (U-7-002) currently exist within the Stuart TSBs (3,657 hectares; Figure 16) to provide high suitability snow interception, cover and foraging opportunities (e.g., shrubs, conifer and arboreal lichen litterfall). These areas were effectively grandparented by replacing environmentally sensitive areas for wildlife from TSR 1 (Sulyma and Vinnedge 2003). Measures are established for specific UWR units that range from no-harvest to conditional harvest (i.e., maintain minimum forest cover requirements).

Regional Biologists are working collaboratively with First Nation to establish additional ungulate winter range within the southern portion of the Stuart TSBs.

7.3 Regionally Important Wildlife

There are other fish and wildlife species within the Stuart TSBs that are currently not categorized provincially at risk, but are affected by forest or range practices. Some species may be abundant with a widespread distribution, others less common and tied to discrete rare habitat features, and some we may not have very much inventory information on making their distribution and abundance somewhat unknown.

The FRPA enables WHAs and General Wildlife Measures to be used to manage and protect key habitat features of designated Regionally Important Wildlife species. While no such designation is in place for the Omineca Region, two key species are discussed below.

8 Biodiversity

Increasing AACs to facilitate salvaging value from the dead pine trees across the province has led to concerns about the stewardship of non-timber values such as wildlife and biodiversity. To accommodate these concerns, the “timber uplift” (AAC increase) was to be accompanied by a “conservation uplift” (an increase in retention of mature forest structure in harvested areas).

To help achieve the conservation uplift, the chief forester provided forest professionals with non-legally binding “Guidance on Landscape- and Stand-level Structural Retention in Large-Scale Mountain Pine Beetle Salvage Operations.” This explains the chief forester’s view of how the conservation uplift could be applied. At the landscape-level, the guidance was “that collaborative, multi-stakeholder, long-term landscape-level planning is the best option for managing increased retention.” At the stand-level, the guidance was that retention of mature forest structure should increase as the size of harvested patches increased.

The Forest Practices Board found that, while some efforts were made to provide the necessary information, no landscape-level planning was done within the study area. Despite this, the board concluded that on average, retention levels increased after the guidance was issued and retention levels were higher in larger cutblocks.

Source: Forest Practices Board. 2009. Biodiversity Conservation during Salvage Logging in the Central Interior of BC

8.1 Stand-Level Retention

MPB impacts are not limited to areas available for timber harvest. Lands reserved to protect sensitive species, riparian areas, wildlife tree patches, and old growth management areas are also affected directly (e.g., increased mortality of pine, roads) or indirectly (e.g., water quality/quantity and equivalent clear cut area). A higher risk of loss to species diversity occurs within landscape units with low biodiversity emphasis (with reduced reserve areas) and species sensitive to changes in pine forest. Stand-level reserves designed to protect species or features will also be at higher risk where salvaging of MPB-attack stands is occurs.

As shown in the MRVA (section 2.8), stand level biodiversity improved in the 2005-2012 study period over the last study period of 1997-2004. Harvesting the AAC uplift for MPB-killed pine salvage will challenge this improving trend. Within the MRVA report the Fort St. James District Manager’s commentary addressed this challenge:

“I am fully aware of the significantly increased harvesting level within the Fort St. James Natural Resource District. Given that the majority of existing and expected harvesting and road building within the next 5 years will be primarily concentrated within a few major watersheds within the southern third of the district, I recognize that there is an elevated likelihood of undesirable impacts to multiple natural resource values.”

Specifically regarding stand-level retention for maintaining biodiversity, she went on to state:

“I am satisfied with results of stand level biodiversity, which is indicating that 72% of the cutblocks have “very low” to “low” impact on cutblock biodiversity. I am also satisfied with an average of 17.5% retention in recent years, particularly considering that a substantial amount of additional non-prescribed forested areas and terrestrial habitat near existing and future cutblocks is also likely to be maintained over time.”

Forest licensees typically target minimum levels for stand-level retention as required under the FPPR, as demonstrated in the following excerpt from BC Timber Sale’s current Forest Stewardship Plan (FSP):

5.1.2.5 Objectives Set by Government for Wildlife and Biodiversity – Stand Level

5.1.2.5.1 All FDUs – Stand Level Biodiversity	
Applicable FDUs	All FDUs
Legal Reference	FPPR Section 9.1 and Section 12.5(1).
Definitions	None.
Result and Strategy	The following results or strategies apply to the holder of this FSP and to each agreement holder. <ol style="list-style-type: none"> 1. Ensure that the total area covered by wildlife tree retention areas relating to one or more cutblocks where harvesting is concluded between April 1st and March 31st of any year, is a minimum of 7% of the total area of the cutblocks; 2. Ensure that at the conclusion of harvesting in a cutblock that is greater than 15 hectares in size, the total amount of wildlife tree retention areas that relate to the cutblock is a minimum of 3.5% of the area of the cutblock; 3. Ensure that for the purposes of (1) and (2) above, a wildlife tree retention area may relate to more than one cutblock if all of the cutblocks that relate to the wildlife tree retention area collectively meet the applicable requirements of this section; and 4. Section 67 of the FPPR.
Map Reference	N/A

Source: BC Timber Sales, Forest Stewardship Plan, December 5, 2015 – December 4, 2020 (see References)

The 2015 Prince George TSA Timber Supply Review Data Package uses the FREP study data as well as BCTS and RESULTS data to develop a TSA-wide estimate of stand-level retention. The data package document explains the estimate:

“The retention estimate includes areas occupied by riparian retention, wildlife tree patch retention, as well as retention for the protection of forest values including archaeological features, site specific habitat features, and blue-listed species. The area weighted median retention value of 12.1% will be utilized in the timber supply model to represent stand-level retention for the entire PGTSA. Once the THLB definition process is complete the retention estimate will be adjusted to reflect retention levels specifically within the THLB.”

8.2 Landscape-level Retention

This section refers to general biodiversity and habitat management provisions not dealt with through other processes such as parks, ecological reserves, UWRs, and WHAs.

8.2.1 Non-spatial Landscape Biodiversity Objectives

The order establishing landscape biodiversity objectives for the Prince George TSA (2004) established objectives for: old forest retention, old interior forest, and young forest patch size distribution. Maps accompany the original order showing management units.

Preamble

This order establishes landscape biodiversity objectives, across the Prince George Timber Supply Area, for:

- A. *old forest retention;*
- B. *old interior forest; and,*
- C. *young forest patch size distribution.*

These objectives were developed using current scientific information with respect to the natural range of variability within this geographic area. They are designed to balance the requirements of environmental and economic sustainability, while considering the expected impacts of the current mountain pine beetle infestation.

These objectives will be periodically updated to incorporate new knowledge and address changing environmental economic and social conditions.

In ensuring that their plans are consistent with the objectives of this Order, licensees and BC Timber Sales, should consider the Implementation Policy, which supports this Order.

Requirements for old forest retention (Table 15). and old interior forest (Table 16) are tracked for a combination of Biogeoclimatic Ecosystem Classification units, while objectives for young forest patch size distribution are tracked for natural disturbance sub-units (Table 17).

Table 15 Old Forest Retention Requirements

Unit Label	Natural Disturbance Unit (NDU)	Merged Biogeoclimatic Units (mBECs)	Minimum percent of the CFLB retained as Old Forest
E1	Moist Interior Mountain	ESSF mv1, ESSF mvp1, ESSF mv3	41
E2	Moist Interior Plateau	SBS dk	17
E3	Moist Interior Plateau	SBS mc2	17
E4	Moist Interior Plateau	SBS mk1, SBS wk3,	12
E5	Moist Interior - Plateau	SBS dw3	12
E6	Northern Boreal Mountains	ESSF wvp, ESSF mcp, ESSF mc, ESSF wv	37
E7	Northern Boreal Mountains	SWB mks, SWB mk	37
E8	Northern Boreal Mountains	SBS mc 2	26
E9	Omineca - Mountain	ESSF wvp, ESSF wv, ESSF mcp	58
E10	Omineca - Mountain	SWB mks, SWB mk, ESSF mc	41
E11	Omineca - Mountain	ESSF mvp3, ESSF mv3	41
E12	Omineca – low elevation	SBS dk, SBS dw3	16
E13	Omineca - low elevation	ICH mc1	23
E14	Omineca - low elevation	BWBS dk1	16
E15	Omineca - low elevation	SBS mc2	16
E16	Omineca - low elevation	SBS mk1	16
E17	Omineca - low elevation	SBS wk3	16

Source: Ministry of Sustainable Resource Management Ministerial Order, October 20, 2004.

Table 16 Old Interior Forest Requirements

Unit Label	Natural Disturbance Unit (NDU)	Merged Biogeoclimatic Units (mBECs)	Minimum percent of the Old Forest required in [Table 15] that must be Old Interior Forest
E1	Moist Interior Mountain	ESSF mv1, ESSF mvp1, ESSF mv3	40 %
E2	Moist Interior Plateau	SBS dk	10 %
E3	Moist Interior Plateau	SBS mc2	10 %
E4	Moist Interior Plateau	SBS mk1, SBS wk3,	25 %
E5	Moist Interior - Plateau	SBS dw3	25 %
E6	Northern Boreal Mountains	ESSF wvp, ESSF mcp, ESSF mc, ESSF wv	40 %
E7	Northern Boreal Mountains	SWB mks, SWB mk	40 %
E8	Northern Boreal Mountains	SBS mc 2	25 %
E9	Omineca - Mountain	ESSF wvp, ESSF wv, ESSF mcp	40 %
E10	Omineca - Mountain	SWB mks, SWB mk, ESSF mc	40 %
E11	Omineca - Mountain	ESSF mvp3, ESSF mv3	40 %
E12	Omineca – low elevation	SBS dk, SBS dw3	25 %
E13	Omineca - low elevation	ICH mc1	40 %
E14	Omineca - low elevation	BWBS dk1	25 %
E15	Omineca - low elevation	SBS mc2	25 %
E16	Omineca - low elevation	SBS mk1	25 %
E17	Omineca - low elevation	SBS wk3	25 %

Source: Ministry of Sustainable Resource Management Ministerial Order, October 20, 2004.

Table 17 Young Forest Patch Size Distribution Objective

Natural Disturbance Sub-unit	Percent of Young Forest For each patch size category			
	>1000 hectares	101 -1000 hectares	51 – 100 hectares	<50 hectares
McGregor Plateau	40	45	5	10
Moist Interior - Mountain	40	30	10	20
Moist Interior - Plateau	70	20	5	5
Northern Boreal Mountains	60	30	5	5
Omineca - Mountain	40	30	10	20
Omineca - Valley	60	30	5	5
Wet Mountain	10	60	10	20
Wet Trench - Mountain	10	60	10	20
Wet Trench - Valley	10	60	10	20

Source: Ministry of Sustainable Resource Management Ministerial Order, October 20, 2004.

8.2.2 Spatial Landscape Biodiversity Objectives

Old growth management areas (OGMAs) have not been spatially established for any of the landscape units within the Stuart TSBs; all are addressed through the non-spatial objectives of the Prince George Old Growth Order.

8.3 Landscape Connectivity

In some areas, stand structures that serve to connect habitats across a landscape have been adversely affected by: salvaging dead pine from mixed stands, extensive clearcuts in pine-dominated watersheds, limited retention, and large scale fires. The loss of landscape connectivity can cause disproportionate impacts to species at risk confined to isolated pockets of suitable habitat. Connectivity is provided through various mechanisms including strategies that prescribe retention for specific resource management zones, young seral forest representation levels, and provisions for riparian management.

Wildlife habitat requirements for connectivity are currently being considered through caribou migration corridors and WHAs.

8.4 Management for Coarse Woody Debris

At a stand level, coarse woody debris is managed through provisions in forest stewardship plans that consider the Chief Forester's guidance and other stewardship principles. While MPB-impacted stands will certainly enhance the supply of coarse woody debris in the short- and medium-terms, activities such as salvage, road building, safety-hazard abatement for roads, replanting and stand tending, can significantly reduce the supply of coarse woody debris over time. Coarse woody debris is also vulnerable to intensive fires promoted by large supplies of MPB-killed pine. Strategies to retain coarse woody debris through time should be considered in developing silviculture strategies.

The Fort St. James District Manager recognized the need for appropriate measures to ensure a continued supply of CWD in her response to the MRVA report:

"I must, however, clearly state that there has been multiple recommendations communicated regarding improving the retention of large coarse woody debris (CWD) across cutblocks. I am expecting the result on CWD to improve, and will take this into consideration when evaluating future FSP results and strategies applicable to stand level biodiversity."

9 Climate Change Adaptation

The rate of change in climate over the last 100 years is equivalent to the rate of change of the preceding 1000 years. Rapid change in climate is an overarching pressure on the forests affecting both timber and environmental values (see table below for predicted change by 2050).

Table 18 Summary of Climate Change for Omineca in the 2050s

Summary of Climate Change for Omineca in the 2050s

Climate Variable	Season	Projected Change from 1961-1990 Baseline	
		Ensemble Median	Range (10th to 90th percentile)
Mean Temperature (°C)	Annual	+1.8 °C	+1.3 °C to +2.7 °C
Precipitation (%)	Annual	+8%	+2% to +15%
	Summer	+1%	-8% to +9%
	Winter	+9%	-2% to +18%
Snowfall* (%)	Winter	+2%	-7% to +10%
	Spring	-54%	-71% to -10%
Growing Degree Days* (degree days)	Annual	+223 degree days	+136 to +379 degree days
Heating Degree Days* (degree days)	Annual	-642 degree days	-975 to -459 degree days
Frost-Free Days* (days)	Annual	+19 days	+11 to +30 days

Projected changes in average (mean) temperature, precipitation and several derived climate variables from the baseline historical period (1961-1990) to the 2050s for the Omineca region. The ensemble median is a mid-point value, chosen from a PCIC standard set of Global Climate Model (GCM) projections. The range values represent the lowest and highest results within the set.

Source: Pacific Climate Impacts Consortium, 2012. Plan2Adapt, <http://www.plan2adapt.ca/tools/planners?pr=47&ts=8&toy=16>

Through the Omineca Climate Action Plan, work is well underway in considering climate change in concert with the development of management plans and strategies. Examples of changes to specific practices include:

- Range expansion and planting of western larch and Douglas-fir.
- Increasing planting density, sites with higher disease risk.
- Implementing forest health stocking standards, rust stocking standards, increasing minimum free to grow heights.
- Increased streamside retention on temperature sensitive streams.
- First Nations tenures awarded as carbon trusts/credits.
- Building road structures to be more resilient.

This ISS project aims to consider the effects of climate change in develop clear objectives and strategies for appropriate tree species to be planted at the landscape and stand level.

10 Other Development

Note 4 - Add blurb about the new (?) rail line

10.1 Mines

Significant mineral values exist within the the Stuart TSBs, including significant mineral potential, mineral occurrence inventory including deposits with well-defined reserves, existing mineral and placer tenure holdings, and a history of significant levels of exploration and development activities. The Mt. Milligan mine (copper/gold) located north of Fort St. James just outside of the Stuart TSBs, is the only active mine in the vicinity. There are also 277 documented mineral occurrences; of these, one is an intermittently producing jade mine in the Ogden Mountain area, and several are small scale seasonal gold operations. Twelve occurrences are developed prospects, 31 are prospects and 17 are past producing mines, most of which are placer gold. The Pinchi Lake Mercury mine 20 km NW of Fort St James has recently been decommissioned and reclaimed, and the Sustut Copper deposit has potential to be developed.

10.2 Hydro-Electric Power

There are no hydro-electric power projects established or planned within the Stuart TSBs.

10.3 Oil and Gas/Pipelines

High values and infrastructure development in oil and gas potentially exist in the northern portion of the Stuart TSBs. The potential for geothermal energy is lower than in other parts of the province.

Planning is underway for two proposed pipeline corridors from Hudson Hope to Prince Rupert. Both will cross the Stuart TSBs from east to west, one just north of Trembleur Lake, and one will pass north of Takla Lake and west through the Kotsine River valley.

10.4 Biomass Plant

A biomass plant is currently being built at Fort St. James, through the Fort St. James Green Energy Limited Partnership, a limited partnership between Fengate Capital and Dalkia Canada Inc., a subsidiary of Veolia Environnement S.A. (Veolia). Veolia will manage the biomass supply by working with forestry companies, sawmills and First Nations.

In total, the new biomass facility will annually consume some 307,000 tonnes of wood biomass wood waste which would otherwise be left in the bush, or burned in piles. By mid 2016, the biomass plant is expected to generate produce about 40 megawatts of electricity that will be sold to the BC Hydro & Power Authority.

11 Other Key Values and Issues

11.1 Watershed Health

Large scale MPB infestations will affect watershed hydrological processes such as canopy interception, transpiration, soil moisture storage, groundwater levels and recharge, snowfall, snow melt, rain-on-snow effects, runoff and peak flow timing and duration, flood events, stream and stream bank stability, erosion, and sedimentation. Changes in these hydrologic factors can increase the risk on a number of watershed values including aquatic ecosystems, species, and supply of domestic water use. In some cases the potential for hydrologic changes may be, to some degree, estimated by equivalent clear cut areas within specific drainages.

The accelerated rate of harvesting and associated road development planned for the Stuart poses an increased risk to water quality, as does the increased amount of road that will be active throughout the salvage period. Significant increases in road density and numbers of stream crossings can increase peak flows, sedimentation, and changes in channel morphology. This can be reduced by accelerating hydrological green-up with an emphasis on maintaining vegetation within riparian ecosystems. This is especially important along fish-bearing streams and wetlands, as well as, within fishery-sensitive watersheds and community watersheds.

The MRVA (section 2.8) assessed: a) water quality as affected by road construction and ongoing maintenance, and b) well riparian management as affected by forest harvesting activities, including blowdown. Together these assessments provide some indication of how well watersheds are faring today compared to past practices and also provide an excellent baseline for comparing ongoing and future operations and the impacts of the increased Stuart harvesting. With trends for Riparian and Water quality being neutral and declining, respectively, there is room for improvement as acknowledged in the Fort St. James District manager's commentary for Riparian and Water Quality in the MRVA report:

"Considering the existing and impending pressure from harvesting and road-building on individual watersheds, I recognize that it is a very high priority to improve sediment control during forest and range practices. Upon further consideration of riparian study results from previous FREP publications, I also find that multiple key causal factors for "medium" and "high" impact ratings within riparian areas are strongly associated with the size of riparian reserves and the type of vegetative cover retained.

To improve the management of riparian areas, stream channels and water quality, I am strongly encouraging the implementation of the riparian and water quality recommendations communicated in previous annual, district reports as well as the soil conservation measures discussed under FREP Extension Note #23 (http://www.for.gov.bc.ca/hfp/frep/publications/extension_notes.htm).

I will also be evaluating the need for revised riparian results and strategies within future, approved forest stewardship plans (FSP), since many FSPs applicable to the district will expire within 3 years."

11.1.1 Community Watersheds

There are no designated community watersheds or watershed reserve notations established within the Stuart TSBs.

11.1.2 Fisheries Sensitive Watersheds

While there are no established fisheries sensitive watersheds (FSW) within the Stuart TSBs, 12 draft FSWs (Figure 18) are currently being examined by the Ministry of Environment. To qualify as an FSW candidate, watersheds must meet two criteria: they must have significant fisheries values and watershed sensitivity. Watersheds which meet the FSW test, and that have been designated by way of an order as an FSW by the Minister, require forest licensees to establish results and strategies in their Forest Stewardship Plans consistent with the objective(s) set by the Minister.



Figure 18 Draft Fisheries Sensitive Watersheds

An FSW order established by the Minister sets out management direction to conserve important watershed level attributes protecting fisheries values. These attributes include the: natural stream bed dynamics; stream channel integrity; quality, quantity and timing of water flow; and natural, watershed level, hydrological conditions and integrity.

Default draft objectives that might accompany each FSW include:

1. maintain an equivalent clearcut area (ECA) less than 20%,
2. maintain long term large woody debris (LWD) recruitment to the stream channel by only impacting the riparian area for the purpose of a stream crossing,
3. manage fine sediment production at all active road crossings on fish streams, and direct tributaries to fish streams, such that sediment production is kept below a moderate rating,
4. maintain fish habitat and fish movement throughout the fisheries sensitive watershed by ensuring that active roads crossing fish streams will be constructed, replaced, and deactivated so that they preserve or replicate, throughout the stream channel at the crossing:
 - the pre-crossing stream channel width, and
 - the natural roughness of the stream channel bed,
5. Permitted access structures must:
 - minimize road densities on unstable terrain directly connected to fish-bearing streams and their non-fish-bearing tributaries such that they achieve < low risk rating, and
 - maintain natural water drainage patterns, and
6. ensure industrial management or primary forest activities in gentle-over-steep terrain that have connectivity or coupling to fish streams do not cause landslides or other mass wasting events.

11.2 Visual Quality Objectives

Scenic areas and visual quality objectives have been legally established, grand-parented under the FRPA, or, in accordance with the FPPR 9.2, set default objectives for known scenic areas. Harvesting constraints associated with visual quality objectives are shown in Figure 19.

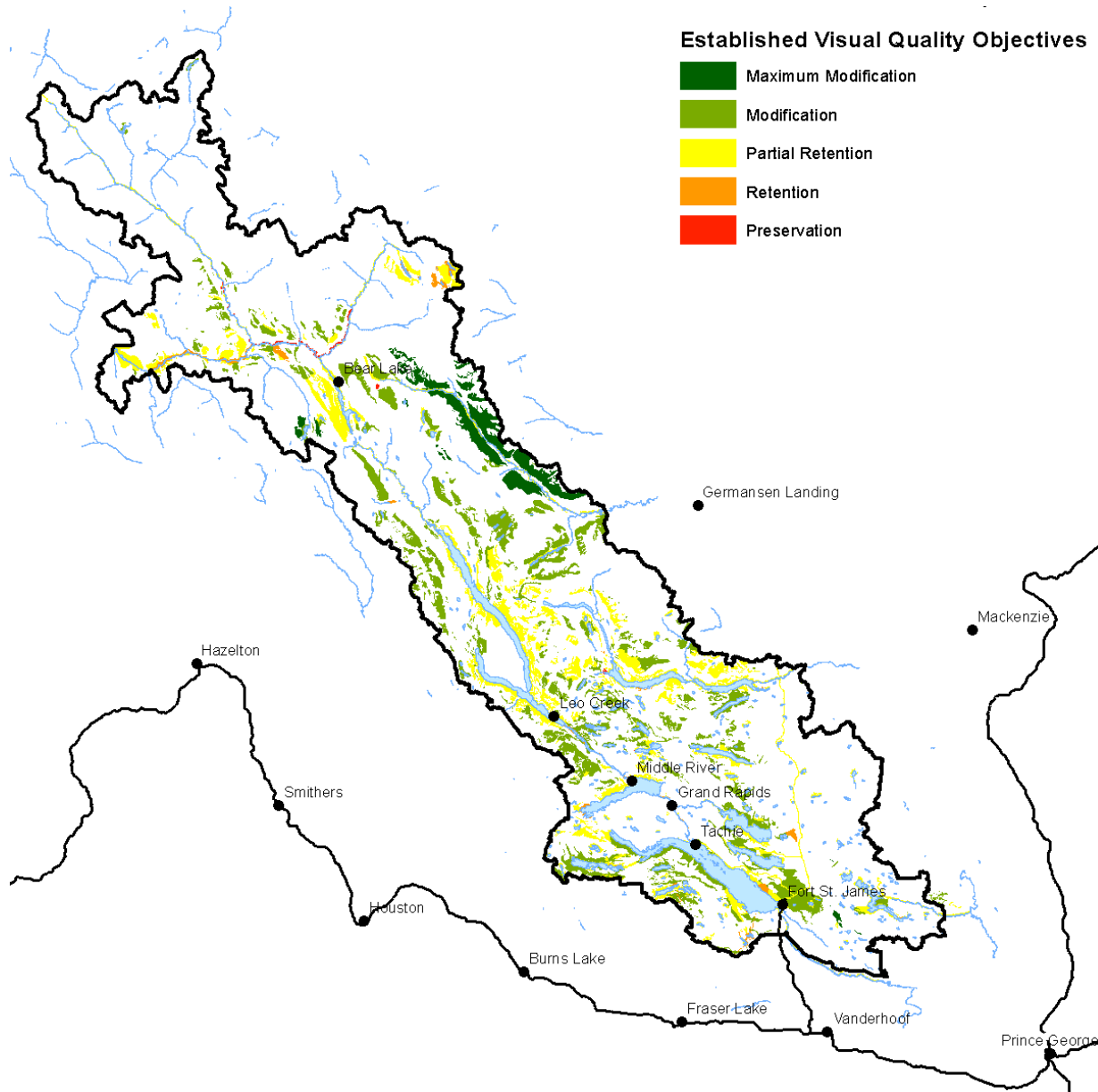


Figure 19 Visual quality objectives

11.3 Recreation Areas

Camping, boating, fishing and hunting are among the most popular recreation activities, while more specialized pursuits include cross-country skiing, snowmobiling, iceboating, canoeing, sailing, and hiking. FLNR maintains 60 recreation sites within the Stuart TSBs; most of which receive heavy local use. FLNR also maintains various recreational trails (i.e., Mt. Pope, Green Lake, Kazchek Falls, Shass Mountain, Tsilcoh Falls and Kazchek Lake). Provincial parks within the area tend to receive more non-local use.

While the majority of those using recreational facilities are residents within the Omineca Forest Region tourists from outside the planning area are increasing annually by an estimated 15%.

Source: Fort St James LRMP

11.4 Guide Outfitters and Trappers

In BC, all non-residents are required to be accompanied by a licenced guide while hunting big game (i.e., deer, mountain sheep, mountain goat, moose, caribou, elk, cougar, wolf, grizzly bear, black bear, lynx, bobcat, and wolverine). In 1926, to protect species from over harvesting, the Province was divided into registered trapline areas sold to a trapper so that he/she is the only person with the right to trap furbearing animals inside this area. Both trappers and guide outfitters rely on the maintenance of wilderness, wildlife and fisheries values and concerns has been expressed that salvage operations within areas that were previously untouched may adversely impact wildlife populations and, in the case of guide outfitters, their clients' experience.

Guide outfitting and trapping are growing contributors to the local economy, and important activities for First Nations. Nearly all of the Stuart TSBs, except private land and reserves, is covered by 97 trapline (Figure 20) and 22 guide outfitter (Figure 21) tenures. Some licensees rely on trapping for a portion of their income, while others participate for recreational or traditional purposes.

Source: Fort St James LRMP LRMP

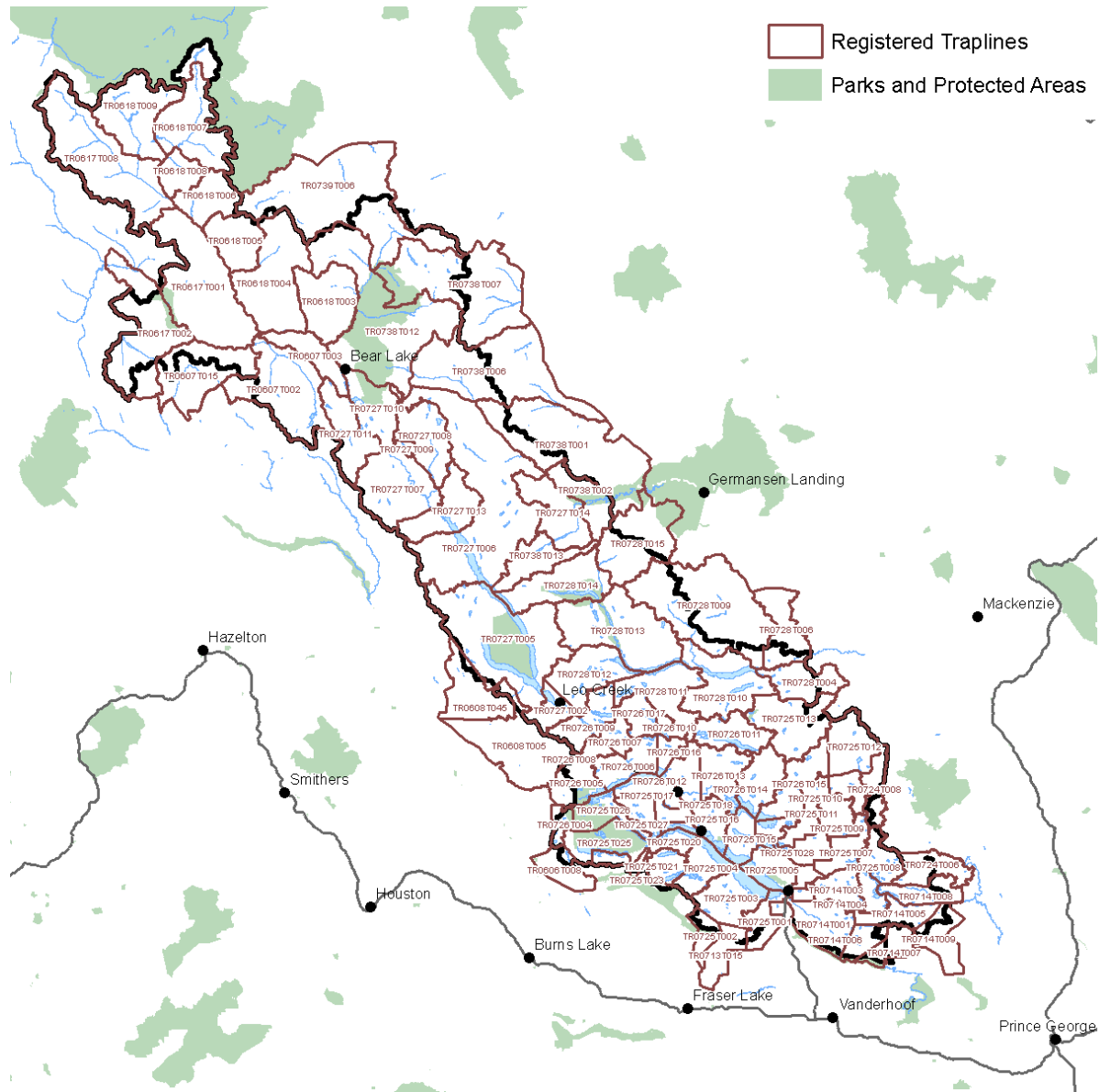


Figure 20 Registered traplines

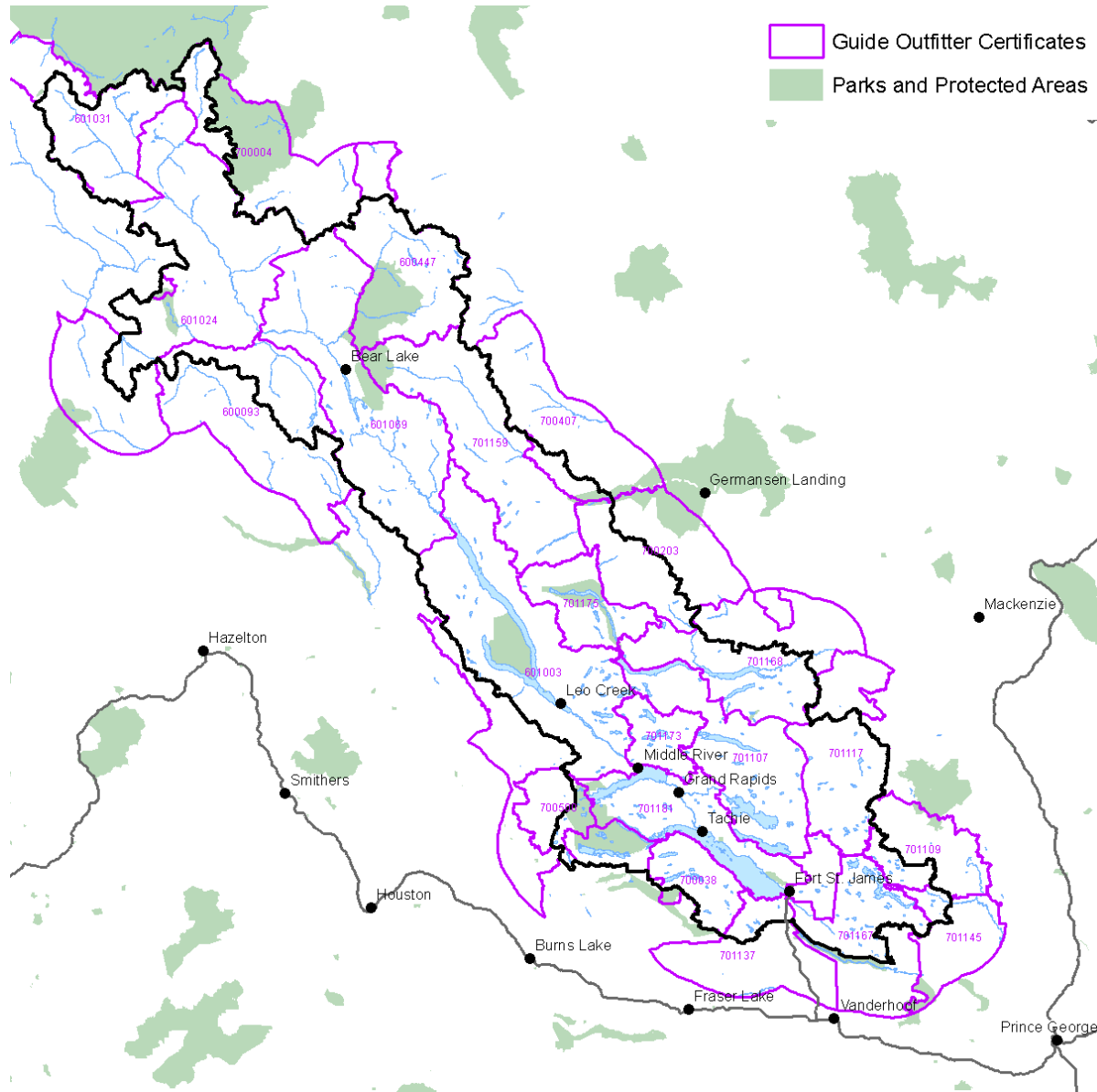


Figure 21 Guide outfitter certificates

11.5 Road Density and Access Issues

The increased harvest of the MPB-killed stands - shifting significantly into the Stuart TSBs - will likely lead to road density throughout the forest landbase will increase at a much faster rate. This can have negative effects on fish and wildlife populations, biodiversity, watershed health, and guide outfitters.

As an example, roads have a negative effect on Grizzly bear habitat use when they reach a density of about 0.6 km/km². This effect is amplified when road density increases over 1.0 km/km². New or improved roads typically bring people into contact with Grizzly bears more frequently which is sometimes lethal for bears.

Source: MoE. Environmental Reporting BC Grizzly Bear Populations Status in BC (2012)

Increased access to the far reaches of the Stuart TSBs allows more recreational and hunting in those areas, and of particular concern is the increase in area accessible to snowmobiles and quads. These

vehicles are potentially disturbing to wildlife in their critical winter habitat. Increases in hunting access may bring higher pressures on specific game populations and impact the unique opportunities offered by licenses guide outfitters.

11.6 Herbicide Use

The increased harvest of the MPB-killed stands - shifting significantly into the Stuart TSBs - may lead to an increased reliance on herbicide applications to ensure regenerating stands with excessive brush competition reach a free-growing status in timely fashion. The most common pesticides (i.e., glyphosate and triclopyr) are applied to reduce the competition of aspen, birch and cottonwood. Licensees utilize herbicides in accordance with a registered Integrated Pest Management Plan (IPMP) which is required by the Integrated Pest Management Act.

Despite their proper and appropriate use, there is public concern that this silviculture treatment could impact habitat/food species and biodiversity values where non-target species are affected by overspray. Riparian areas and grassland/forest interface are also areas of particular concern.

Concern has also been expressed regarding the reduction of aspen and birch stands, fast growing species that might contribute towards mitigating the mid-term timber supply fall down.

12 References

- BC Ministry of Environment. 2010. Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia. Mountain Goat Management Team. Prepared for the Victoria BC. 87pp.
http://www.env.gov.bc.ca/wld/documents/recovery/management_plans/MtGoat_MP_Final_28May2010.pdf
- BC Ministry of Environment. 2011. Whitebark Pine Bulletin, ISSUE 01 December 2011.
http://www.whitebarkpine.ca/uploads/4/4/1/8/4418310/whitebarkpine_bulletin-dec02.pdf
- BC Ministry of Forests and Range. 2010. British Columbia Wildland Fire Management Strategy. 21p.
<http://bcwildfire.ca/prevention/PrescribedFire/docs/BCWFMS.pdf>
- BC Ministry of Forests, Lands and Natural Resource Operations. 1999. Fort St. James Land and Resource Management Plan, March 30, 1999. https://www.for.gov.bc.ca/tasb/slrp/pdf/LRMP/Fort%20St%20James_LRMP.pdf
- BC Ministry of Forests, Lands and Natural Resource Operations. 2015. Chief Forester Information Bulletin - Stewardship and Stabilizing the Timber Harvesting Land Base. March 2015.
<https://www.for.gov.bc.ca/ftp/rco/external!/publish/FMLT%20Publish/North%20Island%20Central%20Coast/April%2015%202015%20FMLT%20Meeting/Chief%20Forester%20Information%20Bulletin%20FINAL.docx>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2011. Prince George Timber Supply Area Forest Health Strategy 2011
https://www.for.gov.bc.ca/ftp/hfp/external!/publish/Forest_Health/TSA_FH_Strategies/2011%20PG%20TSA%20FH%20Strategy%20Final.pdf
- BC Ministry of Forests, Lands and Natural Resource Operations. 2015. District of Fort St James website,
<http://fortstjames.ca/first-nations/>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2011. Prince George Timber Supply Area Mid-Term Mitigation Timber Supply Analysis. Omineca Region November 17, 2011 https://www.for.gov.bc.ca/hts/MPB_Mid_Term/Mid-Term-Timber-Supply-Report_Appendix-5.pdf
- BC Ministry of Forests, Lands and Natural Resource Operations. 2015. Fort St. James Forest District Website, FTP site
<https://www.for.gov.bc.ca/ftp/DJA/external!/publish/Licensee%20Operating%20Area%20Map/>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2013. Omineca Region (Prince George, Mackenzie, Robson Valley Timber Supply Areas) Forest Health Strategy 2013
[https://www.for.gov.bc.ca/ftp/hfp/external!/publish/Forest_Health/TSA_FH_Strategies/2013_OmenicaRegion_FHStrat_v3%20Final%20\(2\).pdf](https://www.for.gov.bc.ca/ftp/hfp/external!/publish/Forest_Health/TSA_FH_Strategies/2013_OmenicaRegion_FHStrat_v3%20Final%20(2).pdf)
- BC Ministry of Forests, Lands and Natural Resource Operations. 2008. Omineca Region Timber Supply Review Prince George Timber Supply Area Information Report November 2008 <https://www.for.gov.bc.ca/hts/tsa/tsa24/tsr4/24ts08ir.pdf>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2013. Forest and Range Evaluation Program Multiple Resource Value Assessment (MRVA Fort St. James Natural Resource District Prince George Timber Supply Area December 2013
<https://www.for.gov.bc.ca/ftp/hfp/external!/publish/FREP/MRVA/MRVA%20Fort%20St%20James%20District%20-%20FINAL.pdf>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2015. Website, Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak, Current Projection Results (Year 12)
<https://www.for.gov.bc.ca/ftp/HRE/external!/publish/web/BCMPB/Year12/>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2015. Land Base Investment Strategy, Strategies at a Glance Website October 26, 2015. <http://lbis.forestpracticesbranch.com/LBIS/taxonomy/term/3>
- BC Ministry of Forests, Lands and Natural Resource Operations. 2013. Ungulate Winter Range Multispecies package for the Mackenzie and Fort St. James Resource Districts. Referral Package for DRAFT Ungulate Winter Range (UWR).
https://www.for.gov.bc.ca/ftp/rni/external!/publish/GAR/UWR/Multi_Species_Referral/Multispecies_UWR_pkg_referral_DMK_DJA_July30_2013.pdf
- BC Ministry of Forests, Lands and Natural Resource Operations. 2017. Provincial Timber Management Goals and Objectives. 7/10/2017. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/silviculture/timbergoalsobjectives2017apr05_revised.pdf

- BC Ministry of Water, Land and Air Protection. 2004. Identified Wildlife Management Strategy. Accounts and Measures for Managing Identified Wildlife. Northern Interior Forest Region. 322p.
http://www.env.gov.bc.ca/wld/frpa/iwms/documents/Accounts_and_Measures_North.pdf
- BC Timber Sales. 2015. Forest Stewardship Plan, December 5, 2015 – December 4, 2020. Updated to Amendment #14. BC Timber Sales Prince George Business Area: For Operations within the Prince George MNRD, Robson Valley MNRD and the Mackenzie TSA. https://www.for.gov.bc.ca/ftp/TPG/external/!publish/Forest_Stewardship_Plans/PG-FSP/Approved%20FSP/TPG-PG-FSP-2015-2020.pdf
- Bergerud, A.T. and J.P. Elliot. 1986 Dynamics of caribou and wolves in northern British Columbia. Canadian Journal of Zoology. 64(7): 1515-1529, 10.1139/z86-226. <http://www.nrcresearchpress.com/doi/pdf/10.1139/z86-226>
- Brumovsky, V.J., and R.S. McNay. 2015. Recommendations for Wildlife Habitat Area Designations for Caribou in the Finlay/Akie, Chase, and Wolverine Herds of North-central British Columbia. Wildlife Infometrics Inc. Report No. 488. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- Bulkley Valley Research Centre. 2013. A Tactical Plan for the Recovery of Whitebark Pine in the Omineca Region. Prepared by Alana Clason M.Sc, March 2013
http://www.whitebarkpine.ca/uploads/4/4/1/8/4418310/wbp_management_in_omineca.pdf
- Canadian Forest Products Ltd. 2014. Fort St. James Defined Forest Area, Sustainable Forest Management Plan. December 2014.
http://www.canfor.com/documents/2014/sfmp_fsj_dfa_dec_2014.pdf
- Coates, K.D. and D.L. Sachs. 2012 Current State of Knowledge Regarding Secondary Structure in Mountain Pine Beetle Impacted Landscapes. MPB Impacted Stands Assessment Project. January 2012. 35p.
https://www.for.gov.bc.ca/hts/pubs/MPB_Impacted_Stands_Report_January_20_2012.pdf
- Cortex Consultants Inc. and C. Farnden. 2000. Prince George TSA Silviculture (Type 1). Cortex Consultants Ltd. March 2000. Prepared for Forest Renewal BC. 22p.
https://www.for.gov.bc.ca/ftp/hfp/external/!publish/fft_standards_on_cms_web/SilvicultureStrategyDocuments/Prince_George_TSA_24/PG_Strategy.pdf
- Cortex Consultants Inc. and C. Farnden. 2003. Prince George TSA Silviculture (Type 1) - Update. Cortex Consultants Ltd. March 2003. Prepared for Forest Renewal BC. 30p. <https://www.for.gov.bc.ca/hfd/library/FIA/2003/FIA-03-04-0107.pdf>
- Fillier, D. and J. Vinnedge. 2009. Mountain Goat Ungulate Winter Range Proposal for the Fort St. James District (U-7-019). August 2009. BC Ministry of Environment. 17p. http://www.env.gov.bc.ca/wld/documents/uwr/U7-019_final_rpt.pdf
- Forest Ecosystems Solutions Ltd. 2008. Prince George Timber Supply Area, Type 2 Silviculture Strategy. FIA Project 2668006. March 31, 2008. 132p.
https://www.for.gov.bc.ca/ftp/HFP/external/!publish/fft_standards_on_cms_web/SilvicultureStrategyDocuments/Prince_George_TSA_24/fia2668006_pgtsa_type2_report_2008_04_14.pdf
- Garbutt R. 1992. Western balsam bark beetle. Pacific Forestry Centre Forest Pest Leaflet No. 64, Canadian Forest Service, Victoria, B.C. <http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/4288.pdf>
- Manning, Cooper and Associates. [Prepared for Ministry of Environment]. 2006. Strategies for maintaining or Recruiting Habitat in Areas Affected by Mountain Pine Beetle and Other Catastrophic Events. 73p.
http://www.env.gov.bc.ca/wld/documents/fia_docs/mpb_habitat_maintenance_recruiting_strategy.pdf
- Martin, M, K. Everett and K. Zimmerman (compilers). 2004. Species Summaries and Procedures for Managing Priority Wildlife in the Omineca Region. FORREX–Forest Research Extension Partnership, Kamloops, BC FORREX Series 16. URL: www.forrex.org/publications/forrexseries/fs16.pdf
- McNay, R. S., J. L. Caldwell, and J. Voller. 2006. Use of habitat by mountain goats in the Mackenzie Timber Supply Area of north-central British Columbia. Wildlife Infometrics Inc. Report No. 201. Wildlife Infometrics Inc., Mackenzie, British Columbia, Canada.
- McNay, S., D. Heard, R. Sulyma, and R. Ellis. 2008. A recovery action plan for northern caribou herds in north-central British Columbia. FORREX Series 22; ISSN 1495-9658. 94pp. http://www.forrex.org/sites/default/files/forrex_series/fs22.pdf
- Omineca Beetle Action Coalition. 2008. [Prepared by Timberline Natural Resource Group]. Future Forest Products and Fibre Use Strategy. 50p. <http://ominecacoalition.ca/Strategies/ForestAndFibre/pdf/OBAC-Forest-and-Fibre-Strategy.pdf>
- Omineca Beetle Action Coalition. 2009. Proposed Interim Action Plan for Future Forest Products and Fibre Use Strategy. OBAC Briefing Note. January 24, 2009. 19p.
<http://ominecacoalition.ca/Strategies/ForestAndFibre/pdf/OBACInterimActionPlanForests.pdf>

- Sulyma, S. and J. Vinnedge. 2003. Mule Deer Ungulate Winter Range (U-7-002) Report. Fort St. James District. Omineca Region. BC Ministry of Water, Land and Air Protection. 38p. <http://www.env.gov.bc.ca/omineca/documents/U-7-002.pdf>
- Ziller, W. G. 1974. The tree rusts of western Canada. Environment Canada, Canadian Forestry Service, Publication No. 1329. Victoria, B.C. 272p. <http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/26396.pdf>