# Integrated Investment Planning – Cariboo-Chilcotin

## 2018 TREATMENT OPPORTUNITIES

**Version 2.0**

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**Project 279-5**


*Prepared for:*

*BC Ministry of Forest, Land, Natural Resource Operations, and Rural Development*
*Resource Management – Habitat Section*
*Suite 400 – 640 Borland Street*
*Williams Lake, BC - V2G 4T1*
*Christine Unghy*
*Christine.Unghy@gov.bc.ca*
*250-991-7260*

*Prepared by:*

*Forsite Consultants Ltd.*
*330 – 42nd Street SW*
*PO Box 2079*
*Salmon Arm, BC - V1E 4R1*
*Patrick Bryant*
*pbryant@forsite.ca*
*250-832-3366*


BRITISH COLUMBIA

FORSITE
Forest Management Specialists

# Overview

This project aimed to integrate the current status of various landscape-level assessments and spatially identify candidate stands for several treatment opportunities for the Quesnel, and Williams Lake and 100 Mile Timber Supply Areas. Comprehensive planning of these treatments will assist in establishing opportunities for land base investment programs and allocating funds to programs aimed to advance environmental and resource stewardship, including the Forest Enhancement Society of BC (FESBC).

Treatment opportunities were developed by first assessing the landscape-level issues and available risk assessments, then assigning a relative ranking to criteria identified for each treatment. These assessments and rankings were combined spatially so that eligible stands could be assigned with a relative treatment opportunity score. This project leveraged work already completed by experts in their respective fields by incorporating landscape-level risk assessments recently completed for an array of values across the land base.

The results are not intended to provide exclusive direction on treatment opportunities but rather, offer reasonable guidance for evaluators to compare and assess proposed projects. In addition, the spatial data produced from this landscape-level analysis will assist in targeting candidate stands for closer examination in the field. The following table lists the total area identified for each treatment opportunity:

| Value/Objective | Treatment Opportunity | Area (ha) |
|---|---|---|
| Human | Wildfire Mitigation | 1,837,860 |
| Ecosystem | Restore Open Forest | 157,517 |
| Ecosystem | Restore Open Range | 262,296 |
| Timber | Rehab Burned Stands | 1,240,998 |
| Timber | Rehab MPB Stands | 1,198,511 |
| Timber | Fd Stand Enhancement | 1,795,958 |
| Timber | Thin Repressed Pine | 159,785 |
| Timber | Enhanced Basic Silviculture | 1,720,153 |
| Carbon | Reforest After Wildfire | 123,194 |
| Moose | Reforest After Burn | 531,915 |
| Marten | Reforest After Burn | 94,366 |
| Mule Deer | Reforest After Burn | 58,697 |
| Mule Deer | Thin MDWR | 33,436 |
| Caribou | Thin Repressed Pine | 37,248 |

# Acknowledgements

The following people made significant contributions that were instrumental in completing this project:

| Affiliation | Team Member, Location |
|---|---|
| BC Ministry of Forests, Lands, Natural Resource Operations, and Rural Development | Becky Bings, RPBio (Williams Lake)<br>Brad Powell, RPF (Quesnel)<br>Carole Mahood (Williams Lake)<br>Cheryl Williston, RPBio (Williams Lake)<br>Chris Cummings (100 Mile House)<br>Christine Unghy, RPF (Quesnel)<br>Jennifer Bowman (Williams Lake)<br>Kelly Osborne (Victoria)<br>Kerri Howse, RPF (Williams Lake)<br>Lee-Ann Puhallo, RPF (Quesnel)<br>Rory Colwell, RFT (Williams Lake) |
| Forsite Consultants Ltd. | Jessica Koroll (Salmon Arm)<br>Patrick Bryant, RPF (Salmon Arm) |

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# List of Acronyms

| | |
|---|---|
| BCSC | Biodiversity Conservation Strategy Committee |
| BCWS | BC Wildfire Service |
| BEC | Biogeoclimatic Ecosystem Classification |
| BEO | Biodiversity Emphasis Option |
| CCLUP | Chilcotin-Cariboo Land Use Plan |
| CE | Cumulative Effects |
| CFLB | Crown Forest Land Base (=PFLB) |
| CWD | Coarse Woody Debris |
| ER | Ecosystem Restoration |
| ESSF | Engelmann Spruce-Subalpine Fir (BEC Zone) |
| FESBC | Forest Enhancement Society of BC |
| FLNRORD | Ministry of Forests, Lands, Natural Resource Operations, and Rural Development |
| FN | First Nations |
| FTEN | Forest Tenure Administration |
| ICH | Interior Cedar Hemlock (BEC Zone) |
| IDF | Interior Douglas-fir (BEC Zone) |
| LU | Landscape Unit |
| MDWR | Mule Deer Winter Range |
| MPB | Mountain Pine Beetle |
| MS | Montane Spruce (BEC Zone) |
| NDT | Natural Disturbance Type |
| NHLB | Non-Harvestable Land Base |
| OGMA | Old Growth Management Area |
| PFLB | Productive Forest Land Base (=CFLB) |
| PSTA | provincial strategic threat analysis |
| RESULTS | Reporting Silviculture Updates and Land Status Tracking System |
| SBS | Sub Boreal spruce (BEC Zone) |
| THLB | Timber Harvesting Land Base |
| TSA | Timber Supply Area |
| UWR | Ungulate Winter Range |
| VRI | Vegetation Resources Inventory |
| WHA | Wildlife Habitat Assessment |
| WUI | Wildland Urban Interface |

# Document Revision History

| Version | Date | Notes/Revisions |
|---|---|---|
| 0.1 | September 13, 2017 | • First version distributed to project team for review and comment. |
| 1.0 | November 1, 2017 | • Numerous edits to treatment ranking criteria and thresholds (section 4).<br>• Minor changes to treatment application matrix (Table 23).<br>• Expanded and updated results (section 6). |
| 2.0 | March 31, 2018 | • Removed 'Patch' and 'Interior Old Forest' assessments as neither are currently available.<br>• Updated hydrological stability risk assessment (section 3.2.2) to reflect the recent regional assessment.<br>• Added details for new and revised treatments (sections 4.1, 4.8, 4.9, 4.10, 4.12, 4.10, and 4.13)<br>• Updated Assessment thresholds (Table 8) and reorganized rationale to align better with assessments and thresholds (Appendix 1).<br>• Updated application matrix (Table 23) and priority scoring matrix (Table 24).<br>• Updated results (section 6)<br>• Dropped a number of items in the discussion and recommendations section (7) to focus on items that were considered but could not be adopted at this time.<br>• Replaced footnotes with references section (8) along with hyperlinks where available.<br>• Include multiple suggestions after preliminary review from project team |

# 1 Introduction

In early 2017, the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (FLNRORD) retained Forsite Consultants Ltd. (Forsite) to spatially identify opportunities on the landbase that align with the investment priorities for the Cariboo-Chilcotin region of British Columbia. This project aimed to integrate the current status of various landscape-level assessments and spatially identify candidate stands for several treatment opportunities. Comprehensive planning of these treatments will assist in allocating funds to programs aimed to advance environmental and resource stewardship, including the Forest Enhancement Society of BC (FESBC).

FLNRORD engaged Forsite again in early 2018 to augment the first set of results with revised assessments and additional treatments aimed to mitigate wildfire, sequester carbon, and enhance wildlife habitat. Building upon the work done in 2017, this document describes the information, approach, and key considerations involved with identifying, ranking, reporting, and mapping candidate stands and/or areas as applicable for different treatment activities that consider the current status of landscape-level indicators.

## 1.1 OBJECTIVES

The project aims to:

1) Develop a comprehensive, spatially defined assessment for the Quesnel, and Williams Lake and 100 Mile Timber Supply Areas (TSAs) that will assist in establishing opportunities for land base investment programs.

2) Build upon the analysis of treatment opportunities previously completed by Forsite Consultants Ltd. in 2017 by incorporating wildfire mitigation, carbon sequestration, and wildlife habitat enhancement.

While there are many appropriate ways to identify treatment opportunities, this project will leverage work already completed by experts in their respective fields by incorporating landscape-level risk assessments recently completed for an array of values across the land base.

The results developed are not intended to provide exclusive direction on treatment opportunities but rather, offer reasonable guidance for evaluators to compare and assess proposed projects.

## 1.2 PROJECT AREA

The project area (Figure 1) encompasses approximately 8.3 million hectares of lands throughout the Cariboo-Chilcotin, within the Quesnel, Williams Lake, and 100 Mile House Timber Supply Areas.

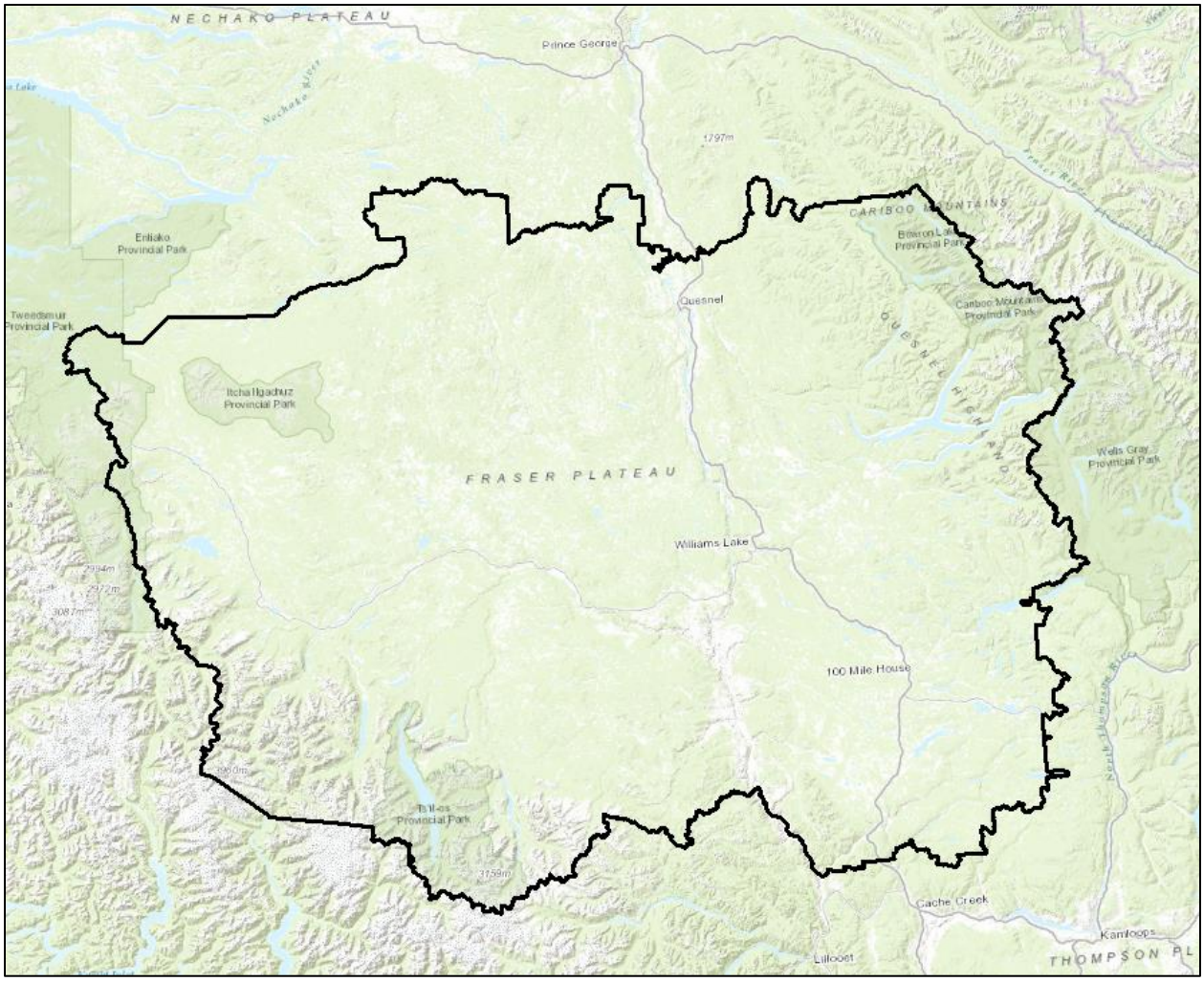


***Figure 1 Project area***

## 1.3 GENERAL APPROACH

Treatment opportunities were developed by first assessing the landscape-level issues and available risk assessments, then assigning a relative ranking to criteria identified for each treatment. These assessments and rankings were combined spatially so that eligible stands could be assigned with a relative treatment opportunity score (Figure 2). Note that the risk assessments applied were recently completed; more could be added as they come available.

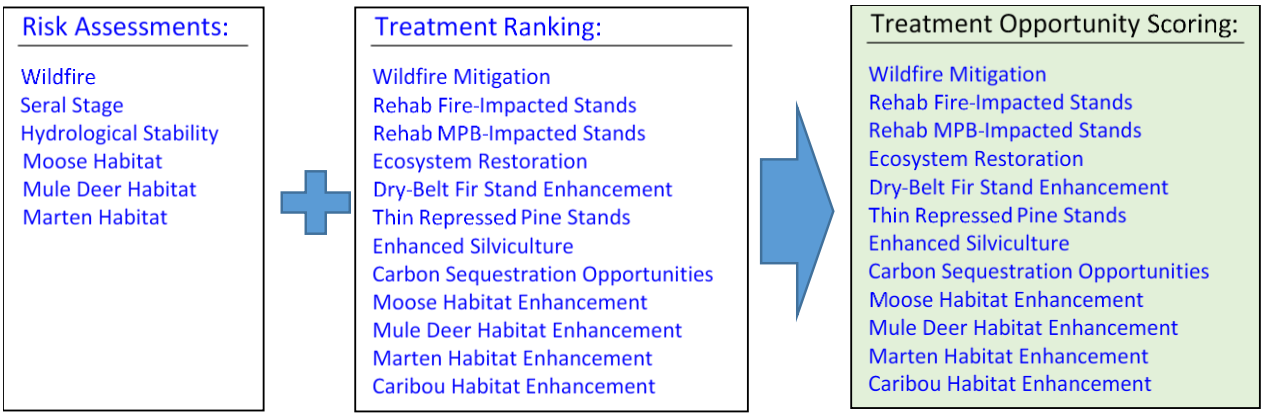


***Figure 2 Approach for developing landscape-level treatment opportunities***

## 1.4 ANALYSIS STEPS

For this analysis, the following steps were scripted in Python and deployed:

1) Data Preparation – Available data sources were assembled and, in some cases, adjusted as described in section 2, below.

2) Resultant - The spatial data were compiled into a single resultant database used for scoring and reporting. This step included a check of topology for each input layer and eliminating redundant slivers that result from overlaying multiple spatial datasets.

3) Assessment Status – Results from each of the assessments described in section 3, below, were assigned or calculated using weighted values, then dissolved into a single spatial layer based on the current status, thresholds, and colour themes shown in Table 8.

4) Treatment Ranking – Criteria and thresholds identified for each treatment described in section 4, below, were used to rank each stand throughout the landbase. The data were then dissolved into spatial layers based on the lowest ranking of all criteria. This is by far the most involved and lengthy component of the process.

5) Treatment Opportunity Scoring – Dissolved results from both the assessment status and treatment ranking steps were combined into a second resultant. Using these combined results, a relative score was assigned to each stand, as described in section 5, below. These treatment opportunity scores were then grouped into, and later dissolved as, four equal-area classes to simplify the presentation of the final results.

# 2 Data Preparation

## 2.1 GATHER SOURCE DATA

Nearly one hundred spatial layers were considered for this analysis. The data sources actually used are listed in Table 1. Data provided by FLNRORD were assumed to be correct and up-to-date, thus incorporated wholly and without verification of previous analysis methods. This included spatial results from previous work completed by FLNRORD to assess values across the land base.

***Table 1 Source data***

| Description | Name | Source and Comments |
|---|---|---|
| Aquatic Ecosystems | AQUATIC_ECOSYSTEMS | FLNRORD: CE_aquatic_ecosystems_cariboo_region |
| Biogeoclimatic Ecosystem Classification | BEC | FLNRORD: BEC_BIOGEOCLIMATIC_POLY |
| Birch Areas for First Nations | BIRCH | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Buffered Trails | BUFFERED_TRAILS | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Burn Severity Combined | BurnSev_all | Forsite: Combined from several FLNRORD sources |
| Community Areas of Specia Concern | COMMUNITYY_AREAS | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Critical Habitat for Fish | CRTICAL_FISH | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Ecosystem Restoration Opportunity | er_align | Forsite: res_landstatus_march2015 (1076-3) |
| Forest Cover Reserves | WTR | DataBC: RSLT_FC_RESERVE |
| Grassland Benchmark | GRASSLAND BENCHMARK | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Grazing Leases | GRAZING_LEASES | DataBC: TA_CROWN_LEASES_SVW |
| Hydrology Combined – CE | Stream_Haz_combo, Sed_Haz_combo | FNLRORD: subbasin, basin, watershed, largewatershed, superwatershed |
| Itcha Ilgachuz Caribou Habitat Area | Itcha_Ilgachuz_Caribou_Habitat_Area | DataBC: Itcha_Ilgachuz_Caribou_Habitat_Area |
| Lakeshore Management Classes | LAKESHORE_MGMT_CLS | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Land Base Definition | LANDBASE_DEFINITION_FINAL_MAR29 | Forsite: Combined from THLB PRODUCTIVE_FOREST_CAR_POLY, CCLUP, Parks, OGMA, WHA, WTR (RESULTs Reserves) |
| Landscape Analysis Units | ANALYSIS_UNITS | FLNRORD: CE – analysis_units |
| Landscape Units | LU | FLNRORD: i_landscape_units |
| Leading Species Group | RCA_LEADING_GROUP | DataBC: RCA_LEADING_GROUP_CAR_POLY |
| Marten Habitat – CE | MARTEN | FNLRORD: aoi_with_joined_ratings_v2 |
| Marten Habitat Capability | MARTEN_CAPABILITY | FNLRORD: marten_dissolve |
| Marten Habitat Risk | MARTEN_HABITAT | FLNRORD: CE - aoi_with_joined_ratings_v2 |
| Moose Habitat – CE | MOOSE | FNLRORD: r1_aoi_moose_ratings |
| Moose Habitat (Road Disturbance) | MOOSE_ROAD_DENSITY | FNLRORD: optimal_with_road_disturbance |
| Moose Habitat Capability | MOOSE_CAPABILITY | FNLRORD: bei_capability |
| Moose Habitat Risk | MOOSE_HABITAT | FLNRORD: CE - r1_aoi_moose_ratings |
| Moose High Value Wetlands | MOOSE_WETLANDS | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Mule Deer Habitat – CE | MULE_DEER | FLNRORD: MuleDeer_Assessment_2013.shp |
| Old Growth Management Areas (legal) | OGMA | DataBC: RMP_OGMA_LEGAL_CURRENT_SVW_polygon |
| Productive Forest Land Base | PFLB | FLNRORD: PRODUCTIVE_FOREST_CAR_POLY |
| RCB Fuel Treatment Opportunities | rcb_fueltreatments | BCWS: RCB_FuelManagement |
| RESULTS Openings | FTG_BLOCKS | FLNRORD: RSLT_OPENING_SVW |
| Roads | ROADS | FLNRORD: BC_CE_IntegratedRoads_2017_v1_20170214_no_TRIM |
| Scenic Corridors | SCENIC_CORRIDORS | DataBC: RMP_PLAN_LEGAL_POLY_SVW |
| Seral Stage – Cariboo Region | SERAL_2016 | FNLRORD: Seral_2016_a_final_resultant_all |
| Slope Class (40, 70, 1000) | | Forsite: Derived from FLNRORD |
| Stand Structure Habitat Class (MDWR) | MDWR_STAND_STRUCTURE | DataBC: WLD_MULE_DEER_STND_STRC_CAR_SP |
| TSA Boundaries (Quesnel, Williams Lake, 100 Mile House) | TSA | DataBC: ADMIN_BOUNDARIES.FADM_TSA |
| Ungulate Winter Range | UWR | FLNRORD: WCP_UNGULATE_WINTER_RANGE_SP |
| Vegetation Resources Inventory | VRI | FLNRORD: VEG_COMP_LYR_R1_POLY |
| Vegetation Resources Inventory TFL52 | TFL_VRI | FLNRORD: TFL52 VRI (summarized in SERAL_2016) |
| Wildfire – Public Threat Rating | wildfire_threat_2017 | BCWS: PSTA_Public_Threat_Rating |
| Wildfire – Public Threat Rating Area-weighted Average by Aquatic Unit | PSTA_WFThreat | BCWS: PSTA_Public_Threat_Rating; FLNRORD: CE_aquatic_ecosystems_cariboo_region Forsite: PSTA_WFThreat (Area-Weighted Average) |
| Wildfire Boundaries | WILDFIRE_MERGED | DataBC: PROT_HISTORICAL_FIRE_POLYS_SP_polygon |
| Wildfire Boundaries | WILDFIRE_MERGED | DataBC: PROT_CURRENT_FIRE_POLYS_SP_polygon |
| Wildland Urban Interface (Interface) | WUI | BCWS: Wildland_Urban_Interface_Buffer |
| Wildland Urban Interface 3 km Buffer | WUI_Buffer | Forsite: Multi-ring buffer from WUI |
| Wildlife Habitat Area | WHA | DataBC: WILDLIFE_MANAGEMENT_WILDLIFE_HABITAT_AREA |

## 2.2 EXAMINE FOREST INVENTORY

The current forest inventory for the Cariboo-Chilcotin TSAs is comprised of various Forest Inventory Projection, Vegetation Resources Inventory (VRI), and silviculture update projects completed to various standards between 1953 and 2014 (Figure 3). The latest forest inventory projects updated into the forest vegetation inventory was a portion of the 100 Mile House VRI completed in 2011 and the Landscape Vegetation Inventory for the western portion of the project area (Figure 4). Reference year is the year of the photo or source survey that was used to generate the stand attributes.

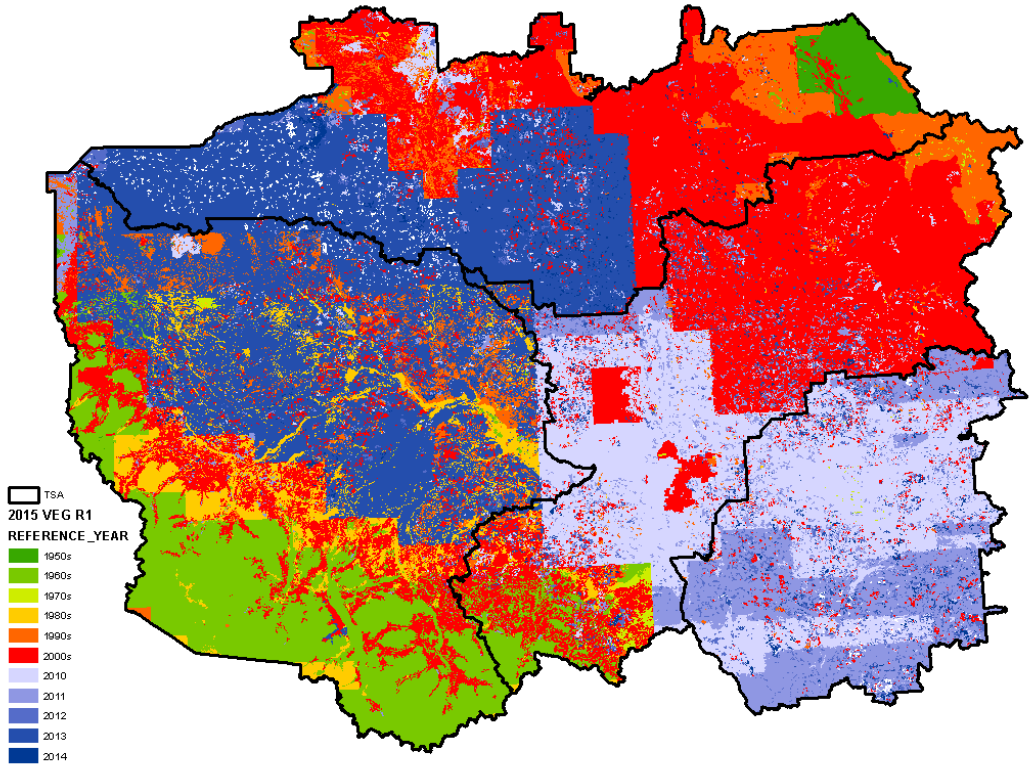


***Figure 3 Vegetation Resources Inventory – Reference Years***

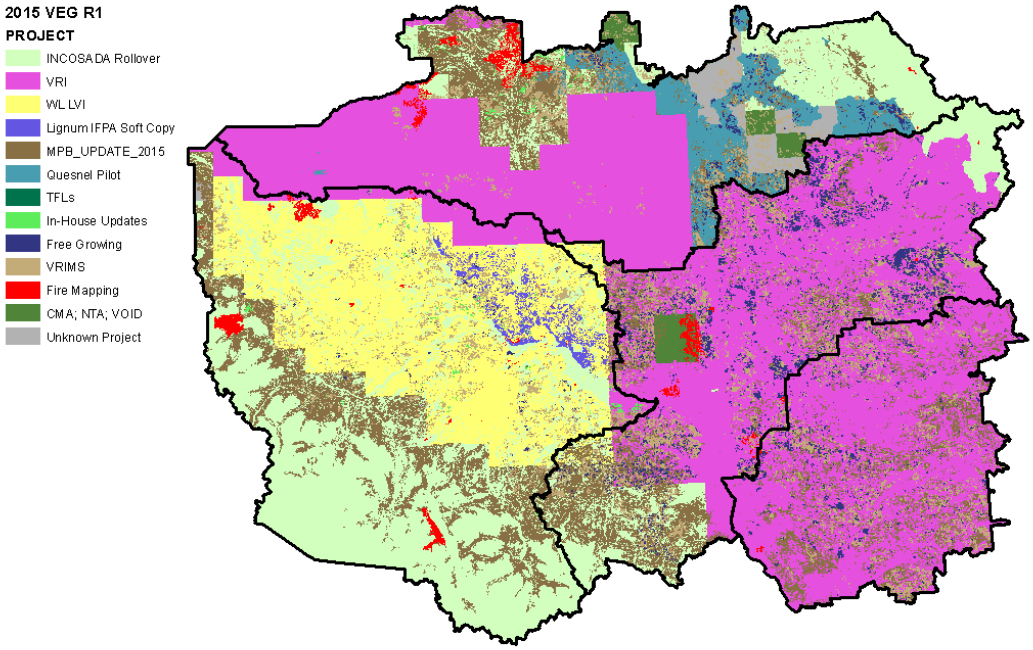


***Figure 4 Vegetation Resources Inventory – Inventory Projects***

The latest forest vegetation dataset provided by FLNRORD was projected for growth to January 2016. This release is significantly different from previous forest inventories as adjustments were made to reflect impacts from mountain pine beetle and fires. To accommodate these changes, a dead layer (Layer D) was added to the operational database to track attributes for dead trees within stands. Volumes are calculated once (at the time of attack) and does not change over time. This means that key attributes for the remaining live component of each stand are adjusted: species composition, crown closure, stems per hectare, basal area, and age.

## 2.3 CLASSIFY LAND BASE

Funding for the treatments considered in this analysis can come from various sources; each with distinctive requirements that support land base components that lack a legal obligation for forest operators to undertake these treatments. The eligibility for most stand-level treatments is predicated whether or not the land base is available to be harvested. This can be done at a landscape level by incorporating land base definition steps that align with the timber supply review process. For treatments considered in this analysis, the entire land base was classified using, the latest spatial designations for timber harvesting land base (THLB) and crown forested land base (CFLB), criteria listed in Table 2, and the following steps:

1) THLB Constrained: THLB_FACT > 0 and 'THLB – Constrained'
2) THLB Unconstrained: THLB_FACT >0 and NOT 'THLB – Constrained'
3) NHLB Reserved: CFLB FACT > 0 and THLB_FACT = 0 and 'NHLB – Reserved'
4) NHLB Subjective: CFLB > 0 and THLB_FACT = 0 and NOT 'NHLB – Reserved'
5) Out: THLB_FACT = 0 and CFLB_FACT = 0

***Table 2 Land Base Definition***

| NHLB – Reserved | THLB – Constrained | NHLB – Subjective | THLB – Unconstrained |
|---|---|---|---|
| Parks | OGMA (Rotational/Transitional) | e.g., Steep Slopes, Low and inoperable sites | (not including landscape-level biodiversity requirements) |
| WHA (no-harvest | WHA (enhanced) | | |
| Critical Fish Habitat | Mature Birch | | |
| Lake Buffers (Class A) | UWR | | |
| Recreation/Trails | Visual (PR, M) | | |
| Riparian Areas | Lake Buffers (Class B-E) | | |
| WTR Areas | WHA (modified harvest) | | |
| Community areas of special concern | Scenic Corridors | | |
| Visual (P, R) | | | |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

## 2.4 CREATE STEEP SLOPE LAYER

While it was not used to rank treatments in this iteration of the analysis, areas identified with "steep slopes" were classified for reference. The steep slopes definitions differ for each TSA accordingly:

- >70% in Quesnel TSA;
- >70% in Old Horsefly District and >40% elsewhere in Williams Lake TSA; and
- >70% east of Fraser River and >40% elsewhere in 100 Mile House TSA.

## 2.5 CREATE DISTANCE TO COMMUNITY LAYER

In some instances, a criterion to consider the distance to an existing community was required for ranking treatments over the forested landscape. To accommodate this, multi-ring buffers with 5 km intervals were created for up to 50 km from identified communities.

# 3 Assessment Risk

The assessments discussed below are intended as a coarse tool to assist forest planners to identify potential concerns with landscape-level objectives. This will improve their ability to plan for treatment opportunities while remaining consistent with these objectives. Users are aware that this is done at a landscape level and the status of specific units may differ with more site-specific information. These assessments are not appropriate for compliance and enforcement purposes. Rather, they provide a good representation of the objective criteria that are approaching or have exceeded a given threshold and thereby indicate where a more detailed assessment and/or changes in treatment opportunities are needed. An area summary of assessments by risk class is provided in section 6 (Table 26).

It must be emphasized that treatments are not necessarily curtailed where thresholds are exceeded. Rather, these coarse-level assessments identify objectives and locations that may require closer examination to determine an appropriate strategy for addressing the established criteria.

It must also be emphasized that these assessments do not consider reductions to the land base beyond the PFLB. Any constraints applied to the timber harvesting land base, such as parks, environmentally sensitive areas and wildlife habitat areas, are not shown on the map or presented in the tables.

## 3.1 WILDFIRE RISK ASSESSMENT

The BC Wildfire Service completed a provincial strategic threat analysis (PSTA) [BCWS 2015] that evaluated multiple datasets to spatially represent wildfire threat across the province. Identifying high-risk areas can provide guidance on management actions to reduce wildfire threats and negative impacts of catastrophic events – particularly within wildland urban interface (WUI) areas where combustible wildland fuels are found near residential structures, businesses, or other built assets or infrastructure that may be damaged by a wildfire.

The goal of provincial strategic threat analysis was to provide spatially-explicit tools for understanding the variables that contribute to wildfire threat (fire occurrence, fire intensity, or spotting) and the implications for values that are already present or are being contemplated for development (risk). The distribution and composition of fuels on the landscape, which are partly determined by resource management activities, are major components of a hazard analysis and they can be managed.

In this project, an updated (2017) version of the spatial datasets for developing the wildfire threat rating was used to provide a generalized assessment of wildfire threat which was then used to identify or modify treatment opportunities. For example, rehabilitation of MPB-Impacted stands to reduce fuel loading and eliminate crown fire threat and reducing surface fuel loads in the short-term may be promoted where wildfire risk is highest.

### 3.1.1 WILDFIRE RISK ASSESSMENT CRITERIA

The wildfire threat rating integrated three identified components of fire threat: fire occurrence (fire density); suppression effort and fire impacts (head fire intensity); and spotting. Results of the final 2017 PSTA were assigned to 10 classes (Table 3) to produce a detailed map of fire threats throughout BC. These 10 classes represent a subjective best estimate of relative fire threats, taking into account fire occurrence history, potential fire intensity under extreme conditions, and spotting impact.

***Table 3 Wildfire Threat Classes***

| Wildfire Threat Description | Wildfire Threat Class |
|---|---|
| Extreme | 9 to 10 |
| High | 7 to 8 |
| Moderate | 4 to 6 |
| Low | 1 to 3 |
| No Threat (Alpine/Ice/Rock) | 0 |
| No Threat (Water) | -1 |
| No Data (Private Managed Forest Land) | -2 |

** Area-weighted average wildfire threat class calculated for watershed reporting units*

The 10 Wildfire Threat Classes represent increasing levels of overall fire threat. Areas classified with wildlife threat above six (high/extreme) are locations where the fire intensity, frequency and spotting risks can be severe enough to potentially cause significant negative impacts in any given wildfire season, if those ratings overlap with significant values at risk. These areas are considered to be particularly prone to wildfires and are most in need of mitigation, where it is feasible to do so based on the fuel types present in those areas.

### 3.1.2 SUMMARIZE WILDFIRE THREAT BY AQUATIC ECOSYSTEM UNITS

In this assessment, an area-weighted average wildfire threat class was calculated for appropriately-sized management units – in this case aquatic ecosystem units from the provincial cumulative effects protocol was

applied (approximately 5,000 ha). This area-weighted average wildfire threat class was then applied to the criteria in Table 3 to assign a generalized wildfire risk description for each aquatic ecosystem unit.

## 3.2 SERAL STAGE ASSESSMENT

The Chilcotin-Cariboo Land Use Plan (CCLUP) implementation process identified the need for a regional biodiversity conservation strategy to maintain ecosystem function and species diversity. The Cariboo-Chilcotin Biodiversity Conservation Strategy Committee [BCSC 1996] prepared regional seral stage guidelines to maintain a natural seral stage distribution over the forested portions of BEC variants. The seral stage assessment is a decision-support tool for evaluating whether the distribution of seral stages within a landscape is sufficient to meet biodiversity conservation objectives.

This analysis project applied the seral stage assessment very recently completed and provided by FLNRORD. It is our understanding that the preparation of this seral stage assessment included the following key datasets:

- Biogeoclimatic Ecosystem Classification (BEC) and Natural Disturbance Type (NDT)
- Productive Forest Land Base (PFLB) or Crown Forested Land Base (CFLB)
- Vegetation Resources Inventory
- Landscape Unit and Biodiversity Emphasis Option
- Leading Species Group for Douglas-fir and Pine [BCSC 2001-3]

Updated stand ages used to assign seral stage were selected and calculated from various sources including Vegetation Resources Inventory, Tree Farm Licence 52, Reporting Silviculture Updates and Land Status Tracking System (RESULTS) and Forest Tenure Administration (FTEN).

Refining the seral stage assessment for this analysis project involved additional steps described in the subsections below.

### 3.2.1 ASSIGN SERAL STAGE CRITERIA

Seral stages were assigned by FLNRORD to each forested stand based on the definitions provided in Table 4. These figures are consistent with table 7 of the Biodiversity Conservation Strategy [BCSC 1996].

***Table 4 Seral stage criteria and thresholds for early, mature-plus-old, and old stands***

| BEC zone | BEC variant | NDT | Leading Species Group | Stand Age | | % Threshold (Max Early/Min Mat+Old/Min Old) by biodiversity emphasis | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Mature | Old | Low | Intermediate | High |
| CWH | un | 1 | | 80 | 250 | na/18/13 | 30/36/13 | 23/54/28 |
| ICH | wk1, wk2, wk4 | 1 | | 100 | 250 | na/17/13 | 30/34/13 | 23/51/19 |
| MH | mm2 | 1 | | 120 | 250 | na/19/19 | 22/36/19 | 17/54/28 |
| ESSF | wc3, wcw, wk1 | 1 | | 120 | 250 | na/19/19 | 22/36/19 | 17/54/28 |
| CWH | ds1, ms1 | 2 | | 80 | 250 | na/17/9 | 36/34/9 | 27/51/13 |
| ICH | mk3, mw3 | 2 | | 100 | 250 | na/15/9 | 36/31/9 | 27/46/13 |
| SBS | vk, wk1 | 2 | | 100 | 250 | na/15/9 | 36/31/9 | 27/46/13 |
| ESSF | mm1, mv1, mw, xv1, xv2, xvw | 2 | | 120 | 250 | na/14/9 | 36/28/9 | 27/42/13 |
| ICH | dk | 3 | | 100 | 140 | na/14/14 | 46/23/14 | 35/34/21 |
| SBS | dk, dw1, dw2, mc1, mc2, mc3, mh, mm, mw | 3 | | 100 | 140 | na/11/11 | 54/23/11 | 40/34/16 |
| SBPS | dc, mc, mk, xc | 3 | | 100 | 140 | na/8/7 | 66/17/7 | 50/25/10 |
| MS | dc2, dv, xk2, xk3, xv | 3 | | 100 | 140 | na/14/14 | 46/26/14 | 35/39/21 |
| ESSF | dc3, dvw, xc3, xcw | 3 | | 120 | 140 | na/14/14 | 46/23/14 | 35/34/21 |
| BG | xh3, xw2 | 4 | Pine | 100 | 140 | na/11/11 | 54/23/11 | 40/34/16 |
| | | | Fir | 100 | 250 | na/22/21 | 12/43/21 | 9/65/32 |
| IDF | dk3, dk4, dw, mw2, ww, xh2, xm, xw | 4 | Pine | 100 | 140 | na/11/11 | 54/23/11 | 40/34/16 |
| | | | Fir | 100 | 250 | na/22/21 | 12/43/21 | 9/65/32 |

*Note: Early ages are all <40 years; mid ages are between Early and Mature*

### 3.2.2 AMALGAMATE NDT-BEC UNITS

The regional Biodiversity Conservation Strategy [BCSC 1996] indicated that non-valley bottom BEC units less than 5000 hectares in size and valley bottom units less than 1,000 hectares are not required to meet all seral stage targets within a specific landscape unit. This is because natural disturbances could potentially alter seral condition across most of the BEC unit due to its small size, thus enabling the amalgamation of small BEC units to assess seral targets.

For this analysis, BEC units were amalgamated according to the guidance as described in the Biodiversity Conservation Strategy [BCSC 1996] and the Regional Biodiversity Conservation Strategy Update Note #2 [BCSC 2001-2]. Amalgamating the small reporting units provides a more appropriate spatial depiction of seral status.

### 3.2.3 ASSIGN SERAL STAGE RISK CLASS

Additional thresholds were applied to differentiate the seral stage into more risk classes rather than simply violated or not. These thresholds were arbitrarily based on number of hectares before the threshold is violated (Table 5 and Table 8).

***Table 5 Seral Stage Risk Classes***

| Risk Class | Criteria |
|---|---|
| Very High | Area of Over Threshold |
| High | Less than 500 ha disturbance before threshold is violated |
| Moderate | Less than 1000 ha disturbance before threshold is violated |
| Low | More than 1000 ha disturbance before threshold is violated |

## 3.3 HYDROLOGICAL STABILITY RISK ASSESSMENT

Hydrological stability is a critical feature of watersheds, affecting the quality, amount and timing of water flows. These, in turn, affect fish and other aquatic organisms, human water use, built structures and the stability of watercourses. The hydrological stability risk assessment is part of a decision support tool designed to assess relative environmental risk to large areas of land and water. This cumulative impact assessment was recently conducted as a 'work in progress' for the Cariboo-Chilcotin [Dawson et. al. 2015] and assists in determining impacts and mitigation measures – including wildfire mitigation activities where water and fish are exposed to potential negative impacts from a high intensity wildfire.

### 3.3.1 HYDROLOGICAL STABILITY RISK ASSESSMENT CRITERIA

The hydrological stability risk assessment evaluated the factors that affect stream flow and sedimentation risk by combining a broad scale assessment with more detailed information on the indicators. Results from this carefully structured GIS-based assessment were designed to flag potential hydrological risk. The assessment report states that they are best used as a screening device to identify units that may require additional, more detailed, hydrological assessment and potentially greater due diligence from development proponents.

Two key outcomes from the hydrological stability risk assessment work – each derived from multiple indicators – were incorporated into this project:

- streamflow hazard - likelihood of harmful streamflow events due to forest canopy loss (e.g., harvesting and stand rehabilitation).
- sedimentation hazard – likelihood of harmful sedimentation events due to roads (e.g., roads constructed close to water and road density on steep slopes).

### 3.3.2 PRE-PROCESSING HYDROLOGICAL STABILITY RISK

The hydrological stability risk assessment produced results for both the streamflow and sedimentation hazards on nearly 1,500 watershed reporting units with areas that often overlapped (Table 6). Preparing these data for this analysis involved three steps. First, units were 'flattened' into a single spatial layer for each hazard type. Second, the highest risk rating was assigned to any overlapping sub-units. Finally, each spatial layer was dissolved according to the assigned risk rating. This produced new spatial layers (525 units with streamflow hazard and 819 units with sedimentation hazard) generalized for evaluating various treatments considered.

***Table 6 Assessment Watershed Reporting Units***

| Reporting Units | Number |
|---|---|
| Super Watersheds | 3 |
| Large Watersheds | 29 |
| Watersheds | 195 |
| Basins | 458 |
| Sub-basins | 796 |
| Total | 1,481 |

## 3.4 MOOSE HABITAT RISK ASSESSMENT

The moose habitat risk assessment is part of a decision support tool - a cumulative impact assessment recently conducted for the Cariboo-Chilcotin [Dawson et. al. 2015] - designed to assess relative environmental risk to large areas of land and water. This assists in determining impacts and mitigation measures.

### 3.4.1 MOOSE HABITAT RISK ASSESSMENT CRITERIA

Recent results from a cumulative impact assessment were used to provide a broad assessment of moose habitat risk. Three components of risk were rated for each assessment unit:

1) **Ecological Importance** evaluates the ecological importance of each assessment unit for each valued ecosystem component. This factor can also be thought of as the level of ecological consequence if the value is impacted.

2) **Hazard** evaluates the current state of the landscape and its ability to meet habitat requirements for each valued ecosystem component. The assessment is a snapshot in time, evaluating the current ecological condition prior to the consideration of the effects of any new project or development.

3) **Current Mitigation** evaluates the level of risk reduction currently in place for each valued ecosystem component. Mitigation measures include mapped, legal land-use designations that specify protection or special management requirements. Examples include mule deer winter ranges, protected areas and riparian reserves.

The moose habitat risk assessment was conducted for 326 landscape analysis units derived from biophysical units that have been used for biodiversity assessments in the Cariboo-Chilcotin since 1995. They are generally based on ecologically similar areas and drainages in consideration of historical natural disturbance regimes.

### 3.4.2 PRE-PROCESSING MOOSE HABITAT RISK

In this assessment, units were assigned the highest assessment class derived from the risk ratings shown in Table 7. For example, an assessment unit with high ecological importance rating, medium hazard rating, and very low current migration rating, would be assigned an assessment class 2 (orange) due to the high ecological importance rating. Note that assessment classes for current mitigation are reversed as it evaluates measures in place to reduce risk.

***Table 7 Assessment Class Assignment by Habitat Risk Rating***

| Assessment Class | Colour Code | Assessment Risk Rating | | |
|---|---|---|---|---|
| | | Ecological Importance | Hazard | Current Mitigation |
| 1 | Red | Very High | Very High | Very Low |
| 2 | Orange | High | High | Low |
| 3 | Yellow | Medium | Medium | Medium |
| 4 | Green | Low | Low | High |
| 5 | Blue | Very Low | Very Low | Very High |
| 6 | White | Null | Null | Null |

*Note1: the highest risk rating observed is used to assign class/colour code.*
*Note2: current mitigation is sorted inversely.*

## 3.5 MULE DEER HABITAT RISK ASSESSMENT

The mule deer habitat risk assessment is part of a decision support tool - a cumulative impact assessment recently conducted for the Cariboo-Chilcotin [Dawson et. al. 2015] - designed to assess relative environmental risk to large areas of land and water. This assists in determining impacts and mitigation measures.

### 3.5.1 MULE DEER HABITAT RISK ASSESSMENT CRITERIA

Recent results from a cumulative impact assessment were used to provide a broad scale assessment of mule deer risk. Like the moose habitat risk assessment (section 3.4.1), three components of risk were rated for each assessment unit.

The mule deer risk assessment was conducted for the 86 individual winter range units within the boundaries for the legally designated mule deer winter ranges.

### 3.5.2 PRE-PROCESSING MULE DEER HABITAT RISK

Like the moose habitat risk assessment (section 3.4.2), assessment units were assigned the highest of the three assessment class derived from the assessment risk categories for mule deer habitat risk, as shown in Table 7.

## 3.6 MARTEN HABITAT RISK ASSESSMENT

The marten habitat risk assessment is part of a decision support tool - a cumulative impact assessment recently conducted for the Cariboo-Chilcotin [Dawson et. al. 2015] - designed to assess relative environmental risk to large areas of land and water. This assists in determining impacts and mitigation measures.

### 3.6.1 MARTEN HABITAT RISK ASSESSMENT CRITERIA

Recent results from a cumulative impact assessment were used to provide a broad scale assessment of marten habitat risk. Like the moose habitat risk assessment (section 3.4.1), three components of risk were rated for each assessment unit.

The marten habitat risk assessment was conducted for 326 landscape analysis units derived from biophysical units that have been used for biodiversity assessments in the Cariboo-Chilcotin since 1995. They are generally based on ecologically similar areas and drainages in consideration of historical natural disturbance regimes.

### 3.6.2 PRE-PROCESSING MARTEN HABITAT RISK

Like the moose habitat risk assessment (section 3.4.2), assessment units were assigned the highest of the three assessment class derived from the assessment risk categories for marten habitat risk, as shown in Table 7.

## 3.7 ROAD DENSITY ASSESSMENT

The road density assessment is part of a decision support tool - a cumulative impact assessment recently conducted for the Cariboo-Chilcotin [Dawson et. al. 2015] - designed to assess relative environmental risk to large areas of land and water. This assists in determining impacts and mitigation measures.

Road density is considered as a risk factor in the framework using the density of roads per square kilometre. In the assessment, road density serves as a surrogate of potential displacement and mortality risk for various wildlife species (e.g., grizzly bear, moose) and, potentially, to rank road rehabilitation treatments for various objectives.

### 3.7.1 ROAD DENSITY ASSESSMENT CRITERIA

Recent results from a cumulative impact assessment were used to provide a broad scale assessment of road density risk. Road density was spatially determined with a roving window approach using the line density tool in Arc Info. A 30m pixel and 500m neighborhood/search radius was used for line density tool application.

The road density assessment was conducted for 326 landscape analysis units derived from biophysical units that have been used for biodiversity assessments in the Cariboo-Chilcotin since 1995. They are generally based on ecologically similar areas and drainages in consideration of historical natural disturbance regimes.

### 3.7.2 PRE-PROCESSING ROAD DENSITY RISK

No pre-processing was required to assess road density. Rather, road densities calculated for each landscape analysis unit were used directly from the biodiversity assessments described above.

## 3.8 SUMMARIZING ASSESSMENT RISK

As described in the objectives (section 1.1), this project aimed to incorporate various landscape-level risk assessments already completed across the land base. These products are typically spatially-explicit depictions of the risk provided as tables and spatial files.

The detailed criteria and methods used to process each landscape-level assessment were described in the subsections above. Table 8 summarizes the thresholds used to colour theme the risk status of each assessment unit.

***Table 8 Summary of Colour Themes Assigned to Illustrate and Assess Risk***

| Assessment | Criteria/Threshold | Assessment Unit | Class[1] | Colour | Threshold |
|---|---|---|---|---|---|
| Wildfire Risk | Wildfire Threat | Aquatic Ecosystems Unit<br><br>(Thresholds calculated from area-weighted average of threat scores) | VH | Red | ≥8.1 |
| | | | H | Orange | ≥6.4 & <8.1 |
| | | | M | Yellow | ≥5.5 & <6.4 |
| | | | L | Green | ≥4.1 & <5.5 |
| | | | VL | Blue | ≥0.5 & >4.1 |
| | | | Nil | White | <0.5 |
| Seral Stage | Min% Old Seral | LU/BEO/BEC/Leading Species Group | VH | Red | Over Threshold |
| | | | H | Orange | <500ha |
| | | | M | Yellow | <1000ha |
| | Min% Mature+Old Seral | | L | Green | >=1000ha |
| | | | VL | Blue | n/a |
| | | | Nil | White | No threshold |
| Hydrologic | Streamflow Hazard | Watershed Units<br><br>(subbasin, basin, watershed, large watershed, super watershed) | VH | Red | VH |
| | | | H | Orange | H |
| | | | M | Yellow | M |
| | | | L | Green | L |
| | | | VL | Blue | VL |
| | | | Nil | White | Nil |
| | Sedimentation Hazard | Watershed Units<br><br>(subbasin, basin, watershed, large watershed, super watershed) | VH | Red | VH |
| | | | H | Orange | H |
| | | | M | Yellow | M |
| | | | L | Green | L |
| | | | VL | Blue | VL |
| | | | Nil | White | Nil |
| | Road Density | Watershed Units<br><br>(subbasin, basin, watershed, large watershed, super watershed) | VH | Red | >=2.0 |
| | | | H | Orange | >=1.2 & <2 |
| | | | M | Yellow | >=0.5 & < 1.2 |
| | | | L | Green | >=0.2 & <0.5 |
| | | | VL | Blue | >=0 & <0.2 |
| | | | Nil | White | Null |
| Wildlife | Moose | Landscape Analysis Units<br><br>(Combined Risk Rating for:<br>• Ecological Importance<br>• Hazard<br>• Current Mitigation) | VH | Red | VH |
| | | | H | Orange | H |
| | | | M | Yellow | M |
| | Marten | | L | Green | L |
| | | | VL | Blue | VL |
| | | | Nil | White | Null |
| | Mule Deer | Winter Ranges within MDWR<br><br>(Combined Risk Rating for:<br>• Ecological Importance<br>• Hazard<br>• Current Mitigation) | VH | Red | VH |
| | | | H | Orange | H |
| | | | M | Yellow | M |
| | | | L | Green | L |
| | | | VL | Blue | VL |
| | | | Nil | White | Null |

[1] *– Very High, High, Moderate, Low, Very Low, Nil*

# 4 Treatment Ranking

The following subsections describe the treatments, their objectives, criteria, and challenges considered for ranking eligible stands across the land base. Assumptions for these details were developed by FLNRORD professionals who used their expert opinions and built upon past work on silviculture strategies, wildlife habitat assessments, ecosystem restoration guidelines, and land-based investment criteria.

## 4.1 WILDFIRE HAZARD MITIGATION

*Description*

The wildland urban interface (WUI) is defined as the area where structures and other human development meet and intermix with wildland areas containing flammable vegetation (trees, brushes, grasses). Activities to prevent or mitigate the effects of wildland urban interface fires include measures such as fuel management, public education, and policy/ legislation. Fuel management is an important part of prevention activities that reduces wildfire hazards and risk through changes to the natural environment, and by changing the fuel stratum resulting in corresponding reductions in fire behaviour. Fuel management is more a new objective than a new concept or practice. It is the treatment of vegetative forest fuels with a greater focus in the Interface to enhance values protection from wildfire. Fuel management involves identifying the location of strategic fuel breaks and fuel treatments to create a more fire resilient landscape [Fitzgerald and Bennett 2013]. A fire resilient landscape mitigates wildfire behaviour, increases suppression options, improves the effectiveness and cost efficiency of wildfire suppression, and reduces the risks to communities and other values.

Wildfire hazard mitigation is an important component of Integrated Investment Planning within forested areas near communities, and can involve a full range of fuel treatment opportunities. This assessment incorporates the work already completed for many areas throughout the Cariboo-Chilcotin through other wildlife management planning processes. Wildfire risk reduction opportunity criteria incorporated additional aspects and separated opportunities according to their relationship to the wildland urban interface:

- Within Wildland Urban Interface areas (i.e., 2 km from structures and other human development) where treatments are focused solely on mitigating wildfire hazard around a specific community or neighborhood. These are often focused from the individual value out ward in zones or priority.
- Within a further 3 km from the Wildland Urban Interface areas as opportunities for wildfire hazard mitigation at a landscape scale.

*Objectives*

Past management choices have altered historical fire regimes, resulting in wildfires that are often much different in intensity, magnitude, and extent than those that burned historically in fire adapted ecosystems. The net result is that vegetative fuel on much of the landscape exceeds historic levels, continues to accumulate, and has and will continue to contribute to larger, higher-intensity fires. The goals for managing hazardous vegetation fuels on the landscape is to create fire resilient ecosystems and contribute to creating fire adapted communities by:

1) Reducing crown fire initiation, spotting and fire intensity so that it is safer and easier for fire fighters to suppress wildfire for the protection of life, values at risk, cultural and natural resources;
2) Reducing fire severity so that it is likely that larger areas of forest will survive, soil damage will be limited and post-fire restoration activities will be minimized; and
3) Restoring the natural cycle of fire-maintained grassland and dry forest ecosystems.

*Criteria*

The criteria described in Table 9 were used to identify and rank eligible stands for wildfire mitigation.

***Table 9 Ranking Criteria for Wildfire Mitigation***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Identified* | n/a | Forested within WUI | | |
| PSTA & WUI areas <2km | n/a | n/a | 7+ (High or Extreme) - Within | 4 to 6 (Moderate) - Outside |
| PSTA & 2-5 km Buffer around WUI areas | Outside | n/a | n/a | 7+ (High or Extreme) - Within |
| Burn severity | High-Moderate | n/a | n/a | Low |
| 2007-2017 Perimeters | Inside | | Outside | |
| Resulting Area (ha) by Rank | | 20,161 | 407,477 | 1,410,223 |

**Identified through wildfire management planning process (e.g., FTOs, CWPPs, Landscape-Level Plans)*
*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

## 4.2 ECOSYSTEM RESTORATION

*Description*

A significant area of dry forest ecosystems occur throughout the interior of British Columbia. These ecosystems are referred to as “dry-belt”, “Natural Disturbance Type 4 (NDT4)”, or “open range / open forest”. Since the early 1900’s, fire suppression has allowed trees to encroach onto hundreds of thousands of hectares of the natural grasslands and naturally open forest types in the NDT4.

Ecosystem restoration is the process of assisting with the recovery of an ecosystem that has been degraded, damaged or destroyed. These treatments aim to re-establish structural characteristics, species composition and ecological process. In BC, ecosystem restoration examples include the reintroduction of ground fires in NDT4 (fire maintained) ecosystems, incorporating snags, coarse woody debris (CWD) or canopy gaps in homogenous secondary forests, rehabilitation of compacted landings and access roads, and the control of invasive species such as knapweed, thistles and broom.

In addition to benefits to overall ecological resilience, ecosystem restoration treatments may also benefit other resource values on the land. For example, ecosystem restoration treatments that are planned within an “interface” area close to a town that result in a measurable reduction in surface fuels, would provide benefit in the form of reduced wildfire hazards.

Where current condition aligns with desired future condition, treatment for the purposes of ecosystem restoration is generally not required. Where current condition does not align with desired future condition of fire maintained ecosystems identifies potential opportunity for treatment. Treatments to bring land closer to desired future condition could involve ecosystem restoration as well as industrial forest harvesting activities. Forest harvesting to align stands with desired future condition could involve:

- Standard harvesting practices – e.g. removal of all forest cover to foster open range conditions,
- Modified harvesting – e.g. removal of some of the tree cover in order to align with an open forest conditions, or
- Modified regeneration objectives – e.g. reduced stocking to maintain open forest conditions.

The scope of this land-based investment planning exercise excludes the identification of more specialized treatments such as addressing road impacts, controlling invasive species, and restoring riparian habitat. Instead, treatment priorities focus on open forest and open range:

- **Open Range** – Lands ecologically suited to production of bunchgrass and dry land shrub species. Snow accumulations are typically low. Generally includes existing open range, meadows, cultivated, and similar cover classes with < 10% tree crown closure. Specific treatment activities typically involve surveys, logging, piling, burning, and monitoring.
- **Open Forest** – Lands ecologically suitable for production of large crowned trees in an open forest with bunchgrass and dry land shrub species. Snow accumulations are typically light. Generally include <40% tree crown closure, multi-stories stand structure and low stocking (tree regeneration) levels. Specific treatment activities typically involve surveys, partial cutting, thinning, piling, burning, and monitoring.

The lack of wildfire or similar disturbance within historically fire-maintained ecosystems of the Cariboo-Chilcotin has contributed to trees encroaching onto grasslands, as well as, excessive in-growth of trees and increased fuel accumulations in previously open forests resulting in increased wildfire threat to values. Treatments for open forest/open range typically involve activities like prescribed burning, tree knockdown (slashing), partial cutting, thinning, and mechanical site preparation.

*Objectives*

Key objectives for ecosystem restoration include:

- shift stands from their current vegetated condition towards a desired future condition,
- partially replace natural processes of frequent ground fires that ignited easily and spread rapidly through extensive areas of ungrazed grass,
- encourage shrub and herbaceous vegetation development, and
- enhance Douglas- fir stem growth and vigor while not decreasing overall stand growth.

*Criteria*

The criteria described in Table 10 and Table 11 were used to identify and rank eligible stands for ecosystem restoration of stands towards a desired open range and open forest condition [Forsite 2015], respectively.

***Table 10 Ranking Criteria for Ecosystem Restoration of Open Range***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| ER Alignment (Current to Desired Condition) – Open Range | Nulls & Good | Poor | Moderate | |
| Resulting Area (ha) by Rank | | 101,451 | 56,066 | |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

***Table 11 Ranking Criteria for Ecosystem Restoration of Open Forest***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| ER Alignment (Current to Desired Condition) – Open Forest | Nulls & Good | Poor | Moderate | |
| Resulting Area (ha) by Rank | | 212,057 | 50,240 | |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with restoring historically adapted ecosystems include:

- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.

- Identification of rare and endangered species and ecosystems.
- Stands identified through the Ecosystem Restoration Alignment exercise considered the grassland benchmark layer (CCLUP) but it is not clear if Ecosystem Restoration treatments are acceptable outside of the grassland benchmark area.

## 4.3 REHABILITATE WILDFIRE-IMPACTED STANDS

*Description*

A range of treatment opportunities can exist with wildfire-impacted stands, depending on the pre-fire stand conditions, fire size, and fire intensity. Recovery of any merchantable volume from these stands will support short- and mid-term harvest levels while long-term harvest levels will increase because of the regeneration volumes are significantly improved. Rehabilitating burned stands should also help to address other issues like fire hazard abatement and watershed recovery.

Wildfire rehabilitation activities can involve a range of activities from mechanized harvest to site preparation treatments. Other specialized treatments may be required to address non-timber values associated with wildfire-impacted stands (e.g., riparian reserves).

Treatment of wildfire-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for rehabilitating wildfire-impacted stands include:

- accelerate the recovery of stands into productive forests that will be available for harvest sooner (e.g., younger stands without merchantable volume),
- recover merchantable volume that would not otherwise be harvested, and
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 12 were used to identify and rank eligible stands for rehabilitating wildfire-impacted stands.

***Table 12 Ranking Criteria for Rehabilitating Wildfire-Impacted Stands***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Harvested | n/a | No | Yes | |
| Fire Year | Out | 2011 to 2017 | 2007 to 2010 | |
| Burn Severity | Unburned | High | Medium | Low |
| BEC Zone | Nulls | ESSF, IDF, ICH, SBS | MS, SBPS | |
| Inventory Site Index ($m_{50}$) | Nulls | ≥15 | ≥ 12 & <15 | <12 |
| Resulting Area (ha) by Rank | | 417,859 | 151,560 | 671,579 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with rehabilitating wildfire-impacted stands include:

- Estimates of fire intensity are used to develop more reasonable estimates of the available live and dead volume but they are not always available and their accuracy is not certain.
- The boundaries used to show the impact on stands by wildfire are not always accurate.
- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.
- Identification of stands with sufficient natural regeneration is difficult.
- New road systems may be required to access wildfire-impacted stands thereby increasing cost.

## 4.4 REHABILITATE MPB-ATTACKED STANDS

*Description*

Many MPB-attacked stands will linger on the land base because they have lost so much of their merchantable volume that they are no longer economically viable to harvest. Effectively, these stands cease to contribute to the working forest. Within this profile, a continuum of stands exists ranging from marginally economic to uneconomic:

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

Recovery of any merchantable (green) volume from these stands will support mid-term harvest levels while mid- to long-term harvest levels will increase as stand regeneration is significantly improved. Rehabilitating damaged stands should also help to address other issues like fire hazard abatement and watershed recovery.

MPB rehabilitation activities typically involve large equipment to harvest trees or knock them down to be piled and burned. Site preparation might also be required to improve conditions for natural regeneration or planting the next crop of trees.

Treatment of MPB-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for rehabilitating MPB-Attacked stands include:

- accelerate the recovery of stands into productive forests that will be available for harvest sooner (e.g., younger stands without merchantable volume).
- recover some merchantable (green) volume from unsalvaged stands that would not otherwise be harvested – particularly within the mid-term or post-salvage period.
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 13 were used to identify and rank eligible stands for rehabilitating MPB-attacked stands.

***Table 13 Ranking Criteria for Rehabilitating MPB-Impacted Stands***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Stand Age (yrs) | Nulls & <40 | ≥100 | ≥40 & <100 | |
| Inventory Site Index ($m_{50}$) | Nulls | ≥15 | ≥ 12 & <15 | <12 |
| Stand Dead Percent (%) | Nulls & <40 | ≥70 | ≥56 & <70 | ≥40 & <56 |
| Live Volume ($m^3$/ha) | Nulls | <40 | ≥40 & <60 | ≥60 |
| Resulting Area (ha) by Rank | | 13,619 | 193,716 | 991,176 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

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

- During the salvage period, 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.

*Challenges*

A major challenge with identifying treatment opportunities for rehabilitating MPB-attacked stands involves determining which stands will not likely be salvaged by the forest licensees. In addition, opportunities to rehabilitate most stands will be limited by access where building new road systems into some stands is cost prohibitive.

## 4.5 DOUGLAS-FIR STAND ENHANCEMENT

*Description*

Absence of understorey fires has resulted in a high level of in-growth, and unnaturally high density (especially in the understorey) Douglas-fir stands. There is also concern that catastrophic wildfires may occur due to the high fuel accumulations associated with dense stands, and a shift from ground fires to crown fires.

The anticipated benefits of this treatment include improving both timber and non-timber resources, such as mule deer habitat and urban interface fuels reduction. Expected gains in merchantable volume post thinning should increase available volumes in the mid- to long-term. It is also anticipated that treated stands are less likely to experience defoliation from spruce budworm because foliage is less palatable and tree response to damage is more vigorous (resilient).

This treatment involves thinning (i.e., mechanical tree 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 partially harvested with diameter-limit cutting, which promotes excessive stocking in the lower layers that behave as if they are repressed.

*Objectives*

Key objectives for Douglas-fir stand enhancement include:

- improve both timber resources and reduce urban interface fuels,

- increase merchantable volume post thinning and thereby increase available volumes in the mid- to long-term, and
- reduce defoliation from spruce budworm as foliage is less palatable and tree response to damage is more vigorous (resilient).
- abate fire hazards by reducing dense thickets and ladder fuels that can shift fires from the ground to the crown.

*Criteria*

The criteria described in Table 14 were used to identify and rank eligible stands for Douglas-fir stand enhancement. This selection of stands is expected to over-represent the extent of the opportunity so refinement is required for each prescription – including determining that these stands have not been thinned before.

The current inventory poorly reflects multi-storied stands but local knowledge suggests that dense thickets are often associated with stands partially harvested between 1960 and 1980.

***Table 14 Ranking Criteria for Thinning Dry-Belt Douglas-fir Stands***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Management | n/a | Non-MDWR | MDWR | |
| Harvest Year | Nulls | ≥1960 & <1980 | ≥1980 | <1960 |
| Species Composition (%) | Nulls & <20 | Fd ≥85 | Fd ≥60 & <85 | Fd ≥20 & <60 |
| Inventory Site Index ($m_{50}$) | Nulls | ≥17 | ≥16 & <17 | <16 |
| VRI Live Stem Density (sph) | Nulls | ≥3,000 | <3000 | |
| Resulting Area (ha) by Rank | | | 69,362 | 1,726,596 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with thinning dry-belt Douglas-fir stands include:

- Current inventory does not capture stocking for young stands very well and site quality may be underestimated.
- Despite the completion of substantial pre-commercial thinning area through various programs, treatment records in RESULTS may be incomplete (especially the spatial component).

## 4.6 THIN REPRESSED PINE STANDS

*Description*

Numerous examples of high density, fire-origin pine stands expressing repression occur throughout the Cariboo region – predominantly on the Chilcotin Plateau. While spacing opportunities have been considered, most areas were deemed unsuitable due to forest health concerns. Currently, there is little or no future timber value in these areas but research suggests that thinning (and possibly fertilization) can ameliorate these extremely dense pines stands originating from wildfire disturbances.

This treatment generally involves thinning (i.e., mechanical tree spacing) dense, repressed stands; ideally followed by a single fertilization treatment.

*Objectives*

Key objectives for thinning repressed pine stands include:

- mitigate the height growth repression (evidence suggests that earlier thinning will result in better results),
- improve timber quality/health/resilience by restoring stand productivity and advancing desired leave trees, and
- increase stand volumes through fertilization and advance operability in these stands.

*Criteria*

The criteria described in Table 15 were used to identify and rank eligible stands for thinning repressed pine.

***Table 15 Ranking Criteria for Thinning Repressed Pine Stands***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| BEC Zone | n/a | MS, SBS, SBPS, IDF, ICH | All Others | |
| Leading Species | Nulls & non-Pine | Pli & Pl | | |
| Stand Age (yrs) | Nulls; <10; ≥40 | ≥30 & <40 | ≥10 & <30 | |
| Inventory Site Index ($m_{50}$) | Nulls | ≥20 | ≥15 & <23 | <15 |
| VRI Live Stem Density (sph) | Nulls & <5000 | ≥5,000 | None | |
| Resulting Area (ha) by Rank | | 57 | 90,576 | 69,153 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with thinning repressed pine stands include:

- Current inventory does not capture stocking for young stands very well, which significantly limits our ability to identify potentially repressed pine stands.
- The return on investment is difficult to rationalize due to the high treatment costs, long return period, and potential for loss due to wildfire, pests, and diseases.
- Wildfire threat will remain with increased thinning activities where surface fuels are not reduced.

## 4.7 ENHANCED BASIC SILVICULTURE

*Description*

Stand stocking guidelines set minimum standards for establishing stands with appropriate species selection, stocking, and specified requirements. The enhanced basic silviculture treatment is intended to be applied where current performance is not optimal over the long-term (i.e., achieving minimum well-spaced trees/ha versus target well-spaced trees/ha).

A suite of specific activities are available for this treatment; aimed to increase initial well-spaced stand densities and reduce stocking gaps. Specific activities include a combination of site preparation, planting to higher densities, and/or fill planting as soon as ingress is complete. Planting would also utilize Class A seed with volume gains associated with it.

A portion of these treatments is expected to exceed basic silviculture activities currently being applied on these stands. As this is clearly defined, forest licensees and BC Timber Sales may seek operational cost allowance to offset the additional costs.

*Objectives*

The key objective for enhanced basic silviculture stands is to increase timber volume and quality when these stands are harvested.

This strategy will only influence stands regenerated in the future that will not be harvested for at least 45-50yrs from now. While this treatment may provide some benefit at the end of the mid-term trough, it is focused on increasing long-term harvest levels by improving well-spaced densities, decreasing regeneration delay, and realizing genetic gains from using Class A seed. In addition to the timber supply benefits, the higher density stands with this activity could result in timber quality improvements such as lower knot sizes, reduced risks from damaging agents and climate change, and provide options for further stand management.

*Criteria*

The criteria described in Table 16 were used to identify and rank eligible stands for enhanced basic silviculture.

***Table 16 Ranking Criteria for Enhanced Basic Silviculture***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| BEC Unit | n/a | ESSFwk1, ESSFwc3, ICHmk3, ICHwk2, SBPSmk, SBSdw1, SBSdw2, SBSmc1, SBSmk, SBSmw, SBSwk1 | All Others | |
| Harvested | Yes | No | | |
| Resulting Area (ha) by Rank | | 1,720,153 | 0 | 0 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with the enhanced basic silviculture treatment include:

- Identifying eligible stands. The predictive ecosystem mapping is a landscape-level inventory that does not accurately define the extent of eligible stands. These units must be verified in the field. Meanwhile, enhanced basic silviculture treatments on additional units are also likely to improve timber volume and quality at rotation.
- Clearly defining the acceptable costs associated with enhancements above basic silviculture requirements so that this portion of these activities is eligible for stumpage allowance.

## 4.8 CARBON SEQUESTRATION – REFOREST AFTER WILDFIRE

Note that many of the parameters for this treatment are very similar to those described in section 4.3, Rehabilitate Wildfire-Impacted Stands.

*Description*

As they grow, forests have the ability to absorb and store carbon, which can affect atmospheric concentrations of carbon dioxide ($CO_2$) and other greenhouse gases that contribute to changes in climate. Reforesting stands after a wildfire aims to improve the carbon balance in these forests over and above that which will come back naturally. This can occur by increasing the adaptive capacity of regenerating forests by replanting areas with a diverse and climatically suitable species mix and integrating wildfire resiliency measures where suitable.

While government funding for this treatment is not available for licensee harvested areas, new funding opportunities are emerging where carbon sequestration is the primary driver, rather than return on investment or hazard reduction, including:

- impacted stands in the THLB without a legal obligation where treatments can deliver an increase in carbon sequestration,
- not satisfactorily restocked areas,
- isolated wildfire- and MPB-impacted sites (i.e., not satisfactorily restocked), and
- wildfire- and MPB-impacted sites within non-harvestable land base (e.g., parks, some wildlife habitat areas, OGMA).

Wildfire reforestation activities may require some form of site clearing and preparation to facilitate new stand establishment and safety of workers. Reforestation standards will seek to achieve well stocked stands and more rapid carbon capture.

Treatment of wildfire-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for rehabilitating wildfire-impacted stands for carbon sequestration include:

- accelerate the recovery of stands into productive forests that store carbon faster, and
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 17 were used to identify and rank eligible stands for reforesting wildfire-impacted stands for carbon sequestration.

***Table 17 Ranking Criteria for Reforesting Burned Stands – Carbon Opportunities***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Burn Severity | Unburned | High | Medium | Low or Unknown |
| Land Base Definition (section 2.3) | Non-CFLB and THLB; Grassland Benchmark | NHLB | | |
| Opening Status | THLB with obligation (not Free-Growing) | n/a | Free-growing (THLB with no obligation) | |
| Inventory Site Index (m50) | Nulls | ≥12 | | <12 |
| Pine Species Composition (%) | Pli ≥70 | Pli <50 | | Pli ≥50 & <70 |
| Pre-Fire Stand Age (yrs) | <20 yrs | ≥20 & <40 | | >=40 |
| Pre-Fire Basal Area ($m^2$/ha) | ≥40 | <20 | | ≥20 & <40 |
| Distance from a community - FN communities and villages to cities | n/a | <15 km | >=15 km & <25km | ≥25 km |
| Resulting Area (ha) by Rank | | 67 | 1,710 | 121,417 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with rehabilitating wildfire-impacted stands for carbon sequestration include:

- Estimates of fire intensity are used to develop more reasonable estimates of the available live and dead volume but they are not always available and their accuracy is not certain.
- The boundaries used to show the impact on stands by wildfire are not always accurate.

- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.
- Identification of stands with sufficient natural regeneration is difficult.
- New road systems may be required to access wildfire-impacted stands thereby increasing cost.

## 4.9 MOOSE HABITAT ENHANCEMENT – REFOREST AFTER WILDFIRE

Note that many of the parameters for this treatment are very similar to those described in section 4.3, Rehabilitate Wildfire-Impacted Stands.

*Description*

Dawson et. al. (2015) describe that winter shelter and forage habitat are important limiting habitats for moose populations. Forest cover is important for security, thermal protection and snow interception while forage habitat, identified as dynamic (created by disturbances like fire or harvesting) and static (like wetlands and riparian areas that do not move around the landscape), have different management implications due to their persistence on the landscape. Spring calving areas are also important and will often overlap with winter forage habitat in the plateau portions of the region. The requirements and relative importance of these three functions of cover vary across the region depending on factors such as snow depth and winter temperature. Moose will use some of the same habitats in spring, summer and fall, but they will range much more widely in those seasons allowing them to spread out to access more forage that was not available in the winter and to more effectively avoid predation.

Reforesting wildfire-impacted stands to enhance moose habitat will reduce the time required for these stands to function as shelter habitat. In the meantime, the younger seral stages will provide forage habitat.

Wildfire reforestation activities may require some form of site clearing and preparation to facilitate new stand establishment and safety of workers. Reforestation standards will seek to achieve well stocked stands and more rapid carbon capture.

Treatment of wildfire-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for rehabilitating wildfire-impacted stands to enhance moose habitat include:

- accelerate the recovery of key habitat components for moose, and
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 18 were used to identify and rank eligible stands for reforesting wildfire-impacted stands to enhance moose habitat.

***Table 18 Ranking Criteria for Reforesting Burned Stands – Moose Habitat Enhancement***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Burn Severity | Unburned | High | Medium or Unknown | Low |
| Moose Habitat Capability WITH CCLUP - High Value Wetlands for Moose | n/a | High (1,2) **or** High; Mod-High | Moderate (3) **or** Moderate; Low-Mod; Low; Very Low - Low | Low (4,5) **or** Everything Else |
| Moose Habitat with Road Disturbance | n/a | n/a | Disturbed by Road | |
| Resulting Area (ha) by Rank | | 12,513 | 353,968 | 165,433 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with rehabilitating wildfire-impacted stands to enhance moose habitat include:

- Estimates of fire intensity are used to develop more reasonable estimates of the available live and dead volume but they are not always available and their accuracy is not certain.
- The boundaries used to show the impact on stands by wildfire are not always accurate.
- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.
- Identification of stands with sufficient natural regeneration is difficult.
- New road systems may be required to access wildfire-impacted stands thereby increasing cost. Meanwhile, reducing access is a key objective with managing moose habitat. Activities should strive to deactivate new roads towards a net zero road impact.

## 4.10 MARTEN HABITAT ENHANCEMENT – REFOREST AFTER WILDFIRE

Note that many of the parameters for this treatment are very similar to those described in section 4.3, Rehabilitate Wildfire-Impacted Stands.

*Description*

Marten occupy forests with higher levels of structural complexity - primarily mature and older forests in the Cariboo-Chilcotin. In the dry parts of the region, their highest capability habitat is found in moister areas near water. Intense fires significantly degrade marten habitat.

Reforesting burned stands with fast-growing deciduous and other species can help to re-establish key habitat components faster. This may include installation of coarse woody debris treatments to act as 'middens' for marten for denning, resting, and foraging.

Wildfire reforestation activities may require some form of site clearing and preparation to facilitate new stand establishment and safety of workers. Reforestation standards will seek to achieve well stocked stands and more rapid carbon capture.

Treatment of wildfire-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for reforesting wildfire-impacted stands to enhance marten habitat include:

- accelerate the recovery of key habitat components for marten, and
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 19 were used to identify and rank eligible stands for reforesting wildfire-impacted stands to enhance marten habitat.

***Table 19 Ranking Criteria for Reforesting Burned Stands – Marten Habitat Enhancement***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Burn Severity | Unburned | High | Medium or Unknown | Low |
| Marten Habitat Capability (Potential) | n/a | Very High Capability (1) | High Capability (2) | |
| Resulting Area (ha) by Rank | | 1,434 | 71,399 | 21,533 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*
*Note: Consider Patch Size to help assess home range size (may over-estimate capability otherwise)*

*Challenges*

Key challenges involved with reforesting wildfire-impacted stands to enhance marten habitat include:

- Estimates of fire intensity are used to develop more reasonable estimates of the available live and dead volume but they are not always available and their accuracy is not certain.
- The boundaries used to show the impact on stands by wildfire are not always accurate.
- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.
- Identification of stands with sufficient natural regeneration is difficult.
- New road systems may be required to access wildfire-impacted stands thereby increasing cost.

## 4.11 MULE DEER HABITAT ENHANCEMENT – REFOREST AFTER WILDFIRE

Note that many of the parameters for this treatment are very similar to those described in section 4.3, Rehabilitate Wildfire-Impacted Stands.

*Description*

Established winter ranges are a key aspect to mule deer survival in the Cariboo-Chilcotin. Dawson et. al. (2015) describes that in the winter, mule deer move to traditional winter ranges centered on areas that can provide available food and reduced snow depths. Reduced snow pack conditions result from a combination of factors including lower elevation, warm aspect slopes and forests with good snow interception cover. These winter ranges are distributed throughout the shallow, moderate and deeper snow areas in the Cariboo-Chilcotin, often on the warm aspect sides of major valleys. They have been carefully mapped and designated for special management. Mature forest cover on winter ranges provides critical snow interception as well as thermal and security cover.

Douglas-fir provides especially good cover attributes with mature stands reducing snowpack by more than 50 per cent while providing important litter-fall forage and a good substrate for arboreal lichen forage.

Reforesting wildfire-impacted stands to enhance mule deer habitat will reduce the time for these stands to reach desired future habitat conditions of a functioning winter range. Rehabilitating burned stands should also help to address other issues like fire hazard abatement.

Wildfire reforestation activities may require some form of site clearing and preparation to facilitate new stand establishment and safety of workers. Reforestation standards will seek to achieve well stocked stands and more rapid carbon capture.

Treatment of wildfire-impacted areas should be delayed where salvage opportunities and or natural regeneration opportunities exist.

*Objectives*

Key objectives for rehabilitating wildfire-impacted stands to enhance mule deer habitat include:

- accelerate the recovery of key habitat components for mule deer, and
- abate fire hazards associated with standing dead trees and damage to understory trees as the dead material falls.

*Criteria*

The criteria described in Table 20 were used to identify and rank eligible stands for reforesting wildfire-impacted stands to enhance mule deer habitat.

***Table 20 Ranking Criteria for Reforesting Burned Stands – Mule Deer Habitat Enhancement***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Burn Severity | Unburned | High | Medium or Unknown | Low |
| Fire Year | n/a | 2016-2017 | 2014-2015 | <2014 |
| Management | Non-MDWR | MDWR | | |
| Stand Structure Habitat Class | Nulls | High & Moderate | Low | |
| OGMA (any) | Inside OGMA | Outside OGMA | | |
| Resulting Area (ha) by Rank | | 11,647 | 23,874 | 23,176 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with rehabilitating wildfire-impacted stands to enhance mule deer habitat include:

- Estimates of fire intensity are used to develop more reasonable estimates of the available live and dead volume but they are not always available and their accuracy is not certain.
- The boundaries used to show the impact on stands by wildfire are not always accurate.
- Planning processes are more complex, given multiple stakeholders and tenure holders – particularly private landowners.
- Identification of stands with sufficient natural regeneration is difficult.

- New road systems may be required to access wildfire-impacted stands thereby increasing cost. Meanwhile, reducing access is a key objective with managing marten habitat. Activities should strive to deactivate new roads towards a net zero road impact.

## 4.12 MULE DEER HABITAT ENHANCEMENT – THINNING IN MDWR

While many of the parameters for this treatment are very similar to those described in section 4.5, Douglas-fir Stand Enhancement, many treatment criteria are different as the objectives are not the same (i.e., timber vs. habitat).

*Description*

Absence of understorey fires has resulted in a high level of in-growth, and unnaturally high density (especially in the understorey) Douglas-fir stands. There is also concern that catastrophic wildfires may occur due to the high fuel accumulations associated with dense stands, and a shift from ground fires to crown fires.

The anticipated benefits of this treatment include improving both timber and non-timber resources, such as mule deer habitat and urban interface fuels reduction. Expected gains in merchantable volume post thinning should increase available volumes in the mid- to long-term. It is also anticipated that treated stands are less likely to experience defoliation from spruce budworm because foliage is less palatable and tree response to damage is more vigorous (resilient).

This treatment involves thinning (i.e., mechanical tree 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 partially harvested with diameter-limit cutting, which promotes excessive stocking in the lower layers that behave as if they are repressed.

*Objectives*

Key objectives for Douglas-fir stand enhancement include:

- improve mule deer habitat by advancing desired leave trees,
- reduce urban interface fuels,
- reduce defoliation from spruce budworm as foliage is less palatable and tree response to damage is more vigorous (resilient), and
- abate fire hazards by reducing dense thickets and ladder fuels that can shift fires from the ground to the crown.

*Criteria*

The criteria described in Table 21 were used to identify and rank eligible stands for thinning within MDWR to enhance mule deer habitat. This selection of stands is expected to over-represent the extent of the opportunity so refinement is required for each prescription – including determining that these stands have not been thinned before.

The current inventory poorly reflects multi-storied stands but local knowledge suggests that dense thickets are often associated with stands partially harvested between 1960 and 1985.

***Table 21 Ranking Criteria for Thinning within MDWR – Mule Deer Habitat Enhancement***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Management | Non-MDWR and South Chilcotin, Hances Timber, Big Lake South, Bonaparte, Hawks Creek | | MDWR | |
| BEC Variants | Other variants | | IDF xm, dk3, dk4 | |
| Harvest Year | ≥1985 | | ≥1960 & <1985 | <1960 |
| History of previous spacing or thinning | Yes | | No | |
| Stand Structure Habitat Class | n/a | High & Moderate | Low | |
| OGMA | n/a (i.e., both in & out OGMA) | Not in OGMA | | In OGMA |
| Burn Severity | Low, Moderate, High | | Unburned | |
| Leading Species (Species_Code_1) | Not Fdi | | Fdi | |
| Stand Volume (m³/ha @ min 12.5 cm dbh utilization) | >80m³/ha | | <80m³/ha | |
| Resulting Area (ha) by Rank | | 1,678 | 330 | 31,428 |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

While stands within Mule Deer Winter Ranges would also benefit from this treatment, the return on investment is expected to be too low to warrant treatment based on timber values alone.

Key challenges involved with thinning dry-belt Douglas-fir stands include:

- Current inventory does not capture stocking for young stands very well and site quality may be underestimated.
- Despite the completion of substantial pre-commercial thinning area through various programs, treatment records in RESULTS may be incomplete (especially the spatial component).

## 4.13 CARIBOU HABITAT ENHANCEMENT – THINNING IN ITCHA-ILGATCHUZ AREA

Note that many of the parameters for this treatment are very similar to those described in section 4.6, Thin Repressed Pine Stands.

*Description*

Numerous examples of high density, fire-origin pine stands expressing repression occur throughout the Cariboo region – predominantly on the Chilcotin Plateau. While spacing opportunities have been considered, most areas were deemed unsuitable due to forest health concerns. Currently, there is little caribou habitat value in these areas but research suggests that thinning (and possibly fertilization) can ameliorate these extremely dense pines stands originating from wildfire disturbances.

This treatment generally involves thinning (i.e., mechanical tree spacing) dense, repressed stands; ideally followed by a single fertilization treatment.

*Objectives*

Key objectives for thinning repressed pine stands include:

- mitigate the height growth repression (evidence suggests that earlier thinning will result in better results), and
- improve caribou habitat by restoring stand productivity and advancing desired leave trees.
- Wildfire threat will remain with increased thinning activities where surface fuels are not reduced.

*Criteria*

The criteria described in Table 22Table 15 were used to identify and rank eligible stands for thinning repressed pine in Itcha-Ilgatchuz area to enhance caribou habitat.

***Table 22 Ranking Criteria for Thinning within Itcha-Ilgatchuz Area – Caribou Habitat Enhancement***

| Criteria | No Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) |
|---|---|---|---|---|
| Management | Not within | Itcha-Ilgatchuz Caribou Habitat Area | | |
| Stand Age (yrs) | n/a | ≥20 & <40 yrs | | |
| Leading Species (Species_Code_1) | Not Pli | Pli | | |
| Resulting Area (ha) by Rank | | 37,248 | | |

*Each stand is assigned the rank associated with the lowest threshold of all criteria.*

*Challenges*

Key challenges involved with thinning repressed pine stands include:

- Current inventory does not capture stocking for young stands very well, which significantly limits our ability to identify potentially repressed pine stands.
- The return on investment is difficult to rationalize due to the high treatment costs, long return period, and potential for loss due to wildfire, pests, and diseases.

# 5 Treatment Opportunity Scoring

After the assessment risk (section 3) and treatment ranking (section 4) are identified for each stand, the next stage in this process involved combining these results and calculating a score that represents the relative opportunity for each treatment (section 1.3), as described in the following modelling steps:

1) Table 23 provides general guidance for each treatment on whether it should be promoted, avoided, or is neutral when considering the higher risk classes associated with each assessment. Note that that this direction is done for each treatment in isolation and does not combine treatments or objectives. For example, thinning dry-belt fir is 'avoided' within an area assessed with a higher risk of wildfire because this costly investment is more likely to be lost here than in another location. This direction alone does not consider potential benefits as a wildfire mitigation treatment because appropriate stands for those activities are already considered, separately, in the wildfire mitigation treatment. Accordingly, combined benefits can be viewed where the two treatment opportunities overlap spatially. The rationale for each direction scenario applied here (i.e., promote, avoid, neutral) is provided in Appendix 1.
2) The priority scoring matrix (Table 24) provides the preliminary priority score based on the assessment risk rating and treatment direction. This step essentially selects a different scoring table based on the treatment direction presented (i.e., promote, avoid, neutral).

3) For each stand within an assessment unit (e.g., watershed/aquatic ecosystems unit, LU/NDT – see Table 8), the model assigns a preliminary priority score according to the assessment risk rating and the treatment rank. For example:
    - thinning within a MDWR (wildlife), a stand with a treatment ranking of 2 (medium),
    - within a LU/BEC unit where Old Seral is assessed as high (orange),
    - has a treatment direction of 'promote' (old seral and thinning within a MDWR)
    - yields a preliminary priority score of 11.

4) The preliminary priority score for each treatment and assessment combination is then multiplied by the assessment weight shown on the right in the Treatment Application Matrix (Table 23).

5) The final priority score is the sum of all preliminary scores calculated for each assessment risk, factored by assessment weights (i.e., treatment scores).

Table 25 provides an example that calculates a final priority score of 90.4 for a rehabilitation treatment (MPB-Impacted Stand) where the stand is assessed with treatment rank 2 (medium), and assessment risks for each assessment type are given in the column "Example Assessment Risks".

***Table 23 Treatment Application Matrix***

| | Value / Treatment | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Assessment Risk** | Human / Wildfire Mitigation | Ecosystem / Restore OR & OF | Timber / Rehab Burned Stands | Timber / Rehab MPB Stands | Timber / Fd Stand Enhancement | Timber / Thin Repressed Pine | Timber / Enhanced Basic Silv | Carbon / Reforest After Wildfire | Moose / Reforest After Burn | Marten / Reforest After Burn | Mule Deer / Reforest After Burn | Mule Deer / Thin MDWR | Caribou Habitat Thin Pine | Weight |
| Section | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 4.10 | 4.11 | 4.12 | 4.13 | |
| Wildfire | P | P | P | P | A | A | A | N | A | A | N | N | N | 1.4 |
| Old Seral Stage | N | P | N | N | P | P | P | N | P | P | N | N | N | 1.6 |
| Mature + Old Seral Stage | N | A | N | A | P | P | P | N | P | P | N | N | N | 1.4 |
| Streamflow | N | N | N | N | N | N | P | P | P | P | P | P | P | 1.0 |
| Sedimentation | N | N | A | A | P | P | P | P | P | P | P | P | P | 1.0 |
| Road Density | N | N | A | A | N | N | N | N | N | N | N | N | N | 1.0 |
| Moose Habitat | P | P | P | P | P | P | P | P | P | P | P | P | P | 1.2 |
| Mule Deer Habitat | P | P | P | P | P | P | P | P | P | P | P | P | P | 1.2 |
| Marten Habitat | N | N | A | A | P | P | P | P | P | P | P | P | P | 1.2 |

*A=Avoid; N=Neutral; P=Promote (see (1) under section 5, above)*

***Table 24 Treatment Opportunity Scoring Matrix***

| Assessment Risk Rating | Avoid | | | Neutral | | | Promote | | |
|---|---|---|---|---|---|---|---|---|---|
| | Treatment Rank | | | Treatment Rank | | | Treatment Rank | | |
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| Very High (Red) | 3 | 2 | 1 | 10 | 7 | 4 | 15 | 14 | 13 |
| High (Orange) | 6 | 5 | 4 | 10 | 7 | 4 | 12 | 11 | 10 |
| Moderate (Yellow) | 9 | 8 | 7 | 10 | 7 | 4 | 9 | 8 | 7 |
| Low (Green) | 12 | 11 | 10 | 10 | 7 | 4 | 6 | 5 | 4 |
| Very Low (Blue) | 15 | 14 | 13 | 10 | 7 | 4 | 3 | 2 | 1 |

***Table 25 Example for Treatment Opportunity Scoring of an Ecosystem Restoration – Open Forest Treatment***

| Assessment Type | Example Assessment Risk [1] | Rehab MPB Stands | Preliminary Score [2] | Assessment Weight | Treatment Opportunity Score [3] |
|---|---|---|---|---|---|
| Wildfire | Very High (Red) | Promote | 14 | 1.4 | 19.6 |
| Old Seral Stage | High (Orange) | Neutral | 8 | 1.6 | 12.8 |
| Mature + Old Seral Stage | High (Orange) | Avoid | 5 | 1.4 | 7 |
| Streamflow Hazard | Moderate (Yellow) | Neutral | 8 | 1.0 | 8.0 |
| Sedimentation Hazard | Very High (Red) | Avoid | 2 | 1.0 | 2.0 |
| Road Density | High (Orange) | Avoid | 5 | 1.0 | 5.0 |
| Moose Habitat | High (Orange) | Promote | 11 | 1.2 | 13.2 |
| Mule Deer Habitat | Low (Green) | Promote | 5 | 1.2 | 6.0 |
| Marten Habitat | Very Low (Blue) | Avoid | 14 | 1.2 | 16.8 |
| Final Score: | | | | | 90.4 [4] |

*1 - in this example, this column provides the assessment risk for each assessment type*
*2 - in this example, the stand is assessed with a treatment rank 2*
*3 - treatment score is the preliminary score multiplied by assessment weight*
*4 - final Treatment Opportunity score is the sum of all treatment scores*

To simplify the presentation of the final results and correct any imbalances in treatment ranking, the final priority scores were grouped into four equal-area classes that reflect the general treatment priorities: very high, high, moderate, and low.

# 6 Results

The following tables summarize areas for assessment risk, treatment ranking, and priority scoring.

Note that assessment risk areas typically extend over entire project area – or where data exists, whereas the treatment ranking and priority scoring only applies to areas that meet the eligibility criteria for the treatment.

***Table 26 Area Summary of Assessments by Risk Class***

| Assessment Type | Area (ha) by Risk Class | | | | | |
|---|---|---|---|---|---|---|
| | Very Low | Low | Moderate | High | Very High | Total |
| **Wildfire** | **1,457,888** | **1,601,664** | **1,643,171** | **2,997,435** | **350,038** | **8,050,195** |
| 100 Mile House TSA | 204,458 | 274,878 | 282,086 | 439,214 | 2,376 | 1,203,012 |
| Old Horsefly District | 302,552 | 512,389 | 484,053 | 675,447 | 40,370 | 2,014,811 |
| Quesnel TSA | 227,071 | 465,614 | 545,977 | 766,023 | 13,624 | 2,018,310 |
| Williams Lake TSA | 723,807 | 348,783 | 331,055 | 1,116,750 | 293,667 | 2,814,063 |
| **Old Seral** | | **1,900,962** | **680,640** | **902,672** | **4,119,253** | **7,603,527** |
| 100 Mile House TSA | | 134,203 | 139,835 | 191,305 | 759,994 | 1,225,338 |
| Old Horsefly District | | 318,419 | 146,514 | 208,717 | 1,280,972 | 1,954,623 |
| Quesnel TSA | | 693,500 | 153,568 | 321,776 | 871,588 | 2,040,432 |
| Williams Lake TSA | | 754,840 | 240,722 | 180,874 | 1,206,699 | 2,383,134 |
| **Mature+Old Seral** | | **5,727,942** | **482,155** | **477,234** | **916,196** | **7,603,527** |
| 100 Mile House TSA | | 847,263 | 131,741 | 62,048 | 184,287 | 1,225,338 |
| Old Horsefly District | | 1,243,756 | 219,917 | 160,993 | 329,957 | 1,954,623 |
| Quesnel TSA | | 1,655,563 | 45,228 | 100,927 | 238,714 | 2,040,432 |
| Williams Lake TSA | | 1,981,361 | 85,269 | 153,266 | 163,238 | 2,383,134 |
| **Streamflow** | **168,869** | **1,924,883** | **4,946,880** | **747,067** | **4,943** | **7,792,641** |
| 100 Mile House TSA | 118,089 | 459,156 | 535,197 | 54,029 | | 1,166,470 |
| Old Horsefly District | 35,379 | 1,035,210 | 699,265 | 185,615 | 4,943 | 1,960,412 |
| Quesnel TSA | 15,401 | 300,290 | 1,197,134 | 282,793 | | 1,795,619 |
| Williams Lake TSA | | 130,227 | 2,515,283 | 224,630 | | 2,870,140 |
| **Sediment** | **2,556** | **50,679** | **770,119** | **5,281,316** | **1,687,972** | **7,792,641** |
| 100 Mile House TSA | 2,556 | 2,388 | 270,857 | 751,113 | 139,556 | 1,166,470 |
| Old Horsefly District | | 44,012 | 418,594 | 1,011,883 | 485,922 | 1,960,412 |
| Quesnel TSA | | 4,278 | 80,668 | 1,403,162 | 307,510 | 1,795,619 |
| Williams Lake TSA | | | | 2,115,157 | 754,983 | 2,870,140 |
| **Road Density** | **762,496** | **716,314** | **1,776,218** | **2,787,710** | **1,818,848** | **7,861,586** |
| 100 Mile House TSA | 2 | 10,744 | 200,989 | 803,429 | 210,329 | 1,225,493 |
| Old Horsefly District | 161,275 | 138,651 | 315,204 | 758,824 | 626,587 | 2,000,540 |
| Quesnel TSA | 159,040 | 266,556 | 333,183 | 415,828 | 887,403 | 2,062,010 |
| Williams Lake TSA | 442,179 | 300,363 | 926,841 | 809,630 | 94,529 | 2,573,542 |
| **Moose Habitat** | **76,791** | **404,092** | **1,022,024** | **3,792,791** | **2,949,640** | **8,245,339** |
| 100 Mile House TSA | | 2 | 40,129 | 896,103 | 298,139 | 1,234,373 |
| Old Horsefly District | 52,936 | 89,209 | 359,440 | 879,530 | 682,340 | 2,063,454 |
| Quesnel TSA | | 15,698 | 270,208 | 548,538 | 1,242,817 | 2,077,261 |
| Williams Lake TSA | 23,855 | 299,183 | 352,247 | 1,468,620 | 726,344 | 2,870,250 |
| **Mule Deer Habitat** | | | | **661,541** | **50,673** | **712,213** |
| 100 Mile House TSA | | | | 165,400 | 6,886 | 172,287 |
| Old Horsefly District | | | | 357,851 | 13,242 | 371,092 |
| Quesnel TSA | | | | 66,232 | | 66,232 |
| Williams Lake TSA | | | | 72,057 | 30,545 | 102,602 |
| **Marten Habitat** | | **127,528** | **1,936,473** | **2,846,567** | **3,334,771** | **8,245,339** |
| 100 Mile House TSA | | 10,744 | 108,797 | 250,783 | 864,049 | 1,234,373 |
| Old Horsefly District | | 40,859 | 479,523 | 594,158 | 948,915 | 2,063,454 |
| Quesnel TSA | | 3,372 | 299,038 | 685,677 | 1,089,174 | 2,077,261 |
| Williams Lake TSA | | 72,553 | 1,049,115 | 1,315,949 | 432,633 | 2,870,250 |

** Thresholds for each risk class were arbitrarily set to balance the relative area for each class rather than provide critical levels*

***Table 27 Area Summary by Treatment Ranking***

| | Area (ha) by Treatment Rank | | | |
|---|---|---|---|---|
| Treatment | Rank 1 (High) | Rank 2 (Medium) | Rank 3 (Low) | Total |
| **Human / Wildfire Mitigation** | **20,161** | **407,477** | **1,410,223** | **1,837,861** |
| 100 Mile House TSA | 4,447 | 106,305 | 326,096 | 436,848 |

| | | | | |
|---|---|---|---|---|
| Old Horsefly District | 4,850 | 129,015 | 416,539 | 550,404 |
| Quesnel TSA | 6,539 | 69,959 | 330,685 | 407,183 |
| Williams Lake TSA | 4,325 | 102,198 | 336,903 | 443,425 |
| **Ecosystem / Restore Open Forest** | **101,451** | **56,066** | | **157,517** |
| 100 Mile House TSA | 26,487 | 14,850 | | 41,337 |
| Old Horsefly District | 66,738 | 34,376 | | 101,114 |
| Quesnel TSA | 1,042 | 1,289 | | 2,331 |
| Williams Lake TSA | 7,184 | 5,552 | | 12,736 |
| **Ecosystem / Restore Open Range** | **212,057** | **50,240** | | **262,297** |
| 100 Mile House TSA | 79,328 | 17,263 | | 96,590 |
| Old Horsefly District | 88,832 | 17,708 | | 106,540 |
| Quesnel TSA | 341 | 117 | | 458 |
| Williams Lake TSA | 43,556 | 15,152 | | 58,709 |
| **Timber / Rehab Burned Stands** | **417,859** | **151,560** | **671,579** | **1,240,998** |
| 100 Mile House TSA | 69,193 | 29,420 | 52,100 | 150,713 |
| Old Horsefly District | 95,673 | 32,240 | 100,466 | 228,379 |
| Quesnel TSA | 178,081 | 52,970 | 154,695 | 385,746 |
| Williams Lake TSA | 74,912 | 36,931 | 364,317 | 476,160 |
| **Timber / Rehab MPB Stands** | **13,619** | **193,716** | **991,176** | **1,198,512** |
| 100 Mile House TSA | 1,649 | 26,343 | 84,711 | 112,703 |
| Old Horsefly District | 746 | 24,521 | 178,537 | 203,804 |
| Quesnel TSA | 11,101 | 131,161 | 353,051 | 495,313 |
| Williams Lake TSA | 123 | 11,691 | 374,877 | 386,691 |
| **Timber / Fd Stand Enhancement** | | **69,362** | **1,726,596** | **1,795,958** |
| 100 Mile House TSA | | 34,359 | 563,546 | 597,905 |
| Old Horsefly District | | 23,725 | 705,352 | 729,077 |
| Quesnel TSA | | 9,740 | 192,801 | 202,541 |
| Williams Lake TSA | | 1,537 | 264,898 | 266,434 |
| **Timber / Thin Repressed Pine** | **57** | **90,576** | **69,153** | **159,785** |
| 100 Mile House TSA | 35 | 10,661 | 2,610 | 13,307 |
| Old Horsefly District | 22 | 24,997 | 9,650 | 34,668 |
| Quesnel TSA | | 25,296 | 1,635 | 26,931 |
| Williams Lake TSA | | 29,622 | 55,258 | 84,880 |
| **Timber / Enhanced Basic Silv** | **1,720,153** | | | **1,720,153** |
| 100 Mile House TSA | 302,969 | | | 302,969 |
| Old Horsefly District | 641,667 | | | 641,667 |
| Quesnel TSA | 774,636 | | | 774,636 |
| Williams Lake TSA | 880 | | | 880 |
| **Carbon / Reforest After Wildfire** | **67** | **1,710** | **121,417** | **123,194** |
| 100 Mile House TSA | 2 | 260 | 35,424 | 35,686 |
| Old Horsefly District | 43 | 443 | 27,338 | 27,824 |
| Quesnel TSA | 8 | 168 | 8,047 | 8,223 |
| Williams Lake TSA | 14 | 839 | 50,608 | 51,461 |
| **Moose / Reforest After Burn** | **12,513** | **353,968** | **165,433** | **531,915** |
| 100 Mile House TSA | 10,905 | 71,334 | 27,568 | 109,807 |
| Old Horsefly District | 1,555 | 79,708 | 38,265 | 119,528 |
| Quesnel TSA | 35 | 50,575 | 22,359 | 72,969 |
| Williams Lake TSA | 18 | 152,352 | 77,241 | 229,611 |
| **Marten / Reforest After Burn** | **1,434** | **71,399** | **21,533** | **94,366** |
| 100 Mile House TSA | 26 | 15,196 | 3,321 | 18,543 |
| Old Horsefly District | 314 | 17,338 | 5,507 | 23,160 |
| Quesnel TSA | 1,075 | 12,359 | 2,513 | 15,946 |
| Williams Lake TSA | 20 | 26,506 | 10,191 | 36,717 |
| **Mule Deer / Reforest After Burn** | **11,647** | **23,874** | **23,176** | **58,697** |
| 100 Mile House TSA | 3,117 | 3,959 | 2,337 | 9,412 |
| Old Horsefly District | 5,635 | 9,537 | 7,551 | 22,724 |
| Quesnel TSA | 147 | 401 | 117 | 666 |

| | | | | |
|---|---|---|---|---|
| Williams Lake TSA | 2,748 | 9,976 | 13,171 | 25,895 |
| **Mule Deer / Thin MDWR** | **1,678** | **330** | **31,428** | **33,436** |
| 100 Mile House TSA | | | 1,858 | 1,858 |
| Old Horsefly District | 1,210 | 300 | 24,981 | 26,491 |
| Quesnel TSA | 124 | | 1,260 | 1,384 |
| Williams Lake TSA | 344 | 29 | 3,330 | 3,703 |
| **Caribou / Thin Repressed Pine** | **37,248** | | | **37,248** |
| Quesnel TSA | 6,407 | | | 6,407 |
| Williams Lake TSA | 30,841 | | | 30,841 |

***Table 28 Area Summary by Treatment Opportunity***

| | Area (ha) by Treatment Opportunity | | | | |
|---|---|---|---|---|---|
| **Objective / Treatment Opportunity** | **Low** | **Moderate** | **High** | **Very High** | **Total** |
| **Human / Wildfire Mitigation** | **459,427** | **459,669** | **459,548** | **459,217** | **1,837,860** |
| 100 Mile House TSA | 108,528 | 105,960 | 106,442 | 115,917 | 436,848 |
| Old Horsefly District | 141,009 | 160,736 | 95,562 | 153,097 | 550,404 |
| Quesnel TSA | 152,321 | 118,540 | 61,791 | 74,531 | 407,183 |
| Williams Lake TSA | 57,568 | 74,433 | 195,753 | 115,671 | 443,425 |
| **Ecosystem / Restore Open Forest** | **39,392** | **39,391** | **39,391** | **39,343** | **157,517** |
| 100 Mile House TSA | 4,661 | 9,111 | 14,759 | 12,806 | 41,337 |
| Old Horsefly District | 29,811 | 26,916 | 22,241 | 22,146 | 101,114 |
| Quesnel TSA | 1,435 | 666 | 153 | 77 | 2,331 |
| Williams Lake TSA | 3,485 | 2,698 | 2,239 | 4,314 | 12,736 |
| **Ecosystem / Restore Open Range** | **65,609** | **65,575** | **65,588** | **65,525** | **262,296** |
| 100 Mile House TSA | 17,434 | 29,947 | 26,924 | 22,286 | 96,590 |
| Old Horsefly District | 32,959 | 23,784 | 26,474 | 23,323 | 106,540 |
| Quesnel TSA | 377 | 51 | 16 | 14 | 458 |
| Williams Lake TSA | 14,839 | 11,794 | 12,173 | 19,902 | 58,709 |
| **Timber / Rehab Burned Stands** | **303,274** | **313,212** | **312,520** | **311,992** | **1,240,998** |
| 100 Mile House TSA | 47,503 | 11,716 | 54,732 | 36,762 | 150,713 |
| Old Horsefly District | 56,701 | 36,377 | 69,839 | 65,462 | 228,379 |
| Quesnel TSA | 43,373 | 89,551 | 101,650 | 151,172 | 385,746 |
| Williams Lake TSA | 155,697 | 175,567 | 86,299 | 58,596 | 476,160 |
| **Timber / Rehab MPB Stands** | **277,742** | **304,631** | **308,770** | **307,368** | **1,198,511** |
| 100 Mile House TSA | 56,750 | 27,563 | 12,441 | 15,949 | 112,703 |
| Old Horsefly District | 56,196 | 62,800 | 58,304 | 26,504 | 203,804 |
| Quesnel TSA | 101,659 | 112,426 | 106,116 | 175,112 | 495,313 |
| Williams Lake TSA | 63,137 | 101,841 | 131,910 | 89,804 | 386,691 |
| **Timber / Fd Stand Enhancement** | **447,837** | **449,411** | **449,355** | **449,355** | **1,795,958** |
| 100 Mile House TSA | 175,548 | 162,163 | 155,759 | 104,436 | 597,905 |
| Old Horsefly District | 114,710 | 177,616 | 183,331 | 253,420 | 729,077 |
| Quesnel TSA | 63,072 | 52,132 | 49,580 | 37,757 | 202,541 |
| Williams Lake TSA | 94,507 | 57,500 | 60,685 | 53,742 | 266,434 |
| **Timber / Thin Repressed Pine** | **39,579** | **40,137** | **40,124** | **39,946** | **159,785** |
| 100 Mile House TSA | 506 | 2,229 | 5,455 | 5,116 | 13,307 |
| Old Horsefly District | 5,841 | 6,535 | 7,317 | 14,974 | 34,668 |
| Quesnel TSA | 1,772 | 3,287 | 6,983 | 14,889 | 26,931 |
| Williams Lake TSA | 31,459 | 28,086 | 20,368 | 4,966 | 84,880 |
| **Timber / Enhanced Basic Silv** | **430,425** | **429,540** | **430,401** | **429,787** | **1,720,153** |
| 100 Mile House TSA | 40,956 | 113,701 | 98,877 | 49,435 | 302,969 |
| Old Horsefly District | 196,736 | 172,127 | 143,645 | 129,160 | 641,667 |
| Quesnel TSA | 192,733 | 142,956 | 187,755 | 251,192 | 774,636 |
| Williams Lake TSA | | 756 | 124 | | 880 |
| **Carbon / Reforest After Wildfire** | **30,799** | **30,800** | **30,799** | **30,796** | **123,194** |
| 100 Mile House TSA | 6,298 | 19,135 | 5,616 | 4,638 | 35,686 |

| | | | | | |
|---|---|---|---|---|---|
| Old Horsefly District | 6,135 | 3,871 | 10,990 | 6,828 | 27,824 |
| Quesnel TSA | 4,719 | 105 | 2,459 | 939 | 8,223 |
| Williams Lake TSA | 13,648 | 7,689 | 11,734 | 18,390 | 51,461 |
| **Moose / Reforest After Burn** | **133,047** | **134,897** | **133,536** | **130,435** | **531,915** |
| 100 Mile House TSA | 25,074 | 9,741 | 40,680 | 34,313 | 109,807 |
| Old Horsefly District | 29,447 | 38,396 | 25,536 | 26,149 | 119,528 |
| Quesnel TSA | 18,955 | 17,730 | 21,400 | 14,884 | 72,969 |
| Williams Lake TSA | 59,571 | 69,031 | 45,920 | 55,089 | 229,611 |
| **Marten / Reforest After Burn** | **23,592** | **23,594** | **23,592** | **23,588** | **94,366** |
| 100 Mile House TSA | 3,329 | 1,251 | 9,337 | 4,626 | 18,543 |
| Old Horsefly District | 5,750 | 7,027 | 4,896 | 5,487 | 23,160 |
| Quesnel TSA | 3,087 | 4,137 | 2,893 | 5,830 | 15,946 |
| Williams Lake TSA | 11,426 | 11,179 | 6,466 | 7,645 | 36,717 |
| **Mule Deer / Reforest After Burn** | **14,671** | **14,675** | **14,676** | **14,674** | **58,697** |
| 100 Mile House TSA | 3,157 | 1,284 | 2,307 | 2,663 | 9,412 |
| Old Horsefly District | 5,546 | 4,255 | 6,709 | 6,213 | 22,724 |
| Quesnel TSA | 120 | 20 | 197 | 328 | 666 |
| Williams Lake TSA | 5,847 | 9,115 | 5,463 | 5,470 | 25,895 |
| **Mule Deer / Thin MDWR** | **8,457** | **8,363** | **8,377** | **8,239** | **33,436** |
| 100 Mile House TSA | 622 | 619 | 336 | 282 | 1,858 |
| Old Horsefly District | 7,510 | 6,774 | 5,774 | 6,433 | 26,491 |
| Quesnel TSA | 274 | 935 | 3 | 172 | 1,384 |
| Williams Lake TSA | 52 | 35 | 2,264 | 1,352 | 3,703 |
| **Caribou / Thin Repressed Pine** | **9,329** | **9,342** | **9,402** | **9,174** | **37,248** |
| Quesnel TSA | 1,390 | 2,094 | 2,542 | 381 | 6,407 |
| Williams Lake TSA | 7,939 | 7,249 | 6,860 | 8,793 | 30,841 |

** Thresholds for each risk class were arbitrarily set to balance the relative area for each class rather than provide critical levels*

Note that for the Wildfire Mitigation treatment opportunities, the scores used to symbolize the spatial data were modified accordingly: Low = 19.6 to 54.8, Moderate = 54.8 to 62.6, High = 62.6 to 90, Very High = 90 to 124.8. This overrides the equal-area classification to highlight planned fuel treatment opportunities as 'Very High'.

# 7 Discussion and Recommendations

For easier reference, the discussions and recommendations below were grouped into topics and sorted, in the authors' opinion, in priority (highest to lowest).

*Avoided Units*

Section 5 describes how treatments are promoted or avoided based on the assessment risk and treatment ranking are identified for each stand. In most cases, units where treatments are avoided suggest that critical issues exist that should be addressed in a more focused and comprehensive manner. For example, the rationale for avoiding rehabilitation within units with high risk for old seral is high is based on preventing further removal of remaining forest cover removal. Closer examination of this unit is likely required to assess what and where activities might occur, if any, to ameliorate the situation overall.

Recommendation 1 - Identify units where treatments may be curtailed due to the current assessment status and develop landscape-level prescriptions aimed to improve the situation.

*Improving the Approach*

This approach combined multiple datasets from various sources to develop spatially-explicit treatment opportunities. No field verification was conducted but the process was created in such a way that results can be updated as new data comes available.

Improving this landscape-level exercise relies on monitoring the results compared to field evaluations by capturing and summarizing feedback on the treatment priority information provided. Specifically, describing how well or why the results do not align with observations on the ground. Ultimately, this monitoring aims to identify issues with the key elements associated with the approach described above:

- data,
- criteria,
- thresholds,
- treatment application matrix,
- assessment weights, and
- treatment opportunity scoring matrix.

While these elements are available in the resultant dataset, a clear understanding of the approach is required to assess how the approach might be improved – at the very least, by tracking observation points that match the treatment opportunity results with those that do not, along with some anecdotal remarks.

Recommendation 2 - Develop a system that tracks specific information observed in the field as comparison to results from this approach for projecting treatment opportunities.

*Disturbance*

This analysis did not consider planned harvest or very recent harvesting that could affect the treatment ranking. This is particularly critical where salvaging of MPB-Attached and Wildfire-Impacted stands is already being considered. Ideally, this would include blocks that licensees and BC Timber Sales have already assessed and decided not to harvest because there is either sufficient secondary structure or the stand is not economical to harvest.

Recommendation 3 - Include planned and very recent harvesting, as well as, stands assessed as uneconomic and will not be salvaged.

*Treatment Criteria*

For this analysis, only a select set of criteria were used to assign treatment ranking. More appropriate features should be considered that affect a planner's decision to treat one stand over another (e.g., distance to the nearest road, minimum treatment size).

Recommendation 4 - Encourage planners to review the current lists and, where required, suggest more appropriate criteria for treatment ranking.

*Streamflow and Sedimentation Hazard*

Provincial guidance and perspective on hydrological risk following natural disturbance is needed. Hydrological recovery may take longer with natural regeneration but it may be preferred, in certain situations, over harvesting and regenerating stands faster.

Recommendation 5 - Develop best management practices for managing hydrological risk on stands severely impacted by natural disturbance.

*Climate change*

Climate change was not specifically incorporated in the development of the treatment priorities presented here.

From a forest health perspective, climate change adds a great deal of uncertainty about the risks posed by various forest pests – including wildfire. Although it is very difficult to make predictions, there are a number of steps that can be taken to reduce the likelihood of catastrophic pest outbreaks. These can include simple tactics like planting a diversity of tree species over a range of different stand conditions, careful monitoring of changes in forest pests and conditions over time, the careful use of facilitated migration to aid in the migration of species or tree provenances as climate changes, and strict controls to limit the movement and accidental introduction of exotic pests.

*Seral Assessment Out-of-Date*

The seral assessment did not use the latest available data. Both the productive forest land base and leading species groups were defined some years ago and since then, ownership and forest inventory data have been updated. Based on results from similar projects, these updates will likely create significant changes in the assessment results.

Recommendation 6 - Update key landscape-level assessments (e.g., seral, hydrological risk) to reflect improvements made to ownership and forest inventory data.

*Section 108 Blocks*

Under the Forest and Range Practices Act (FRPA), section 108 is a provision where the Government may fund extra expense or waive obligation. Identifying candidate blocks under this section was considered for reforesting stands under a carbon sequestration objective. In some cases, more cost-effective reforestation activities could be carried out by combining funding programs. For instance, a fixed buffer width around these section 108 blocks could be used to identify potential areas to treat as a carbon sequestration project. Unfortunately for this project, the data needed to identify section 108 blocks was not available in time.

Recommendation 7 - Develop an approach to identify candidate blocks where government has accepted the obligation to reforest fire-damaged stands.

*Spotting Potential chart*

While spotting potential was incorporated in the PSTA layer that assessed wildfire threat, a chart was introduced that examined fuel type categories relative to spotting distance and potential. This chart was suggested as an additional criterion for the wildfire mitigation treatment category.

Recommendation 8 - Explore opportunities to refine the wildfire mitigation ranking by considering spotting potential (Dana Hicks).

*Road Rehabilitation Treatment*

Rehabilitating surplus road sections was identified as a potential treatment that could contribute towards meeting both wildlife habitat and carbon sequestration objectives. For this analysis, identification of these road sections requires a classified spatial road network and a critical review of future development opportunities. It was suggested that, for a start, existing 'in-block' roads could be identified as candidate road rehabilitation treatments.

*Enhanced Basic Silviculture*

The current criteria for ranking stands is relatively general. Predictive ecosystem mapping could be used to rank more productive stands higher while excluding other stands from being eligible for this treatment. This approach could also be explored for ranking other treatments.

*Treatment Costs*

Treatment costs were not incorporated in this process to develop treatment priorities. Instead, each treatment was assessed separately so that these results can be used for evaluating proposals submitted under any program or funding mechanism.

*Treatment Size Criteria*

Originally treatment size criteria were considered for ranking treatments but this was abandoned until the initial analysis is completed and implemented. Any and all stands with the appropriate criteria are eligible for treatment. The project team intends revisit this as sufficient feedback is received on the treatment opportunities developed.

# 8 References

BCSC 1996. Cariboo-Chilcotin Biodiversity Conservation Strategy Committee. 1996. Biodiversity Conservation Strategy for the Cariboo-Chilcotin Land Use Plan. Province of British Columbia. Williams Lake. B.C. 120pp, plus appendices. https://www.for.gov.bc.ca/hfd/library/Reg_Bio_Con_Str/bio9.pdf

BCSC 2001-2. Cariboo-Chilcotin Biodiversity Conservation Strategy Committee. 2001. UPDATE NOTE #2: Amalgamation of Small NDT-BEC Units in Relation to Assessment of Seral Objectives and Old Growth Management Area Planning. Province of British Columbia. Williams Lake. B.C. 5pp https://www.for.gov.bc.ca/hfd/library/Reg_Bio_Con_Str/UpdateNote2.pdf

BCSC 2001-3. Cariboo-Chilcotin Biodiversity Conservation Strategy Committee. 2001. UPDATE NOTE #3: Definition of the Fir Group and Pine Group for Purposes of Seral Stage Assessments within NDT 4 of the Cariboo-Chilcotin. Province of British Columbia. Williams Lake. B.C. 6pp https://www.for.gov.bc.ca/hfd/library/Reg_Bio_Con_Str/UpdateNote3.pdf

BCWS 2015. BC Wildfire Service. Provincial Strategic Threat Analysis – 2015 Wildfire Threat Analysis Component. March 4, 2016. 33pg. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/fire-fuel-management/bcws_provincial_strategic_threat_analysis_psta_2015_report.pdf

Dawson et. al. 2015. Dawson, R., R. Hoffos, and M. McGirr. A Broad Scale Cumulative Impact Assessment Framework for the Cariboo-Chilcotin. July 31, 2015. 144pg. https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/ce_assessment_for_cariboo-chilcotin_18_mar_2016.pdf

Forsite 2015. Land Base Analysis to Identify Forest Maintained Ecosystem Restoration Opportunity in B.C., Project 1076-3., Prepared by Forsite Consultants Ltd., Prepared for BC Ministry of Forest, Lands and Natural Resource Operations, Range Branch., April 2015., 38pg.

Walton 2013. Walton, Adrian. Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the Provincial Aerial Overview Surveys of Forest Health conducted from 1999 through 2012 and the BCMPB model (year 10). Victoria, BC: BC Ministry of Forests, Lands and Natural Resource Operations, 2013. https://www.for.gov.bc.ca/ftp/hre/external/!publish/web/bcmpb/year10/BCMPB.v10.BeetleProjection.Update.pdf

Fitzgerald and Bennett 2013. A Land Manager's Guide for Creating Fire-Resistant Forests. Stephen Fitzgerald and Max Bennett. Oregon State University. EM 9087. September 2013. 14pp. https://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/43073/EM9087.pdf

# Appendix 1 Rationale for Treatment Application Matrix

The following table provides a very brief rationale for each combination of treatment and assessment risk (i.e., at higher risk levels). These should not be regarded as the definitive direction for treatments on specific stands but rather as landscape-level guidance. More site-specific criteria may provide different direction – as long as this new rationale is provided.

| Assessment Type | Value / Treatment | Direction | Rationale |
|---|---|---|---|
| Wildfire Risk | Human / Wildfire Mitigation | Promote | Treatment likely reduces risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Promote | Treatment likely reduces ladder fuels that shift ground fires into crown fires |
| | Timber / Rehab Burned Stands | Promote | Treatment likely removes dead trees and increased fuel loading susceptible to fire starts |
| | Timber / Rehab MPB Stands | Promote | Treatment likely involves removing dead trees and increased fuel loading susceptible to fire starts |
| | Timber / Fd Stand Enhancement | Avoid | Treatment likely reduces ladder fuels that shift ground fires into crown fires; promote within Wildland Urban Interface areas but avoid for most stands where this costly investment can be lost |
| | Timber / Thin Repressed Pine | Avoid | Treatment likely reduces ladder fuels that shift ground fires into crown fires; promote within Wildland Urban Interface areas but avoid for most stands where this costly investment can be lost |
| | Timber / Enhanced Basic Silv | Avoid | Treatment likely reduces fire risk where considered; promote deciduous or wider spacing within Wildland Urban Interface areas but avoid for most stands where this costly investment can be lost |
| | Carbon / Reforest After Wildfire | Neutral | Treatment likely achieves desired future stand structure conditions sooner to mitigate wildfire; risk but likelihood of losing this costly investment is higher |
| | Moose / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions to mitigate wildfire risk sooner |
| | Marten / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions to mitigate wildfire risk sooner |
| | Mule Deer / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions to mitigate wildfire risk sooner |
| | Mule Deer / Thin MDWR | Neutral | Treatment likely achieves desired future stand structure conditions to mitigate wildfire risk sooner; but some chance of losing this costly investment compared to another location |
| | Caribou / Thin Habitat Area | Neutral | Treatment likely achieves desired future stand structure conditions to mitigate wildfire risk sooner; but some chance of losing this costly investment compared to another location |
| Old Seral Stage | Human / Wildfire Mitigation | Neutral | Treatment likely changes stand structure away from old seral conditions; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Promote | Treatment likely reduces wildfire risk that, in turn, reduces old seral stands throughout the area |
| | Timber / Rehab Burned Stands | Neutral | Treatment likely shifts stands back to early seral condition that is likely occurring anyway as overstory degrades; natural regeneration is acceptable for many of these stands; must also assess secondary structure |
| | Timber / Rehab MPB Stands | Neutral | Treatment likely shifts stands back to early seral condition that is likely occurring anyway as overstory degrades; natural regeneration is acceptable for many of these stands; must also assess secondary structure |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Thin Repressed Pine | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Moose / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Marten / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |

| Assessment Type | Value / Treatment | Direction | Rationale |
|---|---|---|---|
| | Mule Deer / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Mule Deer / Thin MDWR | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Caribou / Thin Habitat Area | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| Mature + Old Seral Stage | Human / Wildfire Mitigation | Neutral | Treatment likely changes stand structure away from mature and old seral conditions; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Avoid | Treatment likely changes stand structure away from mature and old seral conditions; these mixed-species mature overstory may be all that's left for recruitment |
| | Timber / Rehab Burned Stands | Neutral | Treatment likely shifts stands back to early seral condition but mixed-species mature overstory may be all that's left for recruitment; natural regeneration is acceptable for many of these stands. |
| | Timber / Rehab MPB Stands | Avoid | Treatment likely involves shifting stands back to early seral condition but mixed-species mature overstory may be all that's left for recruitment |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Thin Repressed Pine | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Mule Deer / Reforest After Burn | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Mule Deer / Thin MDWR | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| | Caribou / Thin Habitat Area | Neutral | Treatment likely achieves desired future stand structure conditions a bit sooner; but many years from now |
| Streamflow Hazard | Human / Wildfire Mitigation | Neutral | Treatment likely involves removing some trees that contribute to mitigate streamflow hazard; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Neutral | Treatment likely reduces risk of future large-scale disturbance from wildfire that, in turn, maintains forest cover; but these stands do not typically impact streamflow hazard |
| | Timber / Rehab Burned Stands | Neutral | Treatment likely shifts stands back to early seral condition that is likely occurring anyway as overstory degrades; natural regeneration is acceptable for many of these stands; must also assess secondary structure |
| | Timber / Rehab MPB Stands | Neutral | Treatment likely shifts stands back to early seral condition that is likely occurring anyway as overstory degrades; natural regeneration is acceptable for many of these stands; must also assess secondary structure |
| | Timber / Fd Stand Enhancement | Neutral | Treatment likely reduces risk of future large-scale disturbance from wildfire that, in turn, maintains forest cover; but these stands do not typically impact streamflow hazard |
| | Timber / Thin Repressed Pine | Neutral | Treatment likely reduces risk of future large-scale disturbance from wildfire that, in turn, maintains forest cover; but these stands do not typically impact streamflow hazard |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Mule Deer / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |

| Assessment Type | Value / Treatment | Direction | Rationale |
|---|---|---|---|
| | Mule Deer / Thin MDWR | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Caribou / Thin Habitat Area | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| Sedimentation Hazard | Human / Wildfire Mitigation | Neutral | Treatment likely increases road structures that impact sedimentation hazard; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Neutral | Treatment likely increases road structures that impact sedimentation hazard; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Timber / Rehab Burned Stands | Avoid | Treatment likely increases road structures to access stands |
| | Timber / Rehab MPB Stands | Avoid | Treatment likely increases road structures to access stands |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Thin Repressed Pine | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Mule Deer / Reforest After Burn | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Mule Deer / Thin MDWR | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Caribou / Thin Habitat Area | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| Road Density | Human / Wildfire Mitigation | Neutral | Treatment likely increases road structures that impact sedimentation hazard; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Neutral | Treatment likely increases road structures; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Timber / Rehab Burned Stands | Avoid | Treatment likely increases road structures to access stands |
| | Timber / Rehab MPB Stands | Avoid | Treatment likely increases road structures to access stands |
| | Timber / Fd Stand Enhancement | Neutral | Treatment does not likely affect road density |
| | Timber / Thin Repressed Pine | Neutral | Treatment does not likely affect road density |
| | Timber / Enhanced Basic Silv | Neutral | Treatment does not likely affect road density; but may improve status if combined with road rehabilitation |
| | Carbon / Reforest After Wildfire | Neutral | Treatment may improve road density status if combined with road rehabilitation |
| | Moose / Reforest After Burn | Neutral | Treatment does not likely affect road density |
| | Marten / Reforest After Burn | Neutral | Treatment does not likely affect road density |
| | Mule Deer / Reforest After Burn | Neutral | Treatment may improve road density status if combined with road rehabilitation |
| | Mule Deer / Thin MDWR | Neutral | Treatment may improve road density status if combined with road rehabilitation |
| | Caribou / Thin Habitat Area | Neutral | Treatment may improve road density status if combined with road rehabilitation |
| Moose Habitat Risk | Human / Wildfire Mitigation | Promote | Treatment likely reduces risk of future wildfire that maintains future forest cover |
| | Ecosystem / Restore OR & OF | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| | Timber / Rehab Burned Stands | Promote | Treatment likely shifts stands back to early seral condition that encourages forage opportunities |

| Assessment Type | Value / Treatment | Direction | Rationale |
|---|---|---|---|
| | Timber / Rehab MPB Stands | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely reduces crown closure that encourages forage opportunities |
| | Timber / Thin Repressed Pine | Promote | Treatment likely reduces crown closure that encourages forage opportunities |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Mule Deer / Reforest After Burn | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| | Mule Deer / Thin MDWR | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| | Caribou / Thin Habitat Area | Promote | Treatment likely involves returning stands back to early seral condition that encourages forage opportunities |
| Mule Deer Habitat Risk | Human / Wildfire Mitigation | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Ecosystem / Restore OR & OF | Promote | Treatment likely shifts stands back to early seral condition that encourages forage opportunities |
| | Timber / Rehab Burned Stands | Promote | Treatment likely shifts stands back to early seral condition that encourages forage opportunities |
| | Timber / Rehab MPB Stands | Promote | Treatment likely shifts stands back to early seral condition that encourages forage opportunities |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Timber / Thin Repressed Pine | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Carbon / Reforest After Wildfire | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Mule Deer / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Mule Deer / Thin MDWR | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Caribou / Thin Habitat Area | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| Marten Habitat Risk | Human / Wildfire Mitigation | Neutral | Treatment likely involves removing some conifer trees along riparian streams that contribute to Marten habitat; but this will likely reduce risk of future large-scale disturbance from wildfire |
| | Ecosystem / Restore OR & OF | Neutral | Treatment does not likely affect Marten habitat |
| | Timber / Rehab Burned Stands | Avoid | Treatment likely removes trees along riparian streams that contribute to Marten habitat; can be mitigated |
| | Timber / Rehab MPB Stands | Avoid | Treatment likely involves removing trees along riparian streams that contribute to Marten habitat |
| | Timber / Fd Stand Enhancement | Promote | Treatment likely achieves desired future forest cover opportunities sooner while retaining coarse woody debris |
| | Timber / Thin Repressed Pine | Promote | Treatment likely achieves desired future forest cover opportunities sooner while retaining coarse woody debris |
| | Timber / Enhanced Basic Silv | Promote | Treatment likely achieves desired future stand structure conditions sooner |
| | Carbon / Reforest After Wildfire | Promote | Treatment likely achieves desired future forest cover opportunities sooner |

| Assessment Type | Value / Treatment | Direction | Rationale |
|---|---|---|---|
| | Moose / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner while retaining coarse woody debris |
| | Marten / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner while retaining coarse woody debris |
| | Mule Deer / Reforest After Burn | Promote | Treatment likely achieves desired future forest cover opportunities sooner |
| | Mule Deer / Thin MDWR | Promote | Treatment likely achieves desired future forest cover opportunities sooner while retaining coarse woody debris |
| | Caribou / Thin Habitat Area | Promote | Treatment likely achieves desired future forest cover opportunities sooner |