

BIG WHITE SKI RESORT LTD. WILDFIRE RISK ASSESSMENT AND MANAGEMENT PLAN

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1.0 Background

Big White Ski Resort (BWSR) is located 56km Southeast of Kelowna, BC, in the Kootenay Boundary Regional District of British Columbia. Currently, BWSR is operating within their Controlled Recreation Area (CRA) based on the approved 1999 Master Plan and Master Development Agreement. In 2020, BWSR submitted a proposed amended master plan, which included an expansion to their Controlled Recreation Area. This application for the expansion area was dropped in 2025. The CRA with the location of additional development including new chair lifts, additional ski terrain, expanded real estate, commercial development, and additional trail networks, is shown in [Figure 1](#).

This Wildfire Risk Analysis was initiated as a requirement as part of the BWSR CRA updated Master Plan requirements, as stipulated by BC Mountain Resorts Branch (MRB) and the All-Seasons Resorts Policy (2019). This analysis is a high-level review of available geospatial data sourced from BC provincial databases within the CRA, and in-house geospatial tools to generate an overview of Wildfire Risk. The current CRA is in the Kamloops Fire Centre wildfire management area, Penticton Fire Zone Wildland Urban Interface (WUI) Risk Class 1 – this is the highest relative BC Wildfire Service (BCWS) provincial risk class rating and is primarily based on population and/or structural density and wildfire likelihood, consequences, and risk.

The results of this geospatial analysis within Big White Ski Resort’s current tenure boundaries inform the recommendations for local Wildfire Risk and Wildfire Risk Reduction opportunities.

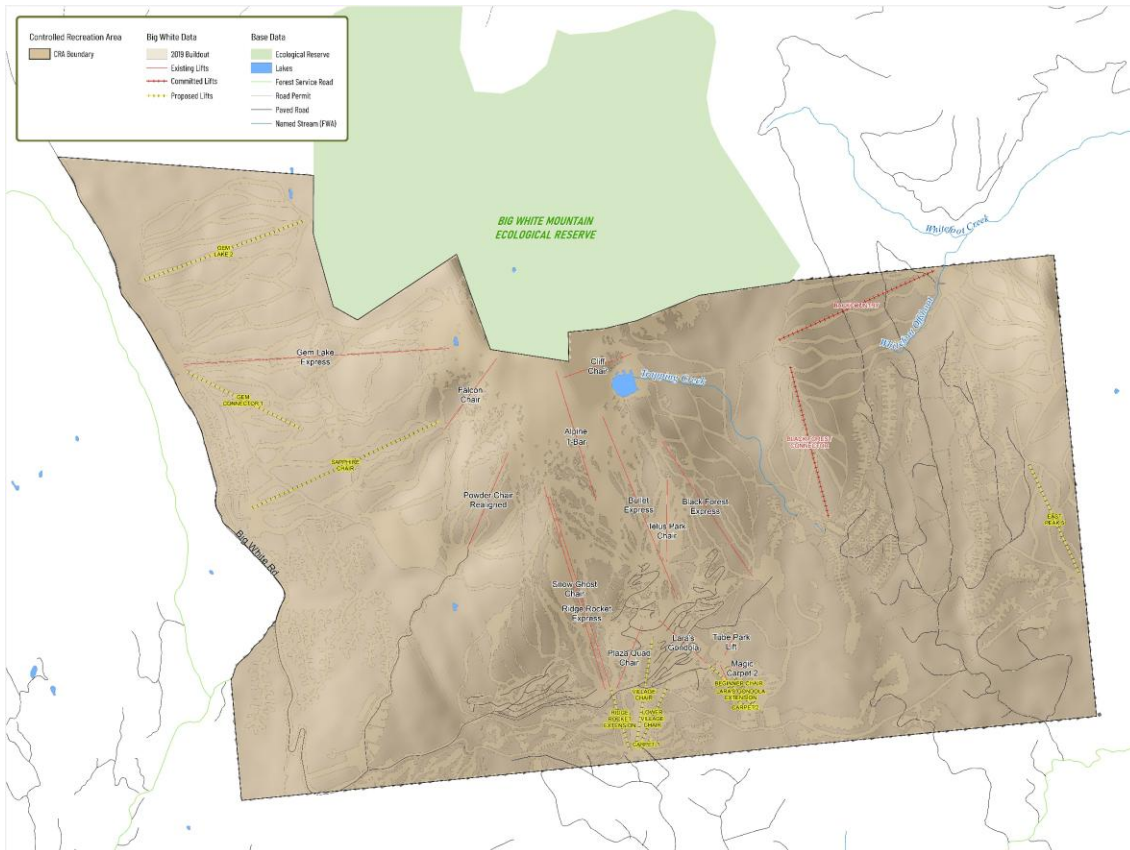


Figure 1. Map of BWSR CRA boundary in tan.

2.0 Wildfire in the Big White Ski Resort

2.1 Overview

The Big White Ski Resort is an all-season Okanagan locale and tourist destination, with a seasonal ‘permanent’ population. It is 56 km East/Southeast from the City of Kelowna, 68 km North of Beaverdell, and 117 km North/northwest from Rock Creek, accessed via Highway 33. The resort sits on the plateau of the Okanagan Highland, intersected by many Indigenous and Government administrative boundaries. Relevant to this study in particular, the resort is within the Westbank First Nation (WFN) Area of Responsibility on the traditional, unceded territory of the Syilx (Okanagan) Nation and peoples. From a broader municipal context, the BWSR is intersected by the Okanagan Shuswap Natural Resource District to the West and Selkirk Natural Resource District to the East. The resort sits on the boundary of the Kamloops and Southeast Fire Centre management zones, straddling the response boundaries of the Penticton and Boundary Fire Zones.

Within the current CRA boundaries there are multiple layers of parcel ownership, ranging from Crown Provincial, Untitled Provincial, Private, Local Government and Unclassified stratifications of the Regional

District of Kootenay Boundary. According to 2021 Statistics Canada Census data, the recorded population and dwelling data indicated 991 fluctuating/seasonal residents (Statistics Canada 2023).

Most of the CRA is within Big White Fire Department Response Jurisdiction. Within their response area, they are responsible for wildfire response, although they can request mutual aid assistance from the BC Wildfire Service. The concept of the BC Wildfire Service dispatching the fire department for initial attack outside of their response area, given the closest and most available resource, has occurred before in areas of the province. These processes are typically handled through the local Zone Wildfire Coordination Officer (ZWCO).

Moving ahead into 2025, the BC Wildfire Service is now encouraging fire departments to enlist on Fire Department Initial Attack (FDIA) crew response (Derby and Chapman 2025). The design of this program is not only to continue to build the structure protection capabilities, but to ensure response times to new wildfire starts are actioned as soon as possible. This program would encourage fire departments to respond to wildfires outside their designated response areas and is to be implemented when the area is experiencing increased fire loads and low resourcing of BC Wildfire personnel (Derby and Chapman 2025).

2.2 BEC Subzones and Natural Disturbance Types (NDTs)

Given the location of the CRA within the Biogeoclimatic Ecosystem Classification (BEC) Zones of Engleman Spruce Subalpine Fir (ESSF), and fringe parts of the Montane Spruce (MS) zones, the resort is located within the Interior-Subalpine Fire Weather Zone. The Interior-Subalpine Fire Weather Zone establishes fire ecology regimes of infrequent high-severity wildfire, as these zones are high elevation and usually cooler or wetter than dry belt zones (BC Wildfire Service). Generally, the fire return interval for ESSF stands range from approximately 200 to 400 years, whilst in drier lower elevation MS zones, a fire return interval of 15.5 to 77.5 years on average has been modelled in southeast BC forests of the MSdk subzone (Daniels and Cochrane 2007; Daniels, Gedalof, et al. 2011).

The Big White Ski Resort falls into several BEC variants; ESSFdc1, ESSFdc2, ESSFdcw, ESSFdcp ESSFmh, , and MSdm1 (Figure 2). The primary stand characteristics and composition are usually trees with lowered Crown Base Height (CBH), species such as Engleman spruce (*Picea engelmannii*) and Subalpine fir (*Abies lasiocarpa*). The lower CBH (increased ladder fuels) and volatile resin stores of these species can lead to a catastrophic wildfire event given the overall susceptibility to crown fire behaviour.

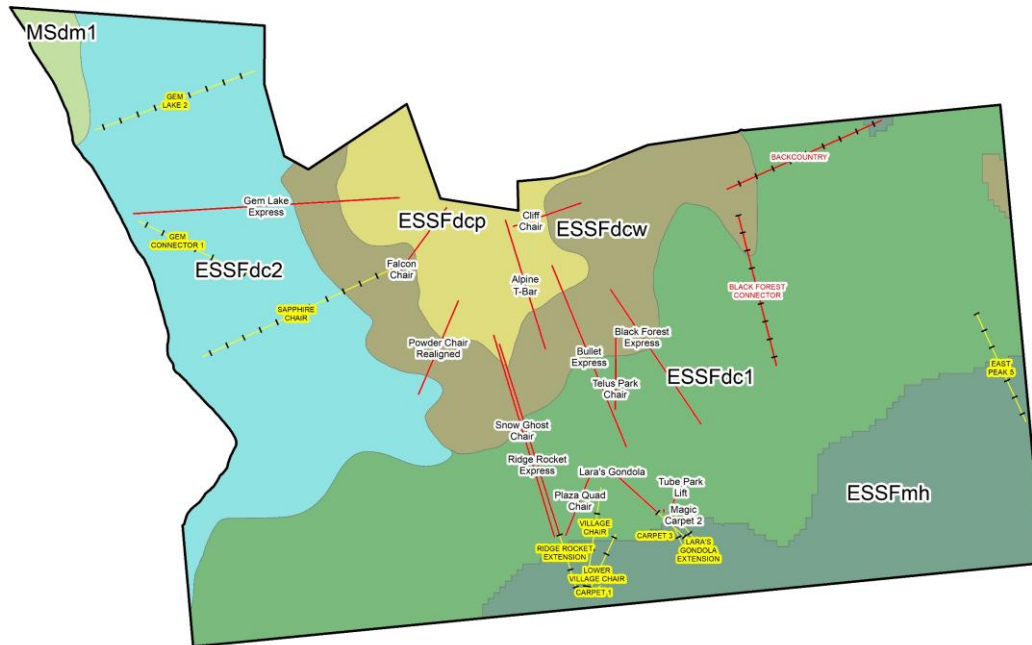


Figure 2. Map showing the location of the BEC Zones across the Big White Ski Resort Controlled Recreation Area.

Each associated BEC zone within the province has a linked and related Natural Disturbance Type (NDT), that generalizes the anticipated disturbance regime and response of the ecosystem (Table 1). They are not static, and with increasing wildfire returns because of climate change, we are seeing successional theories being tested in certain BEC zones in the province. It is important to recognize these influences on the forested ecosystem as wildfire ecology evolves and prevention initiatives, such as fuel management tactics, are employed (Parisien et al. 2023).

Overall, the Big White Ski area has a regime classification of NDT 2 - infrequent stand-initiating events. Therefore, most of the area is not fire-adapted and given the typical climatic conditions, sees far less frequent wildfire events (Table 1). However, in an era of climate crisis, we are seeing a migration of wildfire behaviour and typical ecological cycles expand and change, much like we see the BEC Zones shifting in the next 100-years. As a result, increased forest health stressors and wildfire risk expand higher into the alpine, thus NDT classifications must be supplemented with local knowledge. In some areas of the North Okanagan, it is expected that by the year 2070, an overall increase of 4°C and an 11% decrease in precipitation will increase fire frequency by 30% and an associated increase in wildfire severity of up to 95% (Nitschke and Innes 2008).

Table 1. BEC subzones/variants and corresponding Natural Disturbance Types (NDT) within the Big White Ski Area.

BEC subzone/variant	Natural Disturbance Type (NDT)
ESSF dcw	NDT2 - Infrequent stand-initiating events
ESSF dcp	NDT5 - Alpine tundra and subalpine parkland
ESSF dc1	NDT2 - Infrequent stand-initiating events
ESSF dc2	NDT3 - Frequent stand-initiating events
ESSF mh	NDT2 - Infrequent stand-initiating events
MS dm1	NDT3 - Frequent stand-initiating events

2.3 Stand Types in the CRA

It should be noted that the Fire Behaviour Prediction (FBP) system classifies fuels by related species such as “C-7 Ponderosa Pine-Douglas-Fir”. However, it should be cautioned that to accurately fuel type a stand, stand characteristics must be considered first, not the species of the stand itself. For example, the C-7 fuel type has been applied in some areas of the Big White CRA, however, the stand’s species composition does not include either Ponderosa pine (*Pinus ponderosa*) or Douglas-fir (*Pseudotsuga menziesii*).

According to the FBP fuel types, most of the CRA is composed of C-3 Mature Jack or Lodgepole Pine stand type (Figure 3).

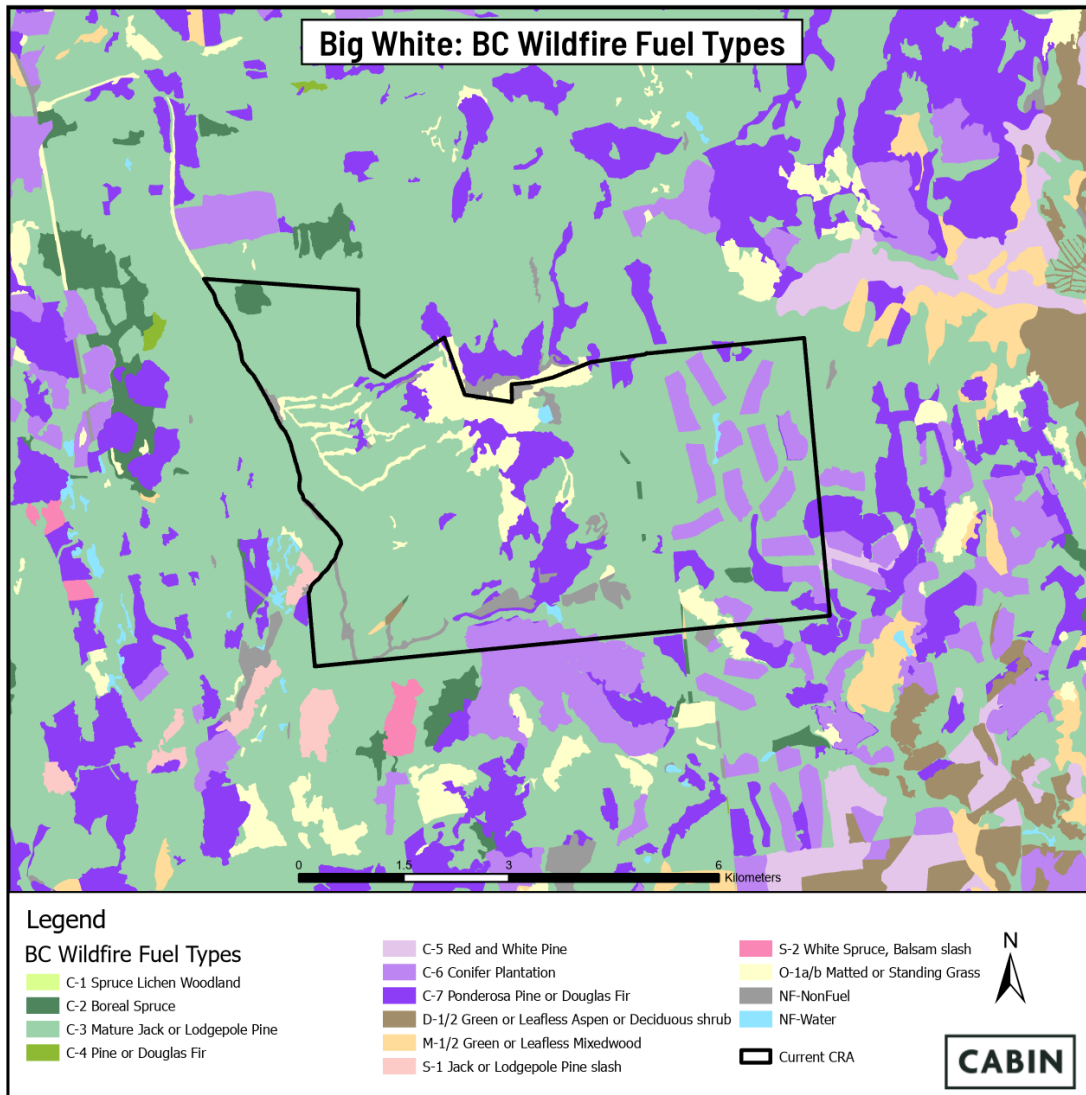


Figure 3. Map of BC Wildfire fuel types within the Big White Ski Area and surrounding region.

The following FBP fuel types are found within the Big White CRA, along with a brief description outlining the fuel type and how it can be defined locally and by the FBP system (NRC 2019):

C-2 Boreal Spruce

The C-2 fuel type consists of pure, moderately well-stocked black spruce stands typically found on lowland (excluding bogs) and upland sites. These trees often have crowns extending to near the ground, with dead lower branches draped in flammable lichens. The forest floor is blanketed by a thick carpet of feather moss and ground lichens over a deep (>20 cm) compact organic layer. This vertical continuity of fuel from the mossy ground to the crown is a hallmark of boreal spruce stands.

C-3 Mature Jack or Lodgepole Pine

C-3 fuel types are mature jack pine or lodgepole pine stands that have reached full crown closure. Stocking is high (approximately 1,000–2,000 stems per hectare), forming a continuous pine canopy. Unlike C-2, the base of the live tree crowns in C-3 stands is well above the ground, often with a noticeable gap between the surface and lower foliage. Surface fuels consist of light, scattered dead woody debris and a feather moss or pine needle litter layer over a moderately deep organic mat (~10 cm). There may be a sparse conifer understory, but undergrowth is generally limited in these closed-canopy pine forests.

C-4 Immature Jack or Lodgepole Pine

C-4 fuels are dense immature pine stands, often the result of regeneration after logging or wildfire. These young jack or lodgepole pine stands can reach an extremely high density (10,000–30,000 stems/ha). The trees are typically smaller in diameter and their crowns extend close to the ground. Natural thinning (self-pruning and mortality) in these dense stands leads to abundant standing dead stems and a substantial accumulation of dead downed woody material. Vertical and horizontal fuel continuity is a defining characteristic: the tightly packed live pines, intermingled with dead stems and low branches, create a continuous fuel complex from the forest floor through to the canopy. Surface fuel loads (needles, twigs, and debris) are higher than in mature pine stands, often with needles caught in low shrubs or suspended on the dense understory vegetation.

C-5 Red and White Pine

C-5 fuel types are mature Eastern pine stands, typically composed of red pine (*Pinus resinosa*) and eastern white pine (*Pinus strobus*) in various mixes. These stands usually have a somewhat open canopy of large pines with moderate undergrowth. Small components of other species can be present. For example, scattered white spruce or veteran birch/aspens might be found in the mix. The understory in C-5 tends to be patchy: it often includes shade-tolerant hardwoods (like maples) or conifer saplings (such as balsam fir) in moderate densities. A shrub layer (e.g., hazel or other deciduous shrubs) may also be present. The forest floor is covered by a combination of pine needle litter and herbs, with a relatively thin organic layer.

C-6 Conifer Plantation

The C-6 fuel type refers to plantations of coniferous trees (often pine or spruce) that are fully stocked and have grown to form closed canopies. These are typically even-aged, human-planted stands. In a C-6 plantation, trees are usually planted at regular spacing and due to silviculture practices, there is little to no deciduous understory or shrub layer (competing vegetation is often removed to encourage crop trees). The result is a uniform stand of conifers with similar height and crown structure. The forest floor is covered primarily by shed needles forming a continuous litter layer, underlain by a shallow duff (up to ~10 cm).

C-7 Ponderosa Pine/Douglas-fir

These stands are usually uneven-aged with a mix of large veteran trees and younger cohorts, and they generally have an open park-like structure. Canopy closure overall is less than 50%. In essence, the fuels are discontinuous: you might find a dense patch of fir regeneration surrounded by broad areas of grassy or sparsely treed ground. The surface fuels reflect this structure. Outside of the thickets, the forest floor is often dominated by grasses, herbs, and scattered shrubs, with a very thin duff layer (often <3 cm) due to frequent historical fires. Within the denser fir patches, you'll find more needle litter accumulation, but those patches are relatively limited in area. Coarse woody debris is light; frequent low-intensity fires in the past kept these fuels minimal. Overall, C-7 is characterized by low fuel load in the open areas and higher fuel load in isolated pockets of regeneration, creating a variable fuel mosaic.

O-1a Matted Grass/O-1b Standing Grass

O-1 fuel type represents open grass fuels, like rangelands, hay fields, roadside grass verges, and natural meadows. The subdivision into O-1a and O-1b reflects the condition of the grass: O-1a is matted grass (often found in early spring right after snowmelt, when last year's dead grass lies flat), and O-1b is standing grass (typically in late summer and early fall, after the grass has grown tall and then cured). In terms of fuel, grasses provide a continuous fine fuel layer that can cover large areas with virtually no gaps. The fuel load is usually not heavy per unit area (maybe on the order of 0.5 to 3 tonnes/ha of dry material, depending on grass productivity), but it is nearly 100% cured (dead) by the end of the growing season and is extremely exposed to wind and sun.

D-1/2 Leafless/Leafed Aspen

D-1/2 fuels are pure deciduous stands, predominantly trembling aspen in this region (often with minor components of birch or other deciduous shrubs). D-1 refers to the condition when these stands have no leaves (e.g., early spring before bud break, or in late fall after leaf drop), and D-2 when they are in full leaf (summer). Structurally, these aspen stands are usually middle-aged ("semimature"), often with tree heights of 15-25 m and without a significant conifer presence. A notable feature is the absence of conifer understory.

M-1 Boreal Mixedwood-Leafless/M-2 Boreal Mixedwood-Green

M-1/2 refers to boreal mixedwood stands, which in this region are mixed forests containing both conifers (such as spruce, subalpine fir, or pine) and deciduous broadleaf trees (typically trembling aspen or paper birch). "M-1" is the classification when these stands are leafless (in spring or fall), and "M-2" when they are in full leaf (summer) – structurally, they are the same stand, just at different seasons. These stands can vary widely in their exact makeup and structure.

N (non-fuel)

"N" (Non-fuel) refers to areas that are not expected to burn under normal wildfire conditions. These include bodies of water (lakes, rivers), exposed rock or very sparsely vegetated ground, permanent snow/ice (at high elevation), and human-made non-flammable surfaces (e.g., roads, large gravel pits, cultivated fields at certain times).

2.4 Wildfire History

Big White has experienced a relatively low amount of severe wildfire event interactions relative to the surrounding Okanagan area (Figure 4). There have been only a few sustained action wildfires documented within the Big White Ski area. There have been 27 wildfires that have occurred within or adjacent to the CRA since 1936. Among these ignitions, approximately 80% of the wildfires were caused by lightning.

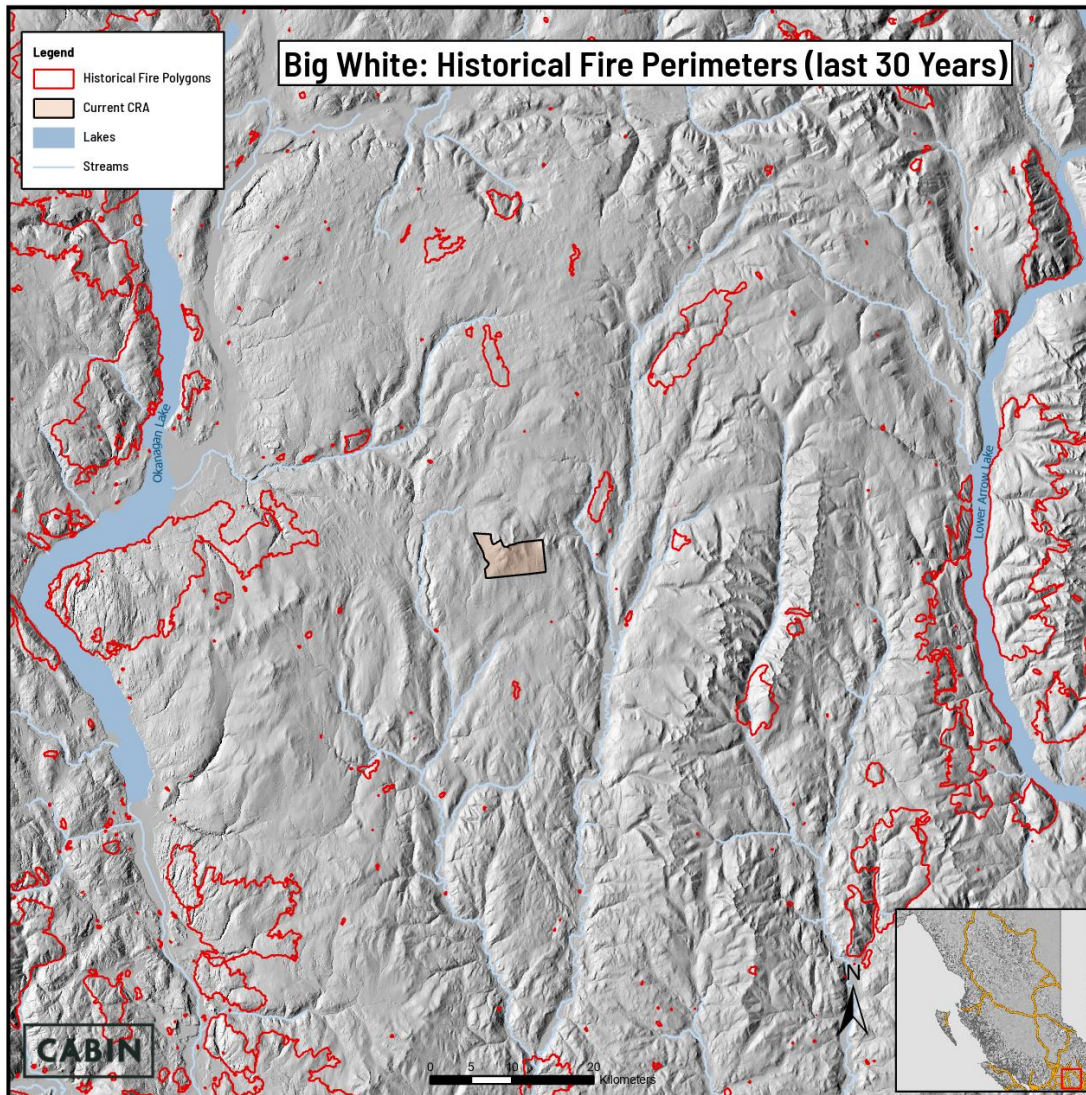


Figure 4. Map of historical wildfire perimeters from the last 30 years surrounding the Big White Ski Area. Red polygons indicate past fire events, highlighting wildfire frequency and proximity to CRA.

In 1936, a human-caused wildfire (1936) burned within the eastern area of the ski area. The wildfire consumed approximately 1,739 hectares. In 1960, the N00354 wildfire impacted the forest to the northeast of the CRA boundary, determined to be lightning-caused, and the blaze affected 136 hectares. The latest larger wildfire impacting CRA boundaries was in 1970, located in the northwest of the resort along the access road labelled KF2116. This wildfire was human-caused and consumed approximately 57 hectares that burned through the Big White Road corridor.

3.0 Current Wildfire Risk

The wildfire threat classification for the CRA boundaries is high to extreme. When referring to the Provincial Strategic Threat Analysis (PSTA) threat classification outputs for the CRA, approximately 74% of the total area falls within the “Extreme” threat class (Table 2).

The PSTA threat classes are comprised of three main inputs of Head Fire Intensity (HFI), fire density, and spotting impact. These inputs are weighted at 60% HFI, 30% fire density, and 10% spotting impact, all together creating a threat class. It should be noted that there are accuracy limitations to the PSTA layers, as the program implemented both the BC Vegetated Resources Inventory (VRI) and the federal Fire Behaviour Prediction (FBP) fuel typing with little verification (PSTA 2017). Given the provincial scope of the PSTA process, it accentuates the importance of applying localized wildfire risk assessments that incorporate verified fuel typing and stand conditions.

Table 2. Percentage of land area within each PSTA Fire Threat Class across the Controlled Recreation Area (CRA) for the Big White Ski Area.

PSTA Fire Threat Class	CRA Area
Low	1%
Moderate	3%
High	4%
Extreme	38%
Water	0%
No Data (Private Land)	2%
Grand Total	49%

When reviewing fire weather inputs for the Big White CRA, the typical inputs into the FBP system are those of the similar Canadian Fire Weather Index System (FWI). When wildfire risk is assessed, wind is one of the most important inputs; however, precipitation and humidity are also important factors to look at. Investigating the climatic trends for the Big White area is vital in understanding future wildfire risk, as well as other disturbances such as forest health factors.

The Hot-Dry-Windy (HDW) Index is a meteorological tool used to assess the probability of extreme wildfire burning conditions. The HDW value itself integrates temperature, low relative humidity or more precisely a higher Vapour Pressure Deficit (indicating dry conditions), and strong wind speeds into a single value. Similarly to the FWI value in Canada, the higher the value, the greater potential there is for a wildfire to rapidly spread. The USDA has created a tool that can create an output for daily and 30-year trends in climatology (Charney et al. 2013). An assessment was done for the latitude and longitude of the Big White Ski Resort to assess the 30-year average trend of the HDW Index over a year by month. The Climate Forecast System Reanalysis (CFSR) was represented on the x-axis as the year by month (January to December). While the y-axis shows the HDW percentile ranges (>95th, 90th, 75th, 50th, and 25th percentile values) (Figure 5). This information shows that consistently, the Big White CRA has seen the most extreme burning conditions during the months of Mid-July to Mid-September (Charney et al. 2013)

1981-2010 CFSR Climatology 49.5°N, 118.5°W

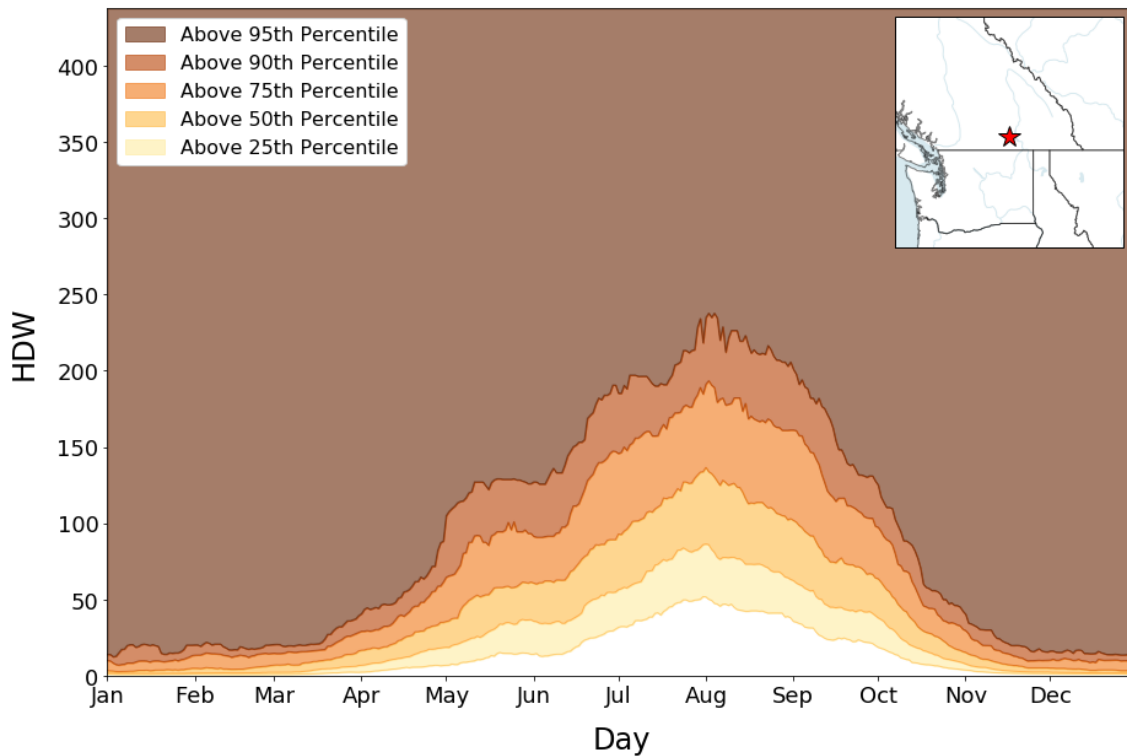
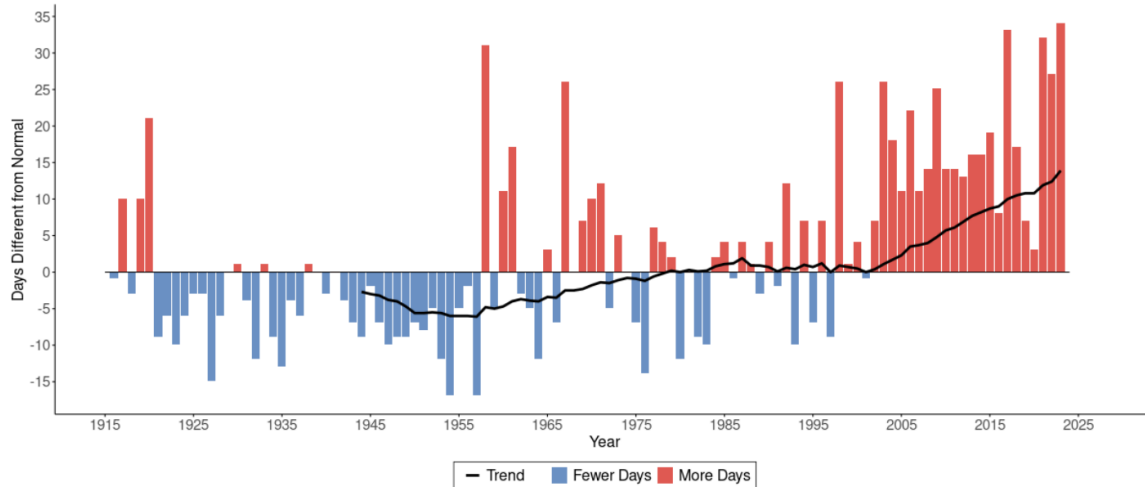


Figure 5. Hot-Dry-Windy (HDW) index percentiles from the 1981-2010 CFSR climatology at 49.5°N, 118.5°W. Peak fire weather conditions typically occur from early July through late August, with values above the 75th percentile indicating elevated wildfire potential.

3.5 Climate Change and Cumulative Impacts on Wildfire Hazard

Wind, precipitation, and temperature are the main factors that influence wildfire hazard at the surface fuel level. Changes in climatic conditions lead to corresponding adjustments in the numerical values used for wildfire behaviour modelling. With climate change contributing to higher temperatures, longer growing seasons, and less precipitation, the emergence of cyclical wildfire interactions poses a significant societal threat.

Climate scientists have observed an obvious warming trend in the Okanagan Valley, experiencing hotter-than-normal summers and warmer annual temperatures (Figure 6). Increases in temperature assists in fuel drying, susceptibility of ignition, as well as overall convective action within the atmosphere, creating increased lightning potential, propagating the wildfire problem. This feedback loop creates more vulnerability to communities within the Okanagan to wildfire season threats and the duration of seasons (Schira 2024).



Trend is calculated by taking a rolling average of the preceding 30 years.

Figure 6. Days with a maximum temperature over 30 °C in Vernon, BC (1951 – 1980), compared to the historical average of 17.9 days (Schira 2024).

Since about 2010, the Kelowna and surrounding Okanagan area has seen a considerable shift towards drier conditions based on the median precipitation amounts from 1951 to 1980 (Figure 7). There are substantial precipitation deficits, which show a departure from the previous normal, which is only compounded when we look at the rise in temperature, particularly from a wildfire behaviour perspective. When we receive lower than normal precipitation amounts, there is increased flammability of fuels and indicators for wildfire seasons with greater intensity and duration (Schira 2024). Higher Drought Codes lead to more severe and intense fires, which also destabilizes the root integrity of standing trees and can lead to increased overhead hazard risks. This may be especially important for upholding mountain resort safety.

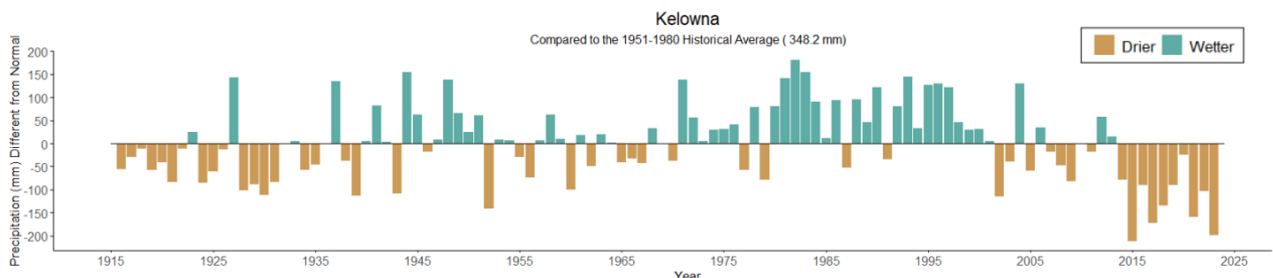


Figure 7. Precipitation amounts from 1915 to 2025 for Kelowna; compared to the historical annual average of 348.2mm from 1951 – 1980 (Schira 2024).

3.6 Relevant Plans and Previous Wildfire Reduction Efforts

The following table is a synopsis of fuel treatments, overlapping relevant plans, and FESBC initiatives related to the BWSR CRA (Table 3).

Table 3. Summary of overhead plans in effect for the Big White CRA and amendments of relevance to the area.

Fuel treatment, Plan, Initiative	Summary	Relevance
Regional District of Kootenay Boundary Electoral Area 'E' – West Boundary CWRP 2023 (Low 2023)	Big White Ski Resort is located within the Regional District of Kootenay-Boundary (RDKB) Electoral Area 'E'. This plan builds on the previous CWPP for the area with the goal of supporting the various communities within the RDKB to achieve a consistent, comprehensive approach towards wildfire risk reduction and resiliency.	Explicitly included in the plan as an Area of Interest (AOI). Addressing population fluctuation of community and fire department resources.
FESBC Fuel Treatment 2021 (FESBC)	~100 ha of WRR completed at Big White Ski Resort. Also increases access for future fire suppression activities and follows recommendations from the 2010 Big White Resort CWPP.	Areas to be re-addressed in future for monitoring and vegetation response.
Land Use Operational Policy All-Seasons Resort – Ministry of Forests 2019 (FLNRORD 2019)	The Ministry of Forests Land Use Operational Policy applies to All-Seasons Resort development projects that take place on Crown upland and/or aquatic land, including Alpine Ski Resorts. Big White Ski Resort falls under a CRA	Addresses use of funds toward reducing wildfire risks through mitigation efforts across all-season resorts across BC.
Big White Ski Resort Master Plan Modification 2018 (BHA 2018)	This 2018 plan builds on the previous approved 1999 Big White Ski Resort Master Plan for the development of two new chairs within Big White's Controlled Recreation Area (CRA). This plan outlines the planned development, potential impacts and implications of the development.	Increasing wildfire risk footprint of the resort area by additional values at risk and ignition likelihood.

<p>2010 Big White Resort Wildfire Protection Plan (Davies et al. 2010)</p>	<p>A wildfire risk analysis was completed for the resort and fuel treatment units were developed as a result. These have since been implemented at Big White Ski Resort. FireSmart principles were also identified and recommended as an important practice to help mitigate wildfire hazard around homes and structures.</p>	<p>Areas to be re-addressed in future for monitoring and vegetation response.</p>
<p>Big White Official Community Plan Bylaw No. 1125 (RDKB 2001)</p>	<p>Big White’s Official Community Plan (OCP) is intended as a guide to help make decisions involving the physical, economic and social development of the plan area. It identifies community goals which have been adopted by the Regional District of Big White and the policies which must be followed to achieve these goals.</p>	<p>The process for revising this plan began in the winter of 2023 but is still in the draft phase and not yet presented to the public.</p>

Fuel Management Prescriptions (FMPs) have been completed throughout the Big White Ski Resort BWSR Area as seen in [Figure 8](#). These are in varying levels of completeness throughout the base area and resort infrastructure, hosting various objectives of stand management or removal targets ([Figure 8](#)). These prescriptions were precipitous by funding or directed objectives through above-listed overhead plans, organizations, and funding bodies seen in [Table 3](#).

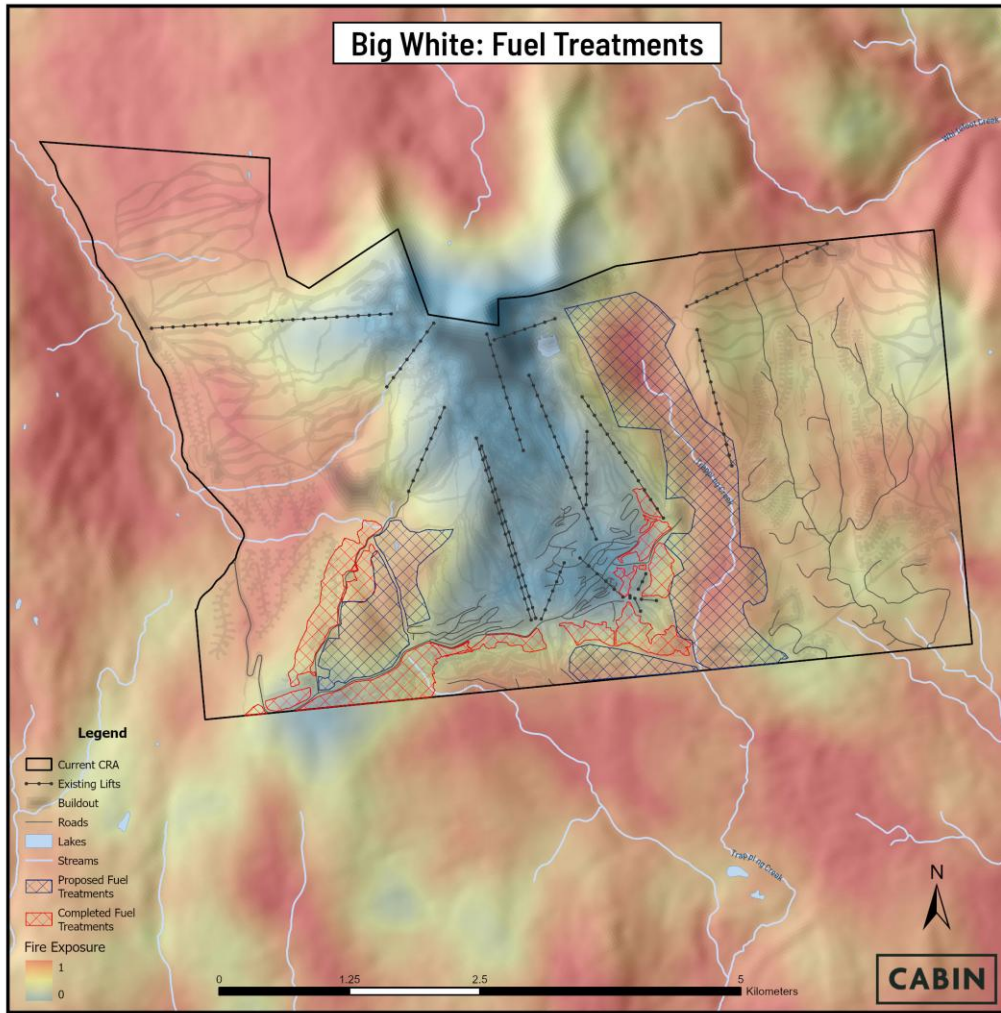


Figure 8. Overview of completed and proposed fuel management prescriptions within the Big White CRA.

4.0 Wildfire Risk Assessment and Analysis

In 2022 Blackwell Consulting Ltd (previously B. A. Blackwell and Associates Ltd. was retained by British Columbia Wildfire Service (BCWS) to “develop a pilot landscape level wildfire risk assessment framework to serve as a decision support tool with the overarching objective of effective collaboration...sets clear guidance and well-defined [metrics] (Blackwell, 2023)”. The basis for this approach is outlined in Beverly et al. (2021). This paper, titled “A simple metric for landscape fire exposure,” outlines a simplified method for determining wildfire likelihood. The location of hazardous and non-hazardous fuel types will either enable or constrain the spread of wildfire. A metric was developed – fire exposure – based solely on the location of a hazardous fuel raster to the value at risk. This metric is easily quantified into a single numerical rating of the potential for wildfire transmission to a location (e.g. value at risk) given the surrounding fuel types, irrespective of fire weather indices, weather, historic ignitions, or suppression capabilities (e.g. proximity to roads and air tanker support)(.).

Wildfire likelihood is a pragmatic, screening-level risk approach we adapted from Blackwell. Beverly et al (2021) exposure-pathway method maps potential fire trajectories without explicitly modelling wind or ignitions; our approach adds both. Wildfire likelihood is treated probabilistically by combining fuel burn potential with areas where the Initial Spread Index (ISI) is consistently high. Exposure transects then identify all plausible pathways to each AOI without heavy modelling. Ideally, clients can provide smaller, more refined AOIs so we can develop trajectory transects at appropriate locations. Because this enumerates possibilities rather than relying solely on predictive models, it provides broad coverage. When treating every trajectory is cost-prohibitive, we prioritize those with a higher likelihood and the prevailing wind directions.

This approach does diverge from traditional probabilistic risk analyses that incorporate these components as outlined in ISO 31000 Principles for Risk Management. This model focuses on exposure rather than modelling likelihood and incorporates other aspects of fire controls, i.e. historic fire ignitions, topography, fire weather indices, and suppression controls. This is a relatively new method that Cabin, in collaboration with Blackwell, BCWS and DMH WRR staff, used in analyzing the wildfire risk for the 100 Mile House Natural Resource District.

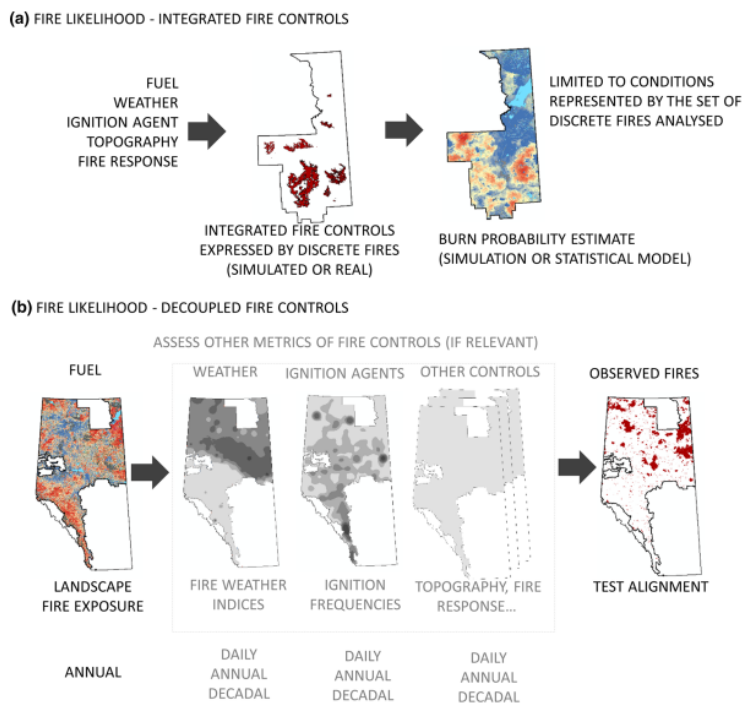


Figure 9. This diagram shows the conceptual contribution of the exposure metric to wildfire risk analyses a) the historic probabilistic modelling is limited in the conditions set by the models (number of runs, model inputs, fire weather inputs, etc.); whereas b) the fire exposure decouples metrics and can be used as a standalone or in combination with other fire controls. (taken from Beverly et al. (2021)).

4.7 Overview

The risk assessment begins by quantifying wildfire likelihood using two primary data layers: historical fire-weather intensity (Initial Spread Index occurrences) and mapped fuel hazard exposure. Each of these raster layers is first normalized to a uniform scale from 1 to 100 so that differences in units and ranges do not bias the outcome. The normalized Initial Spread Index (ISI) layer and the normalized fuel-hazard layer are then averaged with equal weight (50 percent each) to produce a composite Likelihood index. By applying the same normalization procedure to both inputs, the model ensures that neither historical fire behaviour nor present fuel conditions dominate the likelihood estimate.

Potential consequences (Values-at-Risk) are quantified using three inputs: structure density, proximity to evacuation corridors (egress buffers), and the presence of other important infrastructure (e.g., ski lifts). Each input is normalized from 1 to 100, then combined using weighted coefficients that reflect relative importance. Structure density carries a weight of 60 percent because buildings represent the greatest economic and safety exposure. Evacuation buffer proximity carries a weight of 30 percent to emphasize life-safety priorities, and lift infrastructure carries a weight of 10 percent to account for tourism and recreation value. The resulting weighted sum produces a single Consequences index that is again normalized to 1-100. Finally, the normalized Likelihood and normalized Consequences indices are averaged with equal weight (50 percent each) to produce a final risk score from 1 to 100. In this way, locations rank highest only if they are both likely to burn and contain assets or evacuation needs that would face the

greatest loss. See [Figure 10](#) for a schematic of how these inputs and weightings combine to produce the final wildfire risk score.

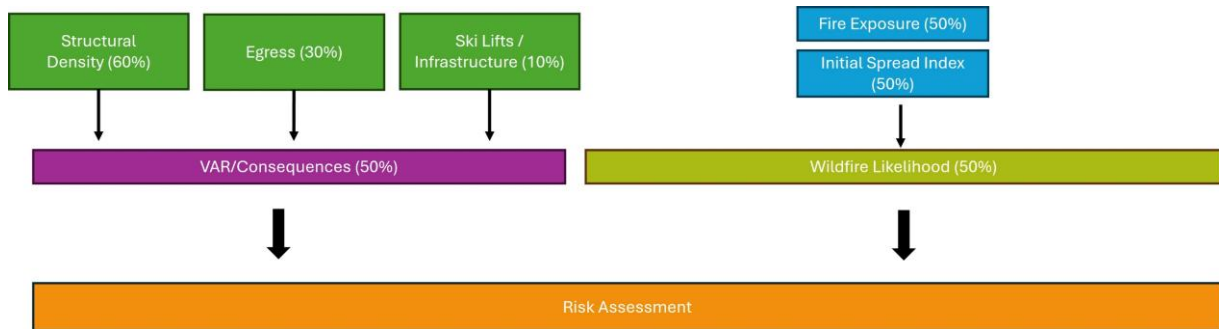


Figure 10. Final Risk combines wildfire Likelihood (50% ISI, 50% Fuel Exposure) with Consequences (60% Structure Density, 30% Egress Buffer, 10% Lifts) using equal weights.

4.8 Wildfire Risk Assessment

Hazardous fuel mapping begins by classifying the landscape into two categories: “hazardous” (fuel types capable of carrying crown or surface fire) and “non-hazardous” (fuel types unlikely to sustain significant fire spread). To achieve this, we leverage Sentinel 2 multispectral satellite imagery and a machine learning classification approach. Training samples drawn from known fuel observations paired with Sentinel 2 bands (including visible, near infrared, and shortwave infrared) and derived indices allow the model to differentiate hazardous versus non-hazardous vegetation at ten-meter resolution. This workflow yields a much finer spatial product than the provincially maintained BC Wildfire Fuels layer, which frequently lags behind in current status and lacks detail in complex terrain. The resulting high-resolution fuel raster (see [Figure 11](#)) therefore reflects current on-the-ground conditions with greater spatial accuracy and is updated more rapidly as new Sentinel 2 scenes become available.

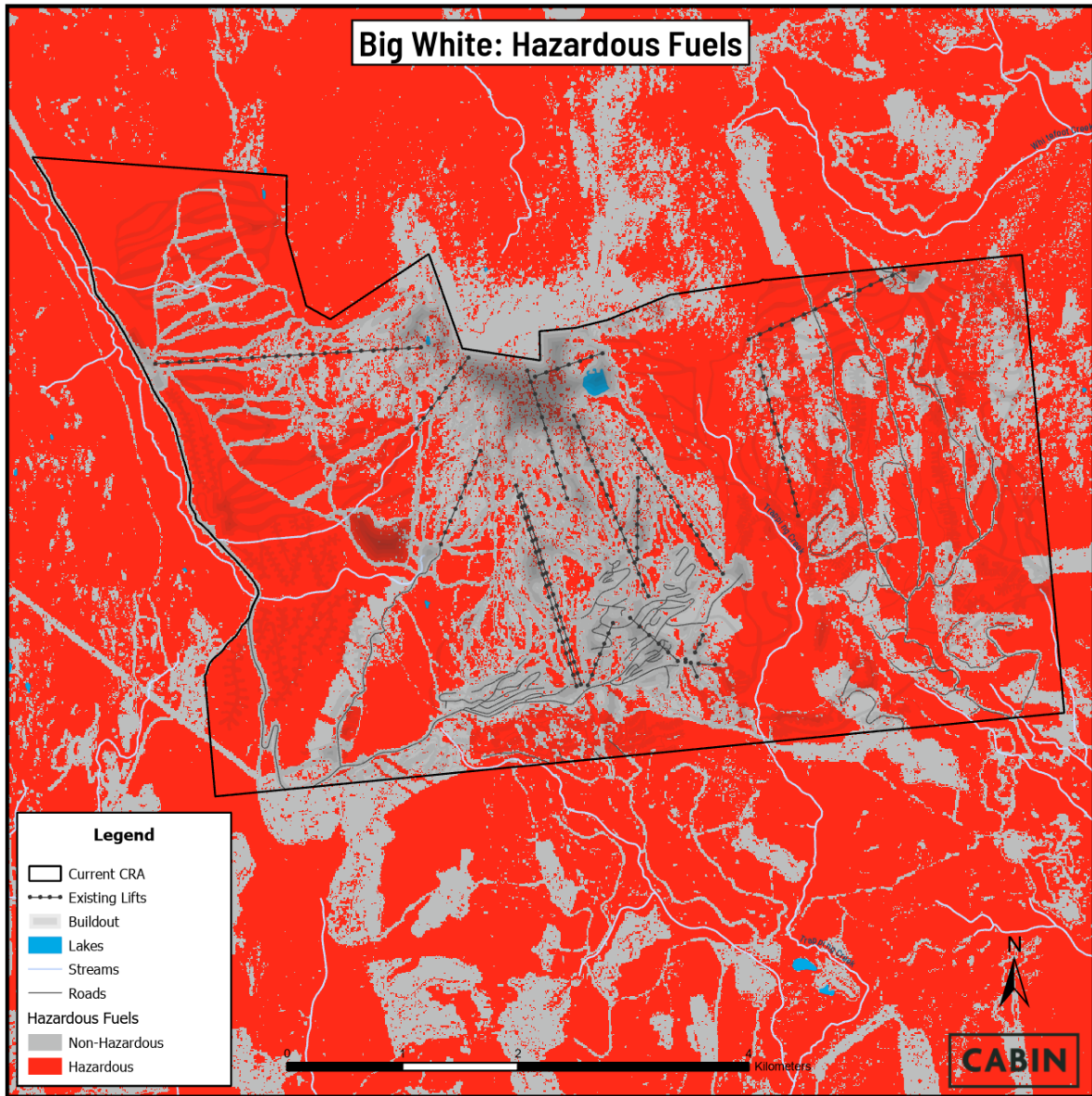


Figure 11. Map of hazardous fuels compared to non-hazardous fuel across the CRA.

From the classified hazardous fuel raster, we derive a continuous fuel exposure surface following the methodology of Beverly et al. (2021). Any cell classified as hazardous contributes to exposure in surrounding cells within a five-hundred-meter radius, reflecting the maximum spotting distance under high wind conditions (although this distance can vary). A moving window function is applied so that cells closer to observed hazardous fuels receive higher exposure values while those beyond five hundred meters approach zero. This exposure raster captures fuel connectivity across the landscape, identifying corridors through which embers or firebrands could travel ahead of the flame front. In our risk model, the fuel exposure layer

becomes one of the two equally weighted inputs (the other being historical fire weather intensity) to quantify wildfire likelihood at every ten-meter cell (see Figure 12).

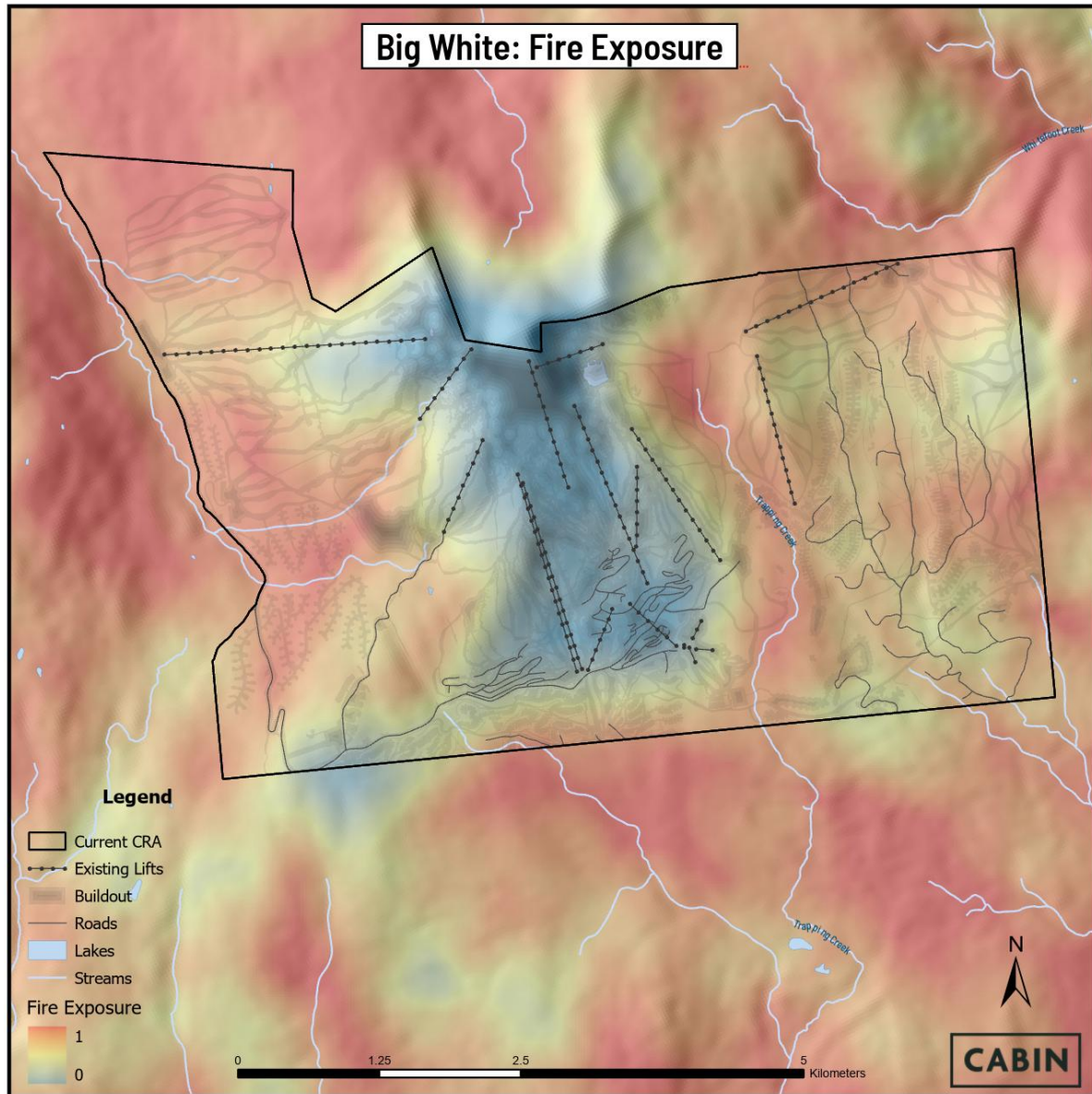


Figure 12. Map of wildfire exposure across the CRA for Big White Ski Resort area.

The wildfire likelihood surface (see Figure 13) merges an index of historical fire weather intensity with a fuel exposure metric by averaging their rescaled values. The result is then adjusted to fit a consistent 1-100 range, ensuring that cells with both frequent fire weather activity and strong fuel connectivity receive the highest likelihood scores.

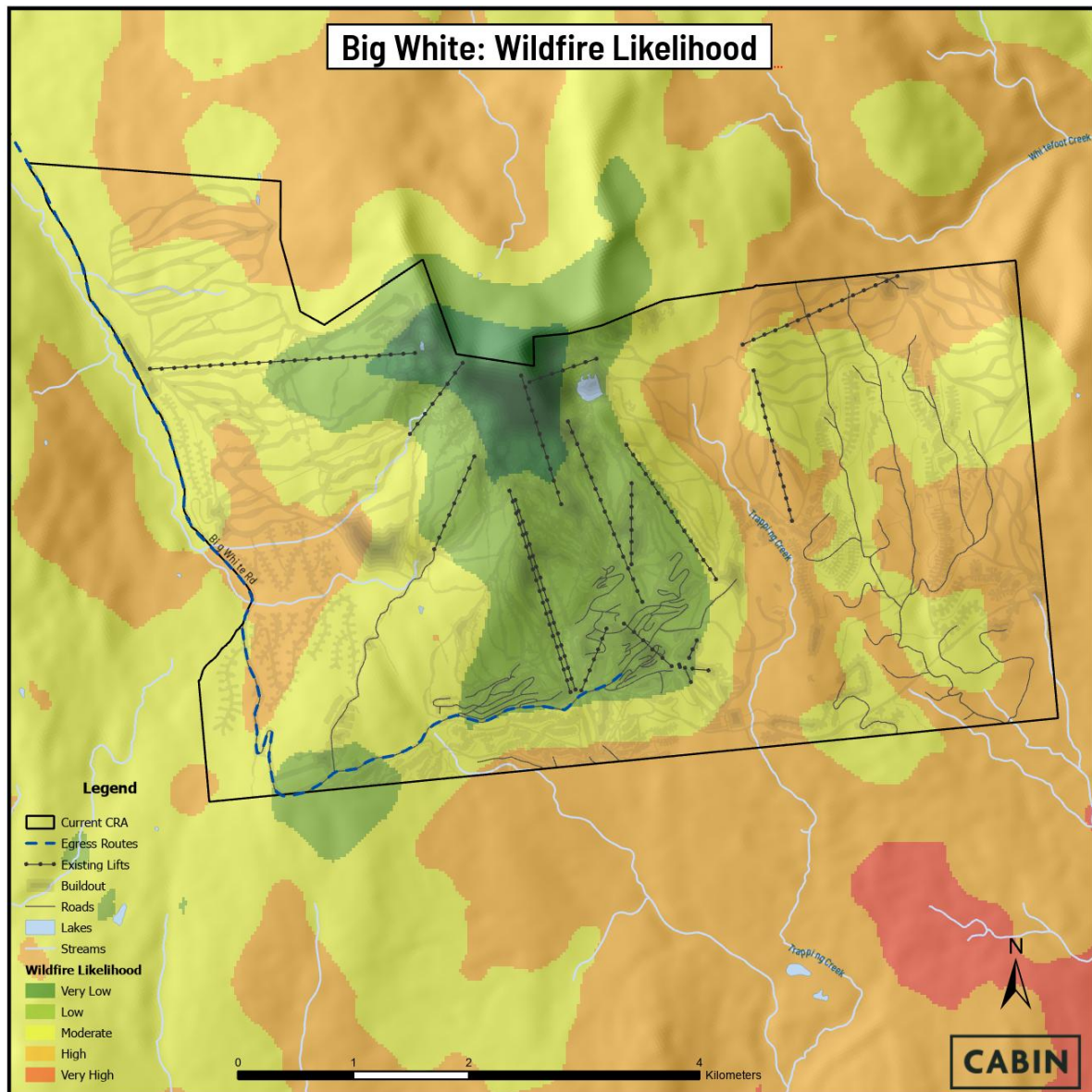


Figure 13. Map of wildfire likelihood across the CRA for Big White Ski Resort area.

The final risk assessment (see Figure 14) combines the likelihood surface with the consequences surface by averaging their normalized values on a 1 to 100 scale. This produces a single raster in which high values correspond to areas that are both prone to fire and contain assets or evacuation routes at risk. Planners use this risk map to prioritize fuel-treatment zones, allocate firefighting resources, and guide evacuation route design. By highlighting areas where ignition probability and potential loss overlap, the assessment ensures that mitigation efforts focus on locations where they will have the greatest impact on reducing both wildfire spread and community exposure.

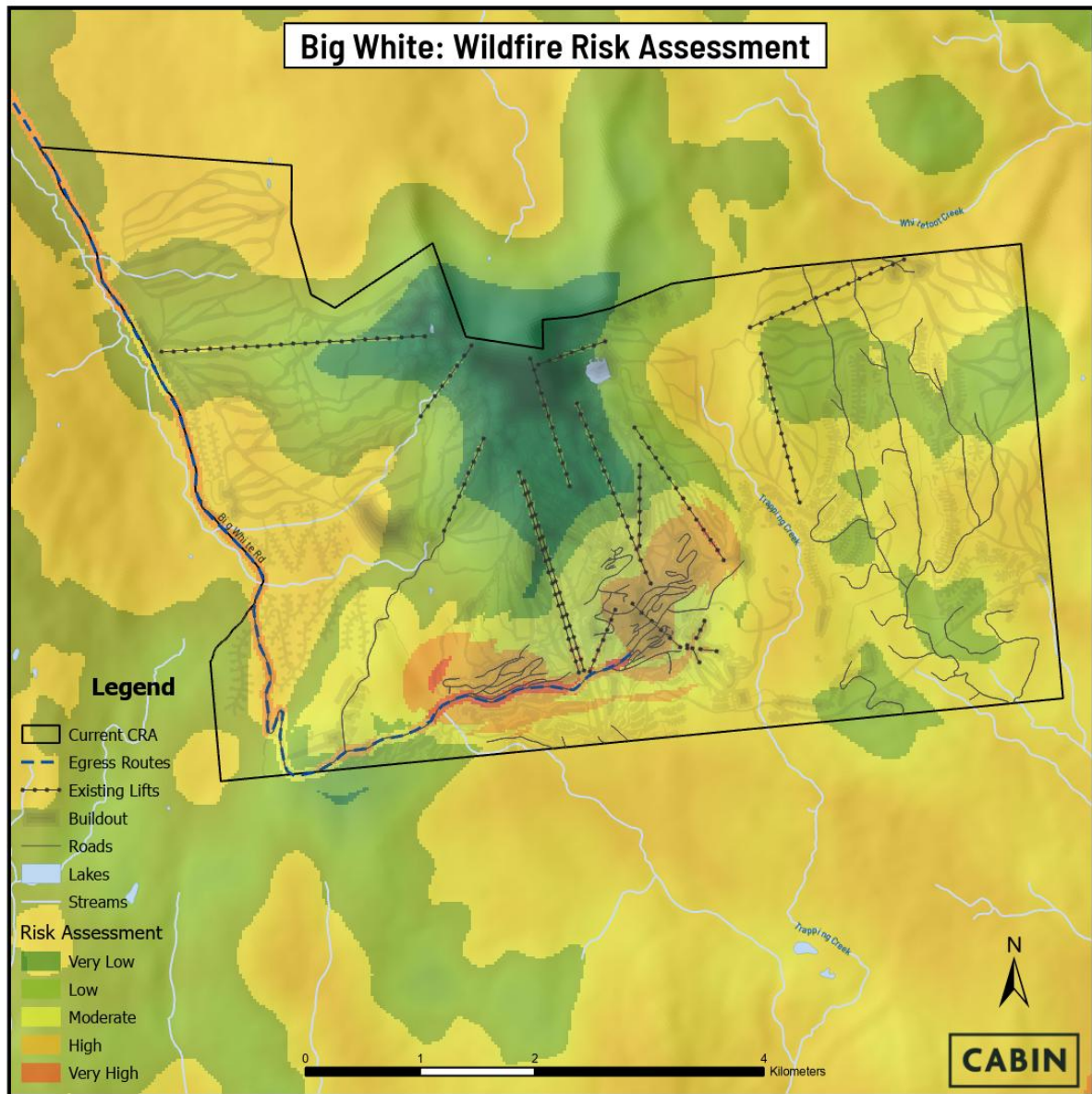


Figure 14. Map of overall wildfire risk across the CRA for Big White Ski Resort area.

4.9 Active Fire Weather Stations and Initial Spread Index (ISI) Roses

The Area of Interest (AOI) for this Wildfire Risk Assessment and Analysis spans the entirety of the Big White Ski Resort Controlled Recreation Area. The CRA is impacted by multiple weather patterns and is represented by weather stations in both Kamloops (KFC) and Southeast (SFC) Fire Centres, include: Beaverdell (SFC), Eight Mile (SFC), Idabel Lake 3 (KFC), Kettle 2 (KFC), Nicoll (SFC), and Octopus Creek (SFC) (Figure 15).

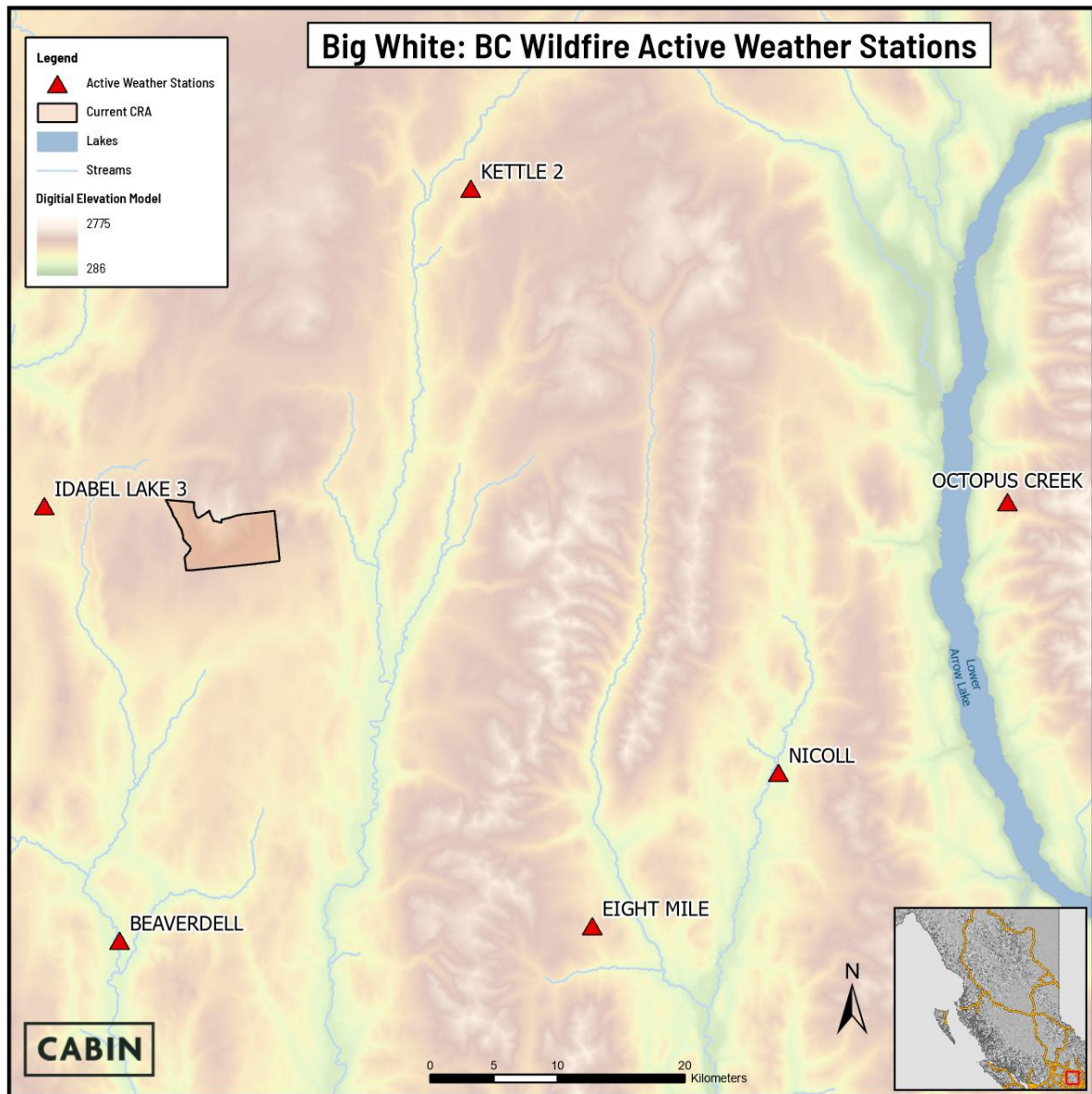


Figure 15. Map of active BC Wildfire Service weather stations near the Big White CRA.

From a fire weather perspective, Big White spans the Semi-Arid Steppe Highlands, a distinctive ecological region featuring rugged, mountainous terrain topographically blending from alpine tundra to dry, open

meadows. The topography is heavily influenced by rolling hills and plateaus, steep slopes, and rocky outcrops and valleys that can produce sheltered and unique microclimates. At Big White, the representative weather stations provide some insight into the prevailing wind directions during wildfire season. The weather data will be incorporated into the wildfire analysis.

Given the area's topographical influences made upon weather patterns and local climates. Variation is seen across these stations in consistent wind patterns from 1996 to 2015. Overall, there appears to be some agreement that there is a consistent Initial Spread Index (ISI) direction of southwest shifting to southeast (Figure 16). However, looking at a station such as Octopus Creek or Ida Bell Lake 3, there are erratic wind directions, lacking a persistent wind direction (Figure 16).

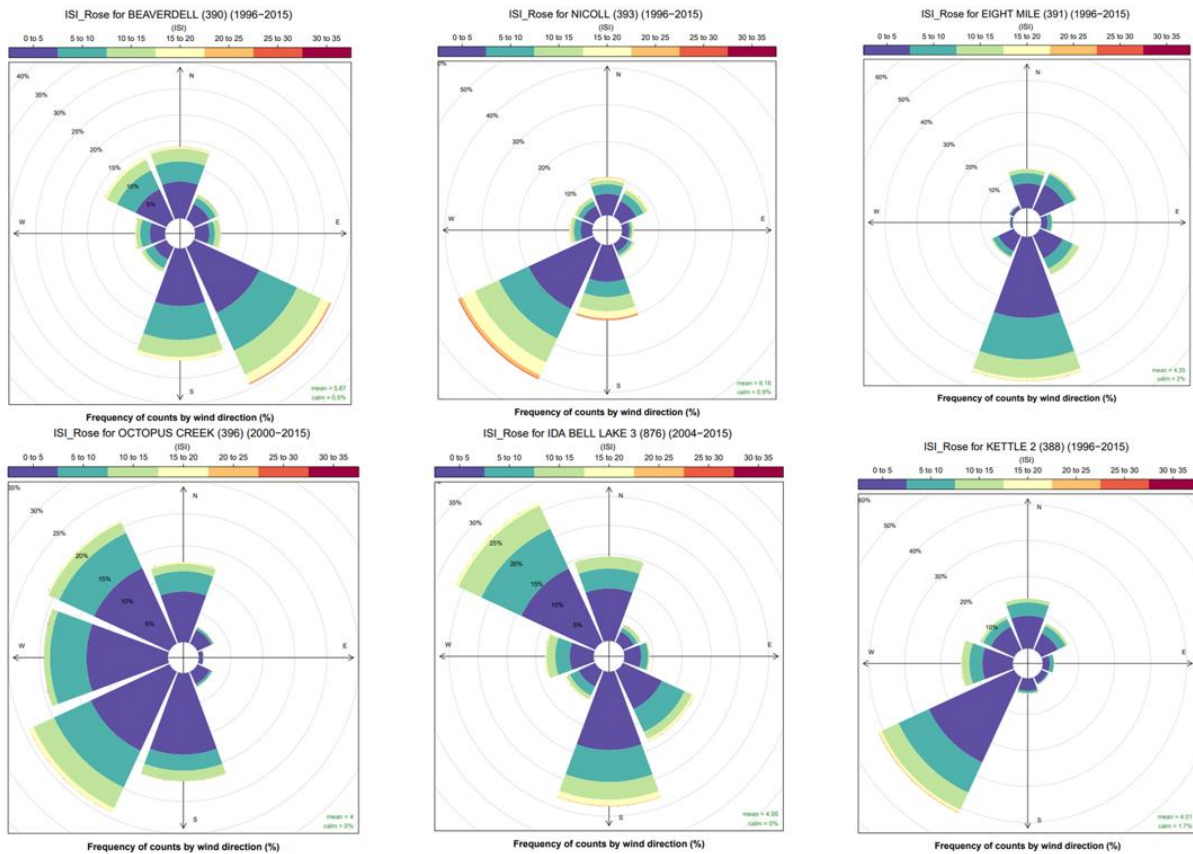


Figure 16. Initial Spread Index (ISI) by wind direction from 2004 - 2015 across both the Kamloops and Southeast Fire Centre BCWS weather stations near the Big White CRA including Beaverdell, Nicoll, Eight Mile, Octopus Creek, Ida Bell Lake 3, and Kettle 2 stations.

The ISI figure for a station can be attributed to a Build Up Index (BUI), together, these can be modelled to receive an approximate Rate of Spread (ROS). Typically seen in units of m/min, ROS is an important metric for wildfires and long-range fire growth planners. Using tools such as FBP Go, RedApp, Behave, or the FBP Field Guide approximation can be made to better understand wildfire behaviour at the practitioner level (Taylor and Alexander 2018). The above indices were applied to the FBP Go tool to gather estimations on expected ROS using 90th percentile ISI for each weather station. Assumptions were used, such as the

weather station is on perfectly flat ground, the wind speed was consistently at 10km/h and northerly, and all modelled ROS was completed for a C-3 FBP fuel type. The modelled behaviour included a minimum ROS at Octopus Creek (396), showing a ROS (head fire) of 6m/min, maximum ROS at Beaverdell (390) station with an output of 18m/min (Table 4).

Table 4. Summary of the Initial Spread Index (ISI) observed at each weather station near the Big White Ski Resort recorded in 90th percentile conditions and modelled Rate of Spread (ROS) in m/min.

BCWS Weather Station	ISI (90 th percentile indices)	ROS (m/min)*
Beaverdell (390)	15.58	18
Eight Mile (391)	12.25	9
Nicoll (393)	17.77	17
Octopus Creek (396)	11.48	6
Ida Bell Lake 3 (876)	12.80	13
Kettle 2 (388)	11.86	13

*ROS calculated using C-3 as a standard fuel type and wind of 10km/h from 0° on flat ground.

4.10 Wildfire Mitigation Management Plan

Wildfire fuel management and provided mitigation factors are relevant to the time of report generation and master plan; should be monitored and re-evaluated on an annual basis, as development occurs, in line with FireSmart or Wildfire Development Permit principles and obligations, and in line with the RDKB CWRP (every 5 years)(RDKB 2001; Low 2023).

5.0 Recommendations

The Land Use Operational Policy: All-Seasons Resort (15.2) provides legal direction for Wildfire Protection/Prevention for all New Resort Master Plans and Resort Master Plan updates (FLNRORD 2019). The policy states that new development must adhere to FireSmart Principles which are outlined in the referenced document named “FireSmart – Protecting Your Community from Wildfire”. This document was published in 2003, and since then, there has been various updated research and documentation supporting FireSmart principles (Partners in Protection 2003). The RDKB Electoral Area E CWRP 2023 also encompasses Big White and provides relevant recommendations. These will also be referenced for the following FireSmart Principles (

Table 5).

The Land Use Operational Policy also describes areas identified by FLNRORD as high fire threat that require a mitigation strategy to address these identified risks. Hence, the development of a resort Wildfire Risk Management Plan.

FireSmart principles from “FireSmart – Protecting Your Community from Wildfire” and RDKB CWRP Relevant recommendations for new development:

Table 5. Summary of recommendations pursuant to the overhead plans pertaining to wildfire management in for the CRA.

Category	Actions
Education	<ul style="list-style-type: none"> • Review FireSmart and Emergency preparedness tips on the RDKB website. • Provide engagement from the local fire department and residents. Educate homeowners on best FireSmart practices.
Legislation and Planning	<ul style="list-style-type: none"> • Refer to the BC Building Act and Building Code for all new developments
Development Considerations	<ul style="list-style-type: none"> • Prior to any new development, a hazard assessment should be completed to integrate hazard mitigation into the design and planning stages of new development. Requirements to assess wildfire risk, fire truck access, and the flammability of building materials is listed under - 3.7(3) Fire Protection Objective - of the RDKB’s Big White OCP Bylaw No. 1125. • Refer to “FireSmart Begins at Home - Home Development Guide” for new development designs and materials. • Consider additional critical infrastructure which may need to be built to manage new development. These will require their own wildfire hazard mitigation. <ul style="list-style-type: none"> o Overhead powerlines o Utility services o Propane tanks o Outbuildings o Lift lines o Lift infrastructure o Lift Right of Way
Interagency Cooperation	<ul style="list-style-type: none"> • Work in collaboration with BCWS, RDKB, MoF, Westbank First Nation for emergency planning • Assess avenues of collaboration between the Big White Fire Department and the BC Wildfire Service through agreements such as the - Fire Chiefs’ Association of BC and BC Wildfire Service Memorandum of Agreement (Derby and Chapman 2025).
Cross Training	<ul style="list-style-type: none"> • Provide Big White fire department personnel training as FireSmart Representatives or Wildfire Mitigation Specialists.
Emergency Planning	<ul style="list-style-type: none"> • If considerable new development occurs at Big White, an updated assessment of water supply and tools for suppression activities should be conducted. • Egress routes should be integrated into new development to manage both evacuees and emergency personnel. • Annually, work with MRB to follow the Public Access Management & Wildfire Preparedness • Public access will be actively managed, including installing clear signage and applying necessary access controls, especially in forested and remote zones where ignition risk is higher and evacuation could be more complex
Vegetation Management	<ul style="list-style-type: none"> • Conduct home assessments on current properties to assess whether they meet FireSmart principles.

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- Support fuel management prescription and development treatments outlined in relevant higher-level plans.
- Identify and assess the vegetation which surrounds any the new development up to 100m from property or more if necessary. This is to include all lift infrastructure, outbuildings, right of ways and communications towers.
- Mitigate fuel loading 100m either side of main egress route on the Big White Road
- Identify fire ignition potential areas within the community and how new development could be impacted.
- Refer to the FireSmart landscaping guidelines when considering vegetation and landscaping materials choice and location.
- Assess funding opportunities to leverage new risk reductions projects and the maintenance of treatment units, some funding sources that can be integrated with the overhead plans include Forest Enhancement Society of BC (FESBC) and BC Wildfire Services' Community Resiliency Investment (CRI) program.
- Depending on land status/ownership i.e. Crown Grant, Lease or CRA Crown Land, Big White will provide support for fuel management activities including logistics, signage, communications, interagency cooperation, labour and capital.

6.0 Appendices

6.11 References

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6.12 Data Sources

Dataset	Source
BC Wildfire Fire Perimeters - Historical	https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-fire-perimeters-historical
BC Wildfire Active Weather Stations and Data	https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-active-weather-stations
BC Wildfire Fire Incident Locations - Historical	https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-fire-incident-locations-historical
BC Wildfire Fire Fuel Types - Public	https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-fire-fuel-types-public
BC Wildfire PSTA Fire Threat Rating	https://catalogue.data.gov.bc.ca/dataset/bc-wildfire-psta-fire-threat-rating

Percentile Calculator	https://wps-prod.apps.silver.devops.gov.bc.ca/percentile-calculator
FBP Go	https://psu.nrs.gov.bc.ca/fbp-go

6.13 Abbreviations

Abbreviation	Definition
AOI	Area of Interest
BC	British Columbia
BCWS	BC Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
BHA	Brent Harley and Associates
BUI	Build Up Index
BWSR	Big White Ski Resort
CBH	Crown Base Height
CFSR	Climate Forecast System Reanalysis
CRA	Controlled Recreation Area
CRI	Community Resiliency Investment
CWPP	Community Wildfire Protection Plan
CWRP	Community Wildfire Resiliency Plan
ESSF	Engleman Spruce Subalpine Fir
FBP	Fire Behaviour Prediction
FDIA	Fire Department Initial Attack
FESBC	Forest Enhancement Society of BC
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
FWI	Fire Weather Index
HDW	Hot-Dry-Windy
HFI	Head Fire Intensity
ISI	Initial Spread Index
KFC	Kamloops Fire Centre
LiDAR	Light Detection and Ranging
MRB	Mountain Resorts Branch
MS	Montane Spruce
NDT	Natural Disturbance Type
NRC	Natural Resources Canada
OCP	Official Community Plan
PSTA	Provincial Strategic Threat Analysis
RDKB	Regional District of Kootenay Boundary
ROS	Rate of Spread

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SFC	Southeast Fire Centre
USDA	United States Department of Agriculture
VRI	Vegetated Resources Inventory
WRR	Wildfire Risk Reduction
WUI	Wildland Urban Interface
ZWCO	Zone Wildfire Coordination Officer