Williams Lake TSA – Type 4 Silviculture Strategy

Tactical Plan

Version 2.0

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Project 419-30

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List of Acronyms

ATV	All-Terrain Vehicle
AU	Analysis Unit
CCLUP	Central-Cariboo Land Use Plan
IDF	Interior Douglas-fir
ITSL	Innovative timber Sale Licence
MDWR	Mule Deer Winter Range
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MPB	Mountain Pine Beetle
RESULTS	Reporting Silviculture Updates and Land status Tracking System
ROI	Return on Investment
SI	Site Index
Sph	Stems per hectare
TSA	Timber Supply Area
WB	Watershed Basin

1 Introduction

In 2012, the British Columbia Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) initiated a Type 4 Silviculture Strategy for the Williams Lake Timber Supply Area (TSA) to help government and licensees better understand the current and future timber and habitat supply situation in the Williams Lake TSA, and what can be done to improve it.

1.1 Project Objectives

In support of government objectives to mitigate impacts from past mountain pine beetle (MPB) and wildfires on mid-term timber supply, the project aims to:

1. Provide a realistic, forward-looking assessment of timber and habitat supply under a range of scenarios that will produce a preferred silviculture strategy supported locally and provincially. This strategy will clearly identify the activities that will provide the best return on investment to government.
2. Provide products that will support operational implementation of the strategy (e.g., a tactical plan).
3. Inform licensees and government on the alternative outcomes that could be achieved through different approaches to basic (mandatory) silviculture in the TSA.
4. Provide context information or indicators that would be useful to support future management decisions in the TSA.
5. Where appropriate, illustrate how the recommended treatments link with other landscape-level strategies while considering treatment risk.

1.2 Context

This is the fifth of five documents that make up the Williams Lake TSA Type 4 Silviculture Strategy:

- Situational Analysis[1] – describes in general terms the current situation for the unit.
- Data Package[2] – describes the information that is material to the analysis including the model used, data inputs and assumptions.
- Modelling and Analysis Report[3] – describes modelling outputs.
- Silviculture Strategy[4] – provides a rationale for choosing a preferred scenario and describes treatment options, associated targets, timeframes and benefits.
- **Tactical Plan** – provides guidance to silviculture practitioners in developing operational plans that identify specific stands for treatment

In the context of this project, the tactical plan describes the steps required to achieve Provincial Timber Management Goals and Objectives (under development) and targets defined in the Silviculture Strategy. It is comprised of this report plus associated maps and georeferenced data that identify spatially-explicit target and candidate treatment areas for specific treatments at a given funding level. In

1 Forsite Consultants Ltd. 2012. *Williams Lake TSA - Type 4 Silviculture Strategy, Situational Analysis*. Technical Report.

2 Forsite Consultants Ltd. 2013. *Williams Lake TSA - Type 4 Silviculture Strategy, Data Package*. Version 3.0. Technical Report. 59p.

3 Forsite Consultants Ltd. 2013. *Williams Lake TSA - Type 4 Silviculture Strategy, Modelling and Analysis Report*. Version 1.1. Technical Report. 47p.

4 Forsite Consultants Ltd. 2013. *Williams Lake TSA - Type 4 Silviculture Strategy, Silviculture Strategy*. Version 1.0. Technical Report. 47p.

this case, the more optimistic funding level of $5 Million/year was applied to highlight sufficient opportunities for any funding level.

2 Approach

This section describes the steps taken to gather and prepare the data, describes the targets applied for each treatment type and summarizes the assumptions used to prepare the tactical plan maps and summaries.

2.1 Data Gathering and Preparation

Data used for this project was derived from modelling output of the Silviculture Strategy Type 4 analysis - specifically, the preferred strategy of composite treatments at a $5M/yr funding rate. Results were queried and linked to generate spatial data for first 4 periods (20 years grouped into 5-year periods) and included treatment availability, as well as, the full extent of scheduled blocks.

Where possible, cleaning of these datasets was done to make the block shapes to look more appropriate for operational planning. Then, based on the defined operational criteria (section 2.4), scheduled blocks were separated into priority and rejected blocks.

2.2 Treatment Targets

For this project, the preferred silviculture strategy was based on a composite set of treatment options and an optimistic budget level of $5M/yr. The target silviculture program was organized into treatment priorities for two planning periods: during and after the salvage period. The following section summarizes the silviculture program targeted for these planning periods.

Years 2011-2020 (during the salvage period)

Table 1 Target silviculture program – Years 2011-2020

Priority	Treatment	Target Area (ha/yr)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Rehab	2,371	1,750	4.150
2	Fertilize	667	525	0.350
3	Space Fd	467	750	0.350
4	Enhanced Basic	345	725	0.250
5	Investigate	n/a	n/a	0.150

- Rehabilitate eligible stands that will not likely be salvaged (e.g., younger stands without merchantable volume, including fire-damaged areas).
- Focus fertilization on stands closest to harvest eligibility; prioritize by Sx, Fd, Pl; apply multiple treatments on Sx where possible.
- Space eligible dry-belt Fd stands.
- Employ enhanced basic silviculture practices on stands currently being salvaged.

Years 2021-2030 (after the salvage period)

Table 2 Target silviculture program – Years 2021-2030

Priority	Treatment	Target Area (ha/yr)	Unit Cost ($/ha)	Target Funding ($M/yr)
1	Rehab	2,286	1,750	4.000
2	Fertilize	952	525	0.500
3	Space Fd	467	750	0.350
4	Enhanced Basic	345	725	0.250
5	Partial Cut	533	563	0.300
6	Investigate	n/a	n/a	0.150

- Continue rehabilitation levels but shift priority onto stands that optimize various aspects including: merchantable volume, site productivity, haul distance, road access and fire risk. Also consider rehabilitating stands damaged by spruce budworm (east TSA).
- Increase fertilization levels with same approach.
- Continue to space eligible dry-belt Fd stands.
- Continue to employ enhanced basic silviculture practices.
- Start to explore opportunities for partial cutting within constrained areas while maintaining the appropriate non-timber values.

2.3 Planning Considerations

The following sections summarize elements considered for modelling and subsequent mapping of treatment opportunities and priorities. For easier reference to make this a stand-alone document, information from the data package was sometimes copied directly.

2.3.1 Rehabilitation

Rehabilitation is the primary activity to the overall strategy and currently warrants the majority of available funding. It focuses on ameliorating poorly performing stands severely impacted by MPB to provide more harvest opportunities during the forecasted timber supply shortage (mid-term) while increasing the effective landbase in the long-term.

Following the salvage period, some stands are not expected to recover to reach the minimum merchantability criteria (110 m^3/ha) to harvest again within the planning horizon. These stands effectively cease to contribute to the working forest. A continuum of stands exists within this profile; ranging from uneconomic to marginally economic:

- Uneconomic stands: younger, small-diameter trees, higher percent dead and long haul distances.
- Marginally economic stands: some green volume and larger piece sizes to produce lumber, pulp chips or possibly bio-fuel feed stocks (similar for stands treated under the ITSL program).

In some situations, rehabilitation treatments may utilize trees that are still merchantable (e.g., green) and deliver them to a mill for processing. These logs would not have otherwise contributed to the annual harvest.

Rehabilitation typically involves the removal of standing and fallen trees, site preparation and reforestation of productive stands of suitable tree species.

Objectives

Key objectives of rehabilitation activities include:

- Accelerate the recovery of stands into productive forests that will be available for harvest sooner (e.g., younger stands without merchantable volume, including fire-damaged areas).
- Recover some merchantable (green) volume from unsalvaged stands that would not otherwise be harvested – particularly in the mid-term.
- Abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

Eligible Stands

Criteria applied to identify and prioritize stands eligible for rehabilitation activities include:

- All unlogged MPB-impacted stands (identified from the Base Case scenario) with at least 40% dead and greater than 40 yrs old at time of attack.
- Stands adjacent to communities and key resource features where fire hazard abatement is a priority.
- During the salvage period:
  - Younger and fire-killed stands with little opportunity to cover merchantable volume;
  - Identified stands with lower volume, high pine content, high dead stand percentages (i.e., ≥80%), little understory stocking, and are unlikely to provide much green volume in the mid-term when timber availability is limited.
  - Prioritize according to higher future stand productivity.
- After the salvage period (mid-term):
  - Identified stands that optimize various aspects including: merchantable volume, site productivity, haul distance, road access and fire risk.
  - Consider identified stands from that were checked for harvesting but not actually pursued – suggests rehabilitation might offset cost to harvest.

In the field, other criteria that should be used to identify or prioritize stands include, but are not limited to: potential benefits to non-timber values, the amount of remaining green volume, site productivity, distance from communities, access difficulties, and proximity to appropriate seed sources.

Responses

Stand response for rehabilitation was modelled by transitioning stands onto future managed stands from the treatment date. Accordingly, these responses take advantage of improved OAFs, lower regeneration delay and select seed to produce higher yields that achieve minimum harvest volumes much sooner. These stand regeneration improvements will contribute to the long-term harvest flow and potentially the end of mid-term period.

The more immediate response from this treatment activity involves the additional harvest volume of incidental green timber that will contribute to the mid-term harvest flow. While all of the live volume is considered recoverable in this analysis, further work is needed to determine if this is actually the case.

Costs

Treatments and costs associated with the rehabilitation strategy can vary considerably depending on specific site characteristics. Treatments and costs were applied according to the amount of recoverable sawlog volume in the stand and distance cost criteria were added based on haul cycle times (see Table 3).

Table 3 Treatments and costs for rehabilitating damaged stands

Treatment	1. Uneconomic (<50m³/ha)	2. Marginal Economic (≥50 m³/ha)
Knockdown and site prep	$1000/ha	$500
Planting	$1000/ha	$1000/ha
Total Cost [(1)]	$2000/ha	$1500/ha

(1) Add distance costs: <5 hrs @ $0/ha, ≥5 & <7 hrs @ $50/ha, ≥7 hrs @ $250/ha

Challenges

The success of this activity depends, in part, on the proponents developing opportunities to improve utilization of merchantable material, improve markets for low quality fibre and/or sequestering carbon credits.

A significant challenge with this strategy involves the identification of stands that would not otherwise regenerate into merchantable stands on their own while maximizing return on investment (ROI). Moreover, the analysis data does not include some spatially-explicit, stand-level criteria required to distinguish the viability of some treatments.

Very little direct stand-level information was available to develop assumptions for rehabilitating non-salvaged stands. Some aspects of the assumptions used here may not be appropriate operationally.

Operational plans employing this strategy should also consider potential issues related to animal damage (e.g., hare, horse, cattle, etc.).

2.3.2 Fertilization

Despite the limited number of stands currently available to treat, fertilization continues to play an important role in the overall strategy. There is no immediate incentive to fertilize since there is still plenty of time to treat the eligible stands before they are harvested at end of the mid-term.

Objective

Key objectives of fertilization activities include:

- Accelerate the rate of stand development;
- Increase merchantable yield and value of stands harvested within the mid-term.

Eligible Stands

The approach for implementing this activity should consider:

- Fully stocked and healthy stands.
- Treat stands progressively closest to harvesting to minimize risk of loss and maximize the net present value.
- Prioritize stands according to species types: 1) spruce, 2) Douglas-fir, 3) pine.
- Apply multiple treatments every 5+ years on spruce stands where possible.
- Delay harvesting for 10 years following the final fertilizer application.

Eligible stands for this strategy were identified using the criteria provided in Table 4.

Table 4 Criteria for the multiple fertilization strategy

BEC Zones	Species Groups	SI Range	Existing Density Range (sph)
ICH, SBS, SBPS	Pl leading	≥19 & <25	≥1,000 & <10,000
ICH, SBS, SBPS	Sx leading	≥15 & <24	≥1,000 & <10,000
ICH, SBS	Fd leading	≥15 & <24	≥1,000 & <10,000

Note: Stands within the IDF were not included as responses are less certain with the drier sites.

Responses

Responses followed the same progression regardless of the stand age when the first fertilization was applied. As well, minimum harvest ages for applicable analysis units were reduced by 2 years for each application.

Cumulative responses to multiple fertilization treatments are shown in Table 5 and Table 6. The response from multi-fertilization of Pl and Fd were based simply on multiples of a single treatment response applied every 10 years.

Table 5 Cumulative incremental responses from multiple fertilization treatments (Pl & Fd)

Number of Applications	Stand Age Window (yrs)	Pine Response (m^3/ha; 10 yrs after treat)	Fd Response (m^3/ha; 10 yrs after treat)	Efficiency
1	30 – 80	12	15	100%
2	30 – 70	24	30	100%
3	30 – 60	36	45	100%
4	30 – 50	48	60	100%

Pl and Fd response are simple multiples of the single treatment response.

The response from multi-fertilization of Sx was developed from initial research findings and ongoing monitoring of repeat applications would be needed to ensure the full response is being achieved (per com. Rob Brockley). Responses were based on a stand with SI 18 (SI 20 and 22 had even higher gains) where N, S and B are applied every 6 years.

Table 6 Cumulative incremental responses from multiple fertilization treatments (Sx)

Number of Applications	Stand Age Window (yrs)	Spruce Response (m^3/ha; 10 yrs after treat)	Efficiency
1	30 – 80	15	100%
2	25 – 55	49	100%
3	25 – 50	89	100%
4	25 – 45	132	100%
5	25 – 40	155	100%
6	25 – 35	176	100%

Note: Sx response was derived from information provided by the MFLNRO in the document "Intensive fertilization graphs.xlsx" (Rob Brockley email June 14,, 2012, Mel Scott/Ralph Winter email June15, July 28, 2012).

Due to the methodology for developing analysis units, some inappropriate stands were identified for treated (i.e., Sx leading AUs include the leading species: B, Ba, Bl, S, Sb, Se, Ss, Sw, and Sx).

Costs

Application costs were applied as follows:

- $450 per hectare for each treatment application on Pl and Fd stands; and
- $600 per hectare for each treatment application on Sx stands as different fertilizer blends are required to ensure an appropriate mix of micro-nutrients.

Challenges

Because of the limited number of eligible stands identified for this treatment in the short-term, plus the relatively narrow eligibility window, fertilization treatments are more sensitive to time. Treatment layers for the first 10 years were separated into two 5-year periods. Each fertilization regime (number of fertilizer applications) is also attributed in these layers.

In developing operational plans, access to treatment areas is a prime consideration for transporting fertilizer. While B-Train trailers are typically utilized for these projects, other means are also employed – at a much higher cost – to reach areas with difficult access.

2.3.3 Space Douglas-fir

This treatment involves spacing stagnant thickets in the second and third layers of dry-belt Douglas-fir stands. Research on these stands suggests this strategy can rehabilitate stands that were partially harvested with diameter-limit cutting, which promoted excessive stocking in the lower layers that behave as if they are repressed.

Stand management within multi-aged Douglas-fir stands of the IDF is expected to provide even greater benefits than those described in the modelling assumptions as both the number of eligible stands and the gains in stand yield are likely underestimated. Further investigation is required to quantify these and other opportunities[5].

Objective

The anticipated benefits of this strategy include:

- improve both timber and non-timber resources, such as mule deer habitat and urban interface fuels reduction.
- increase merchantable volume post thinning and thereby increase available volumes in the mid- to long-term.
- Reduce defoliation from spruce budworm as foliage is less palatable and tree response to damage is more vigorous (resilient).
- Mitigate fire risk or improve wildlife habitat characteristics by ameliorating dense thickets.

Eligible Stands

Table 7 describes eligible stands for spacing Douglas-fir stands that have not yet been thinned. This selection of stands is expected to over-represent the extent of the opportunity so refinement at the operational level is required. The current inventory poorly reflects multi-storied stands but local knowledge suggests that many stands could benefit from this treatment and produce an acceptable return on investment (ROI).

Dense thickets are often associated with areas partial harvested between 1960 and 1980[6]. While stands within MDWR would also benefit from this treatment, the ROI is expected to be too low to

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[5] Day, K. and McWillilams, J. 2013. IDF Strategy for Williams Lake and 100 Mile TSAs. 17pp.

[6] Per. com. Ken Day/Jeff McWilliams

warrant treatment based on timber values alone. Consideration should be given to treating these stands for other values.

Table 7 Criteria for the spacing dry-belt Douglas-fir strategy.

BEC Zones	Species Groups	SI Range (Managed SI)	Existing Density Range (sph)	Harvested	Management
IDF	Fd leading	≥15	≥1,000	1960-1980	Non-MDWR

Responses

Treated stand curves were developed by adjusting the base VDYP curves to reflect responses seen in exploratory Prognosis modeling.

Targeted stands exceed a maximum density of 3,500 stems per hectare in layers 2, 3, and 4. Stands outside of MDWR will provide higher ROI but stand improvements in MDWR are still valuable and should be considered.

- The following modelling assumptions will incorporated for this strategy:

Initial entry harvest volume (shelterwood and selection) is increased by 10% for stands treated at least 30 years prior to harvest.

Costs

Spacing treatment costs are applied at $750 per hectare; this is less than typical because much less cutting will be required.

Challenges

Challenges involved with implementing this treatment include:

- Inventory poorly represents stand structure and may underestimate site quality
- Despite the completion of substantial pre-commercial thinning area through various programs, treatment records in RESULTS may be incomplete (especially the spatial component)

2.3.4 Other Pre-Commercial Thinning

With the impending timber supply shortage, less focus was applied to activities that are not expected to increase the amount or access to timber volume flow over time. While there may be some opportunities to improve piece size, set up additional stands for fertilization (i.e., repressed Pl or cleaning) or improve habitat supply, pre-commercial thinning was regarded as a lower priority due to the limited opportunities and questionable timber quality benefits. It is likely more beneficial to defer this density management activity until commercial thinning allows logs to be extracted.

2.3.5 Enhanced Basic Silviculture

The enhanced basic reforestation activity is most attractive in the near term for stands regenerated from salvage harvesting as the incremental volumes are expected to contribute to the harvest at the end of the mid-term trough. Unfortunately, some immediate opportunities may be lost until a mechanism to fund this activity is developed.

In addition to the timber supply benefits, the higher density stands developed through this activity are expected to improve timber quality through lower knot sizes, reduced risks from damaging agents and climate change, and increased options for future stand management.

2.3.6 Partial Cutting in Constrained Areas

Partial Cutting in constrained areas (i.e., only mature plus old seral, scenic, lakeshore management zones and hydrological constraints) is not expected to take place right away. Instead, it should be implemented throughout the mid-term, when available timber volumes are lowest, to leverage volume from areas that are otherwise inaccessible. This treatment is most applicable throughout the mid-term period (11-50 years from now). Other than perhaps operational trials within periods 3-4, this activity does not contribute to the preferred strategy in the short-term.

2.4 Mapping

Two spatially explicit layers were prepared and used to produce tactical plan maps for this project:

- <u>Eligible Stands</u> - For each planning period and treatment type, candidate stands meeting the defined eligibility criteria were generated from the model. Based on the operational criteria discussed below eligible stands were then ranked to assign relative priorities (High, Medium, Low, Nil) for treatment.
- <u>Treatment Blocks</u> - For each planning period and treatment type, scheduled treatment blocks were generated from the model. No operational constraints were applied to this set of stands.

These layers were produced from modelling results for the preferred silviculture strategy and assessed further based on the operational criteria discussed below. They were also loaded onto the Resource Practices Branch's web mapping platform for viewing and organized into a standard spatial package for easy delivery.

2.5 Operational Criteria

Defining operational criteria is a critical component in developing a tactical plan. This step further refines the eligible stands to reflect specific operational aspects used to rank and prioritize stands for treating. Through this process, the prioritized stands provide more realistic options for planners to consider for field verification.

Based on perceived operational realities, limits or thresholds were designated for each treatment criteria to assign a relative ranking of stand types. Criteria with nil rankings identify stands where treatment is not practicable in the near future. These rankings were then grouped to assign operational priorities (high, medium, low and nil) to each eligible stand. Ideally, once these data are verified in the field, the improved operational criteria, thresholds, ranking and priorities can be re-introduced with future tactical plans or silviculture strategies (out of scope for this project).

Generally speaking, wildfire management seeks ways to reduce significant losses from fire. While spatial information is still under development, available wildfire management layers were used to identify how treatment blocks should be considered.

2.5.1 General

<u>Access</u>

Treating some stands can be limited by costs required to access each treatment block. Depending on the treatment, any incremental costs can make the treatment unfeasible. The access criteria shown above reflect extraordinary costs associated with distances (e.g., travel, haul, flight), road construction/reconstruction and barging or other barriers to mobilizing materials and equipment.

Application of this constraint is relies heavily on the accuracy and completeness of road system data. Ideally, this exercise requires a complete road network classified according to the type of traffic is currently capable of carrying (i.e., distinguish between ATV and B-Train) and whether it is actively maintained or requires some level of work for safe and effective travel. Unfortunately, a road network with these features is currently not available for the Williams Lake TSA. For this project, the best available information was adapted without local knowledge so may not be appropriate for some areas.

Project Size

Overall treatment costs typically decrease where blocks are less dispersed or fragmented. Planners can reduce project costs by grouping nearby treatment blocks. The criteria discussed below reflect desired block and project sizes for each treatment type.

Timing

Some treatment strategies can change depending on timing. For example, rehabilitation aims to target different stand types during and after the salvage period. The planning periods for this project align with the harvest flow from the Type 4 analysis – periods 1-2 in the short-term (1-10 yrs) and periods 3-4 in the mid-term (11-110 yrs). The criteria shown above reflect desired stand types targeted for treatment relative to the 5-year planning periods examined.

Wildfire Management

Landscape-level wildfire management seeks to identify wildfire risks and potential losses to timber supply and silviculture investments. The objective of integrating wildfire management into this tactical plan is to mitigate losses to communities and natural resource values.

The BC Wildfire Management Branch (WMB)[7] provides much more information than is captured here. While there are many silviculture treatments that can influence wildfire risk, the scope of this very brief discussion is limited to the three silviculture treatments explored in the Type 4 silviculture strategy.

The WMB is developing spatial information to evaluate wildfire susceptibility over large fire-prone landscapes. WMB is currently developing burn probability models that can be used to evaluate wildfire susceptibility over large fire-prone landscapes. When it becomes available this information, along with local fire management specialist expertise, can be integrated into future Type 4 analyses and tactical plans.

For this analysis, WMB provided a Wildland-Urban Interface layer that can be used to identify blocks scheduled for treatments that should be carefully considered for wildfire management. General approaches for each of the three treatments identified in this tactical plan are described in Table 3.

[7] http://bcwildfire.ca/

Table 8 Wildfire management criteria for each treatment

Treatment	Approaches to Reduce Wildfire Risk
Rehabilitation	○ Greatly reduces surface fuels by removing or ameliorating the accumulating dead material. ○ Provides opportunities to reduce future fire risk where managing for deciduous stands is practical. ○ Promote within areas identified with higher fire risk (i.e., treat within WUI, high burn probability, high spotting potential).
Fertilization	○ Increases crown bulk density and surface fuel loading. ○ Avoid within areas identified with elevated fire risk (i.e., treat outside from WUI, high burn probability, high spotting potential). ○ Where possible, group treatments into units that can be easily identified as a priority value for suppression.
Pre-Commercial Thinning	○ In this strategy, PCT exclusively targets dense pine stands to make them eligible for future fertilization. ○ Apply the same approach as fertilization.

2.5.2 Rehabilitation

Modelling criteria used to identify eligible stands for rehabilitation are described in section 2.3.1. The criteria described in Table 9 were used to rank and prioritize eligible stands for rehabilitation.

Table 9 Operational criteria for rehabilitation

Criteria	Rank #1	Rank #2	Rank #3	Nil
Access (km)	<1	≥1 & <2	≥2	n/a
Block size (ha)	≥5	n/a	<5	n/a
Stand Age (yrs)	≥80	n/a	<80	n/a
Inventory Site Index (m_{50})	≥10.4	<10.4 & ≥ 9.4	<9.4	n/a
[1] Stand Dead Percent (%)	≥56	<56 & ≥42	<42	n/a
[2] Live Volume (m^3/ha)	≥59	<59 & ≥43	<43	n/a

Priority for each stand assigned based on the lowest shade category (green=High; yellow=Medium; orange=Low).
[1] - During salvage period (1-10 years)
[2] - After salvage period (11-20 years)

Unfortunately, reliable spatial data is not readily available for some rehabilitation criteria. While they were not assessed directly in this tactical plan, the following criteria should be considered at the operational planning and field verification stages:

- During the first two periods, target stands rejected from normal harvest plans and dropped from consideration into a cutting permit. These may also be identified as eligible stands with larger trees starting to tip over from decay.
- Avoid stands, or portions, with adequate secondary structure expected to develop into operable stands.

2.5.3 Fertilization

Modelling criteria used to identify eligible stands for fertilization are described in Table 4. The criteria described in Table 10 were used to rank and prioritize eligible stands for fertilization.

Table 10 Operational criteria for fertilization

Criteria	Rank #1	Rank #2	Rank #3	Nil
Location	E of Fraser River	W of Fraser River	n/a	n/a
Project size[(1)] (ha within each LU)	≥200	<200	n/a	n/a
Treatment size (ha)	n/a	n/a	n/a	<2
Access (km from any road)	<1	≥1 & <2	≥2	n/a
Leading Species	Sx/Sw/Fd	Pl	Others	n/a
Stand Age (yrs)	≥25	<25	n/a	n/a
Potential Site Index (m_{50})	≥20	≥15 & <20	n/a	n/a
Crown Closure (%)	<60	≥60	n/a	n/a
Density (sph)	≥1,000 & <4,500	n/a	<1000 or ≥4,500	n/a
Previously fertilized	1 or 2 treat prior to 2008 or No treat	1 or 2 treat since 2008	n/a	n/a

** Priority for each stand assigned based on the lowest two shade categories (green=High; yellow=Medium; orange=Low).*

[(1)] Landscape Units (LU) were used to group treatment blocks into appropriately sized project areas.

Unfortunately, reliable spatial data is not readily available for some fertilization criteria. While they were not assessed directly in this tactical plan, the following criteria should be considered at the operational planning and field verification stages:

- Avoid stands with moderate or severe forest health damage
- Non-legal objectives from the Central-Cariboo Land Use Plan (CCLUP)
- ROI ≥ 2%

2.5.4 Spacing Douglas-fir

Modelling criteria used to identify eligible stands for spacing Fd are described in Table 7. The criteria described in Table 11 were used to rank and prioritize eligible stands for spacing Fd stands.

Table 11 Operational criteria for spacing Douglas-fir

Criteria	Rank #1	Rank #2	Rank #3	Nil
Harvest Year	≥1960 & <1980	≥1980 & <2000	n/a	≥2000
Species	Fd ≥80%	Fd ≥40% & <80%	Fd ≥30% & <40%	n/a

** Priority for each stand assigned based on the lowest shade category (green=High; yellow=Medium; orange=Low).*

Unfortunately, reliable spatial data is not readily available for some Spacing Fd criteria. While they were not assessed directly in this tactical plan, the following criteria should be considered at the operational planning and field verification stages:

- Avoid stands with moderate or severe budworm damage
- Ensure secondary structure within stands is adequate to achieve the treatment objectives set in section 2.3.3.
- ROI ≥ 2%

3 Results

Table 12 provides links to further information on how to access documents for the overall project and the spatial layers for this project.

Table 12 Sources for information on treatment layers

Source	Link
Williams Lake Silviculture Strategy Documents	for.gov.bc.ca/HFP/silstrat/Williams%20Lake/Williams%20Lake%20index.htm
Spatial Treatment Layers (Tactical Plan)	forsite.ca:7070/analysis/419/WilliamsLakeTSA/WLT4.html

The main products generated from this project are the spatial layers and the various attributes used to rank and prioritize candidate stands for the various treatment types. Because these data can be summarized in a multitude of ways, it is preferable to provide results in as tools for planners to access. The spatial data can also be provided for more detailed summaries, maps and reports.

The mapping application for this tactical plan provides users with a tool to explore the various treatment options at different locations and scales throughout the TSA (Figure 1). Besides the navigational aids, pre-formatted layers can be turned off or on and clicking on polygons produces a pop-up window with the underlying attributes.

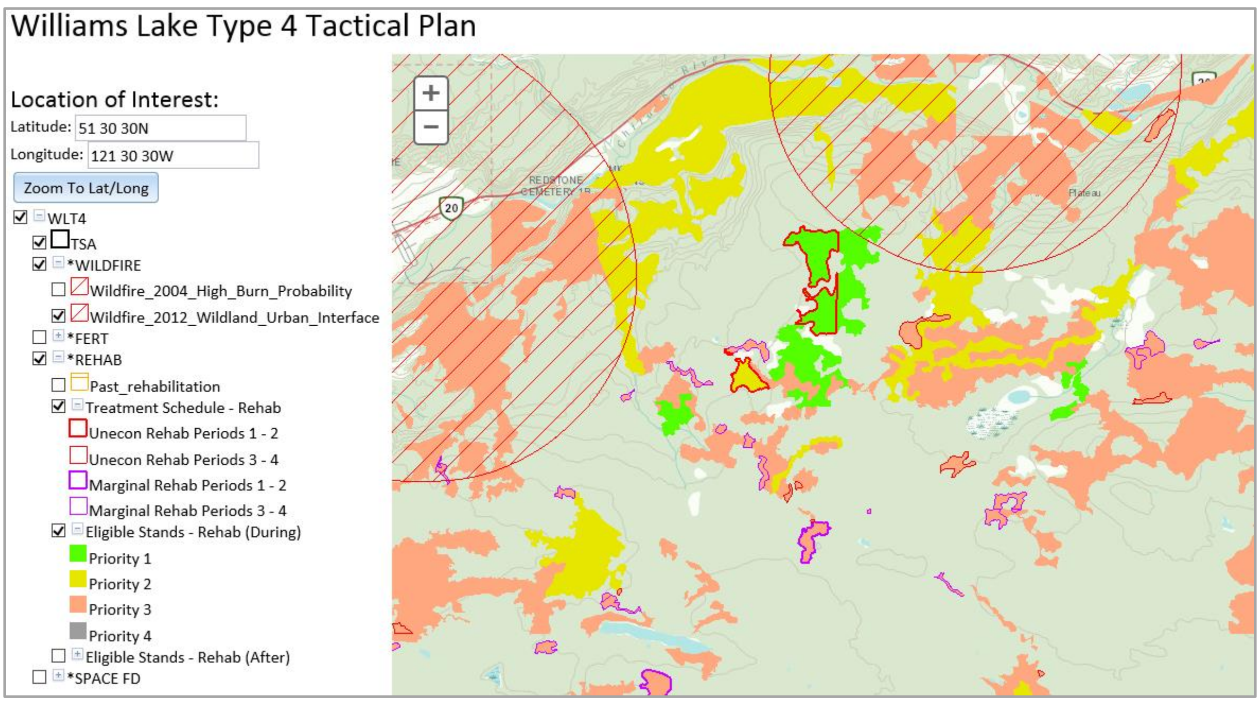

Figure 1 Tactical plan mapping application – rehab example near Puntzi Lake

In this example, key reference information is also included to show where past treatments have occurred and where wildfire risk should be considered.

Table 13 summarizes the total area of candidate stands over the first 4 periods after the operational criteria and priorities were applied to each treatment type. Areas are summarized further to identify where special considerations are required to address wildfire risk, as described in section 2.5.1.

Table 13 Area of eligible stands by priority

Treatment Type	Considerations	Total Eligible Area (ha) by Priority			
		1	2	3	Nil
Rehabilitation (During Salvage)	Normal	11,787	62,775	233,332	
	Wildfire	7,932	35,193	93,280	
Rehabilitation (After Salvage)	Normal	28,580	65,988	213,325	
	Wildfire	16,501	35,881	84,023	
Fertilization	Normal	14,649	27,572	1,076	5
	Wildfire	11,272	22,437	58	3
Space Douglas-fir	Normal	5,137	3,531		9
	Wildfire	3,188	2,925	14	25

More recent work to refine the prioritization of eligible stands for fertilization resulted in the leading species group breakdown shown in Table 14.

Table 14 Area of eligible stands by priority for fertilization

Leading Species Group	Total Eligible Area (ha) by Priority			
	1	2	3	Nil
Spruce	14,575	12,625	32	5
Douglas-Fir	10,095	4,510	1,102	2
Pine	1,252	32,874		1
Totals	25,921	50,009	1,134	8

Table 15 summarizes the total area of treatments scheduled by the model for each 5-year period. Again, areas are summarized further to identify where special considerations are required to address wildfire risk, as described in section 2.5.1.

The scheduled treatment areas are intended to provide general guidance for developing operational plans but they are likely be revised as more site-specific criteria are considered, as discussed in section 4 below.

Table 15 Area of scheduled treatments by period

Treatment Type	Considerations	Total Area Scheduled (ha) by Period			
		1-5 yrs	6-10 yrs	11-15 yrs	16-20 yrs
Rehabilitation	Normal	8,041	8,292	7,227	8,184
	Wildfire	3,572	3,424	3,713	3,792
Fertilization	Normal	697	482	353	460
	Wildfire	557	311	307	228
Space Douglas-fir	Normal	252	386	521	336
	Wildfire	272	305	103	76

4 Application

With an aim to increase harvest levels throughout the mid-term, this tactical plan provides a schedule of activities, at ideal and constrained funding levels. It is intended as a guide for silviculture practitioners to consider in developing operational plans that identify specific stands for treatment.

While the tactical plan is primarily focused on the scheduled blocks generated from the model, eligible stands are also included to provide alternative locations for consideration during field assessments. Points presented in following sections should be considered when using the tactical plan to prepare operation plans.

4.1 Translate budget to area

- Prioritize and schedule treatments by considering the annual budget against the recommended treatment targets in section 2.2.
- Calculate annual target areas based on relative unit costs for each treatment. Cost assumptions used to develop this tactical plan are provided section 2.3.

4.2 Consider treatment risk

- Assess the financial risk associated with the proposed suite of activities by considering the time these treatments are exposed to natural disturbance events before becoming eligible for harvesting.
- Review local wildfire management plans to identify areas and priorities for specific treatments. This should include visiting the wildfire management website and working with local fire management specialists to assess the proposed operational plan against existing wildfire management strategies.

4.3 Consider related plans and strategies

- Check how the proposed treatments align with related plans and strategies – particularly for forest health, wildfire management, ecosystem restoration, and watersheds (see Silviculture Strategy document). Identify locations or conditions that might protect or improve timber and non-timber values.
- Periodically update information on related strategies to ensure they are current.
- Identify locations or conditions that might be explored to help inform future treatments and strategies.

4.4 Verify data

- Determine whether new or better information is available for key spatial layers such as: ownership, old growth management areas, wildlife habitat areas, ungulate winter ranges, and visual landscape polygons.
- Check silviculture history records to identify stands where similar treatment activities have occurred in the past and assess efficacy of those treatments (Note: this may be included on the silviculture strategy mapping website).

4.5 Identify candidate treatment blocks

While the best available forest-level data were used to develop the silviculture strategy and tactical plan, these data are not considered to be accurate at a stand level. Consequently, candidate treatment blocks must be assessed in the field before treatments are prescribed. The tactical plan should be used to identify candidate treatment blocks that will be assessed in the field.

- Blocks that do not conform to the operational criteria defined (section 2.5) are unlikely to be practical on their own.
    - Consider scheduled blocks for the specific treatment
    - Include other eligible stands – particularly those close to priority blocks – to guide field survey crews in developing logical treatment programs.
    - Add other stands that meet the treatment eligibility criteria but were not considered based on deficient or inaccurate forest inventory data.

4.6 Assess candidate treatment blocks

- Consider timing issues that must be incorporated (e.g., linkages to related activities, road access, restoration requirements and rehabilitation treatments).
- Assess candidate treatment blocks in the field. Survey crews should also consider eligible stands close by.
- Track all assessments to explore trends with the data and record outcomes for areas already assessed.
- Develop a mechanism to identify and track miscellaneous stands that are not already represented spatially.

5 Discussion

This tactical plan provides guidance to silviculture practitioners in developing operational plans that identify specific stands for treatment. It was developed by using modelling outputs from the silviculture strategy and was further refined by incorporating operational criteria (section 2.5) to rank and prioritize potential stands for treating.

It must be stressed that the spatial data used to develop this silviculture strategy were typically forest-level inventories that are not accurate at large-scale applications. While these data are limited for stand-level planning, they are appropriate for guiding planners to areas where more detailed fieldwork can be done to assess potential treatment opportunities.

The exercise of incorporating operational criteria into the tactical plan highlighted new constraints that could be added to future silviculture strategies. Documenting the assumed operational criteria now and tracking how these are actually implemented over the next few years will assist in improving future modelling exercises that explore ways to improve timber and habitat supply in the Williams Lake TSA.