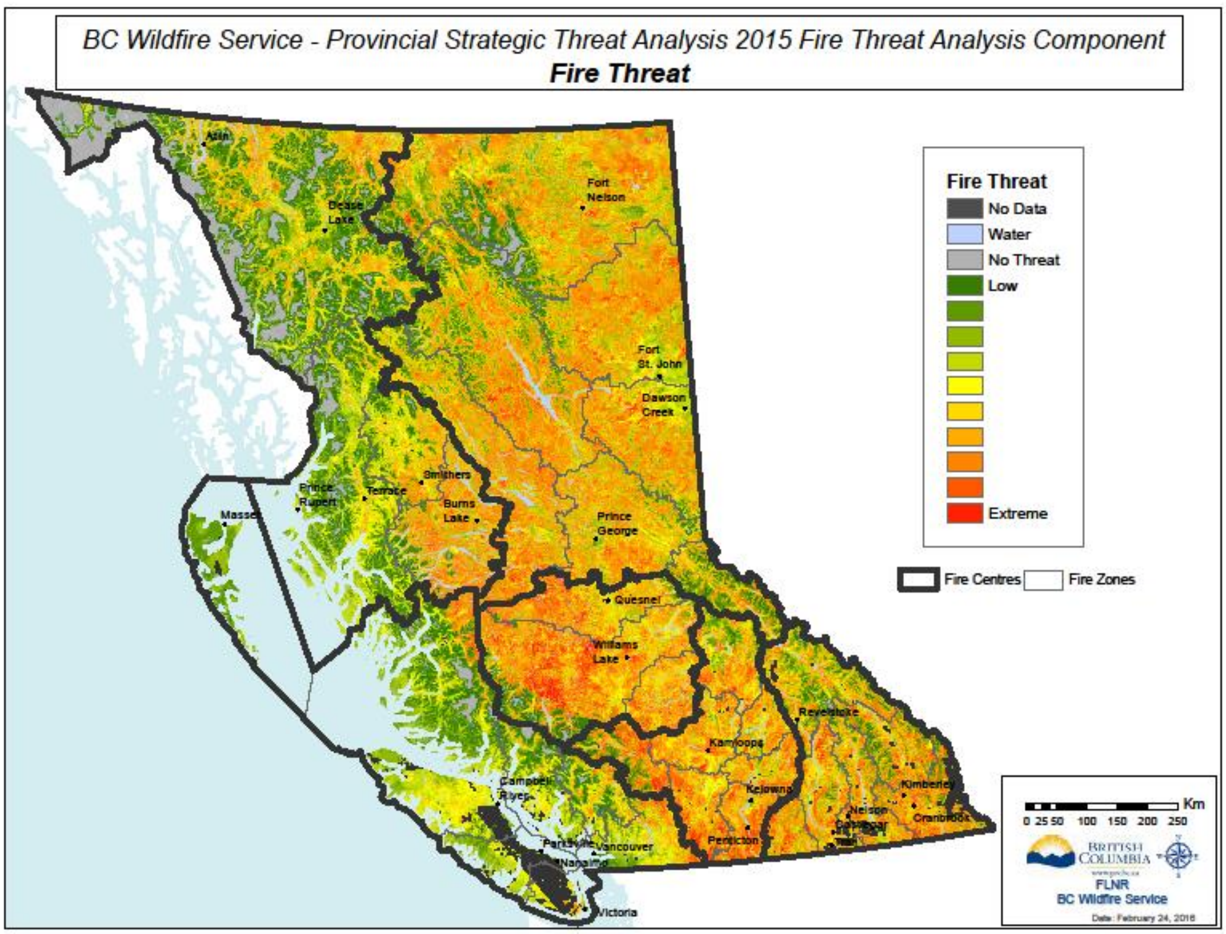
BRITISH COLUMBIA

Ministry of
Forests, Lands and
Natural Resource Operations

Provincial Strategic Threat Analysis
2015 Wildfire Threat Analysis Component

BC Wildfire Service



PSTA DISCLAIMER

The information presented within the Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component is derived from datasets and models that represent a provincial-level assessment of approximate relative fire threats across the land base.

It is intended to provide a strategic-level analysis of many different factors that contribute to fire threats, but it is not intended to represent absolute, site-specific values. The PSTA 2015 Wildfire Threat Analysis was conducted at a small (coarse) scale, so users of this product need to confirm that the initial wildfire-risk rating assigned to a given area is accurate by having a qualified professional validate that rating at the forest stand level.

Limitations of the 2015 Wildfire Threat Analysis are related but not limited to the following factors: accuracy of the Vegetation Resources Inventory (VRI); the 17 fuel types identified under the Canadian Forest Fire Behaviour Prediction (FBP) System; historical fire data collected across decades using different standards and technologies; and assumptions associated with the development of the head fire intensity and spotting impact data layers.

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EXECUTIVE SUMMARY

The Provincial Strategic Threat Analysis (PSTA) 2015 Wildfire Threat Analysis Component project evaluated multiple data sets to provide a spatial representation of wildfire threats across British Columbia. Natural resource management agencies, resource-based industries, First Nations, local governments and stakeholders may be able to mitigate wildfire threats and negative impacts of catastrophic[1] events by using this information to identify high-risk areas and undertake management actions to reduce those threats.

The PSTA 2015 Wildfire Threat Analysis (WTA) currently informs the government's landscape fire management planning (LFMP) and the Strategic Wildfire Prevention Initiative (SWPI) fuel treatment programs. Fuel management is the process of modifying forest or rangeland fuels (vegetation and biomass) to reduce aggressive wildfire behaviour. The wildland urban interface (WUI) is any area 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 this analysis is 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.

The PSTA 2015 Wildfire Threat Analysis was conducted at a provincial scale to assess the broad threat presented by wildfire across the geographic extent of BC. Land managers will need to confirm that the initial wildfire-risk rating assigned to a given area is representative by validating that rating at the stand level. Once the threat level is determined on the ground, the next steps include analyzing options for site modification and strategically altering or reducing fuel loads on the landscape.

Additional management actions may include creating landscape-level fuel breaks or other fuel modification activities: enhancing natural features (lakes, rivers, talus slopes, etc.); using targeted harvesting methods to reduce fuel loading or connectivity; establishing linear fuel breaks (along roads, power lines, gas lines, etc.); conducting prescribed burning; and using alternative silviculture practices such as modified stocking standards.

The PSTA 2015 Wildfire Threat Analysis represents a digital mapping layer that combines three key fire behaviour inputs: fire density; spotting impact; and head fire intensity. These inputs were combined to produce an overall fire threat analysis layer that integrates many different aspects of fire hazard and risk.[2] This WTA only focuses of the fire behaviour aspects of a wildfire risk analysis; a separate component of the PSTA is currently in preparation that will include identification of the Wildland Urban Interface and other values at risk on the landbase.

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[1] A catastrophic event does not have to be a large wildfire. It can be defined as any event that causes "damage/loss to values."

[2] Risk is usually defined as "probability x consequences". This is often calculated as 'expected loss' (a monetary figure) and requires an estimate of the replacement cost of values at risk (VARs) that could be impacted by fire. This analysis does not include VAR data (except as an example at the end of this document) and therefore only answers the fire portion of the equation, referred to as 'fire threat' in this document.

The Wildfire Threat Analysis is a high-level GIS raster analysis suitable for provincial-level assessments and provides relative threat information across the landbase. However, stand-level information must be used to determine localized land management activities.

Limitations of the Wildfire Threat Analysis are related but not limited to the accuracy of the source data and modeling tools: the Vegetation Resources Inventory (VRI)process; the fuel types that comprise the Canadian Forest Fire Behaviour Prediction (FBP) System; historical fire data records maintained by the BCWS over decades, using varying standards and technologies; and assumptions associated with the development of the head fire intensity, fire history, and spotting impact data layers.

This document outlines the uses, information, assumptions and development methodology overview of the Wildfire Threat Analysis. Information on key inputs and composite outputs is also provided, since it may influence various fire management activities and help promote a common understanding of the fire environment. The Wildfire Threat Analysis is meant to be used at a strategic level and at a relatively coarse resolution that is suitable for the area in question.

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INTRODUCTION

Wildfire is a key process and component of ecosystems in British Columbia and has influenced nearly all forest and grassland environments. These ecosystems have evolved with the presence of wildfire and have the capacity to respond to fire as an important natural disturbance event.

Since the early 1900s, wildfire suppression efforts have significantly reduced wildfire activity on the landscape with the intention of protecting values at risk, including timber. However, the present wildfire situation in British Columbia is presenting challenges:

- Continued growth of the wildland urban interface (WUI) and the expansion of infrastructure related to energy development (and other industries) on the forested landbase
- Suppression of naturally occurring wildfires has contributed to unhealthy forest and range ecosystems and habitats, and unnaturally high fuel loads
- The effects of climate change are resulting in longer and more extreme fire seasons

Increasing wildfire activity also presents challenges for preserving natural values that are important to British Columbians and that are sensitive to the detrimental effects of wildfire. There is a need to improve fuel management performance by planning and carrying out forest activities in a manner that reduces future fire risks and the potential impacts of wildfire.

Resource managers and proponents should view land management activities through a “fire management lens”, where the objectives are to reduce damage from wildfires, improve the effectiveness and cost efficiency of wildfire suppression, and improve the wildfire resilience of landscape and community values.

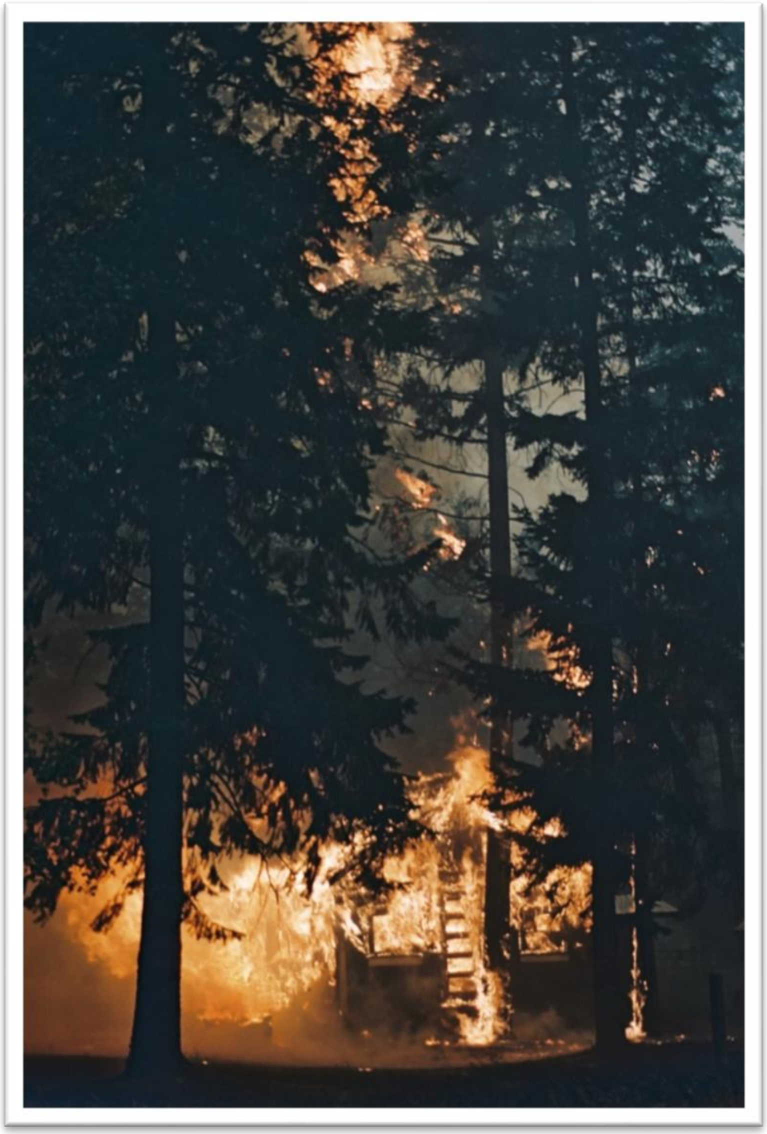
Current fire threats must be understood to identify areas where FireSmart and fuel management activities would be most effective. This is the first step in the Landscape Fire Management Planning process.

The objective of landscape fire management planning is to first identify and quantify the wildfire threat across the landscape using the best available modelling tools. Once threats have been quantified and the values at risk have been identified, land management activities can modify the amount and distribution of fuels on the landscape. This will help mitigate future wildfire behaviour and support more successful fire suppression.

This Wildfire Threat Analysis will also inform the Strategic Wildfire Prevention Initiative (SWPI) when combined with the Wildland Urban Interface (WUI) data to identify areas that may be at risk of damage from wildfires. Under SWPI, fuel management is the process of modifying or reducing the amount of forest or rangeland fuels to help reduce aggressive wildfire behaviour in interface areas.

The Wildland Urban Interface is any area where combustible wildland fuels (e.g. vegetation) are found adjacent to homes, farm structures or other buildings. For the purposes of the Strategic Wildfire Prevention Initiative, the Wildland Urban Interface consists of areas within two kilometres of a community with a density of between six and 250 structures per square kilometre.

FIGURE 1: INTERFACE WILDFIRE



The 2015 Wildfire Threat Analysis (FTA) is also meant to be used in making resource and land management decisions in areas where a landscape fuel management plan has not been completed. For example, it can identify where homeowners and development proponents could implement FireSmart activities. More detailed information about FireSmart principles and activities can be found at https://www.firesmartcanada.ca

FIGURE 2: FIRESMART CRITICAL INFRASTRUCTURE

This document provides background information that was used to develop the 2015 Wildfire Threat Analysis. Information about key inputs and composite outputs is also provided since it may influence fire management activities.

Inputs aid in building a common understanding of the fire environment within the planning unit overall, but the degree of precision must be determined at the stand level. The PSTA 2015 Wildfire Threat Analysis is meant to be used for strategic purposes and at a coarse resolution encompassing the total area of British Columbia.

USES OF THE PROVINCIAL STRATEGIC THREAT ANALYSIS 2015 WILDFIRE THREAT ANALYSIS

Successful wildfire management requires an integrated approach where risks related to wildland fires are fully recognized and considered when making resource management decisions at all levels. By integrating wildfire, forest and resource management planning, communities and values at risk across the landbase will benefit from the mitigation of large-scale, high-intensity and high-severity wildfires.

The goal of the wildland fire risk values analysis is to provide an understanding of the sources of the hazard (fuel, weather or ignition probability) and the implications for values that already exist or are contemplated for development on the landbase (risk). This WTA only focuses of the fire behaviour aspects of a wildfire risk analysis; the subsequent component of the PSTA includes identification of the Wildland Urban Interface and other Values at risk on the landbase.

If the 2015 Wildfire Threat Analysis (WTA) identifies a high threat area, then land managers and development proponents should look at the stand-level characteristics to confirm this rating. The next step for a “high threat” area is to analyze potential site modification and structure development options. Finally, they could strategically alter or reduce fuel levels and potentially conduct landscape-level fuel treatments through the enhancement of natural features, targeted harvesting, the establishment of linear fuel breaks, prescribed burning and the use of alternative silviculture practices such as modified stocking standards. During this process, land managers could also identify areas where fire would be ecologically beneficial and where they would support the reintroduction of fire (natural or prescribed) on the landscape.

The overall goal is to reduce fuel loading in wildland areas identified as “high threat” areas and thereby reduce the potential for devastating wildfires. Key forest treatment objectives within identified fuel modification or high-risk areas may include:

- reducing surface fuels (e.g. burning, removing, or crushing fuels) or encouraging live deciduous understory vegetation to raise the average moisture content of surface fuels
- reducing ladder fuels that allow fire to spread to the upper branches and crowns of trees (e.g. shrubs, dead lower tree branches, arboreal lichen)
- decreasing crown density through thinning or prescribed fire
- increasing the distance from the ground to live tree crowns by pruning or thinning (to help ensure that flames will not reach the crowns and initiate a crown fire)
- retaining large-diameter trees of fire-resilient species (to provide shade and maintain higher understory moisture levels, as well as maintaining forest ecosystem functions)

FIGURE 3: FUEL TREATMENT NEAR KIMBERLEY

INPUTS INTO THE 2015 WILDFIRE THREAT ANALYSIS

FIRE BEHAVIOUR DRIVERS

Fire behaviour is defined as "the manner in which fuel ignites, flame develops, and fire spreads and exhibits other related phenomena as determined by the interaction of fuels, weather and topography."[3] These three influences (fuel, weather and topography) are also referred to as the "fire behaviour triangle" and are the main elements of the fire environment. This document presents a brief overview of the elements of fire behaviour that relate to wildfire risk and threat assessment in British Columbia; for a more technical review of the science of fire behaviour and management we suggest other sources. [4]

[3] Source: Canadian Interagency Forest Fire Centre 2003 Glossary of Forest Fire Management Terms. See http://bcwildfire.ca/mediaroom/backgrounders/2003_fire_glossary.pdf

[4] See, for example, Beck, J., J. Parminter, M. Alexander, E. MacDermid, T. Van Nest, A. Beaver, and S. Grimaldi. 2005. Fire ecology and management. Pages 490-525 *in* S. B. Watts and L. Tolland, editors. Forestry handbook for

Each of these elements can vary widely in time and space to influence fire behaviour. Although the short-term fire weather (from a period of minutes to a few days) plays the greatest role in fire behaviour, the best opportunity for land managers to modify fire behaviour is by treating the existing fuels on the landscape. The other two factors are outside of their control.

The Canadian Forest Fire Danger Rating System[5] (CFFDRS) is the basis for all operational fire behaviour prediction and classification activities in Canada. The CFFDRS consists of two main sub-systems, the Fire Weather Index (FWI) System and the Fire Behaviour Prediction (FBP) System.

The Fire Behaviour Prediction (FBP) System provides the final fire behaviour outputs that are used in fire behaviour forecasts and other analyses. These outputs include quantitative estimates of spread rate, fuel consumption and fire intensity, as well as fire type descriptions.

Secondary outputs include estimates of fire area, fire perimeter, perimeter growth rate, and flank and back fire behaviour. The Fire Behaviour Prediction (FBP) System provides this information based on 17 standard fuel types. More information can be found at http://cwfis.cfs.nrcan.gc.ca/background.

Climate, weather conditions, type and condition of fuels, previous fire history, time of year, aspect (orientation to the sun and prevailing winds), topography and ignition source all interact to affect the behaviour of the fire, as well as the intensity and extent of the burn. This multitude of variables means that fire behaviour on the landscape is also highly variable, both within a single fire and between separate fires. One of the purposes of this document is to review these variables as they apply to the 2015 Wildfire Threat Analysis.

WEATHER AND HOW IT INFLUENCES FIRE BEHAVIOUR

Weather is one of the key inputs that affect fire behaviour and it is a factor in the "head fire intensity" portion of the Wildfire Threat Analysis. "Fire weather" is measured either hourly or daily and is the leading environmental factor that can cause variations in fire behaviour throughout the day. This section is a very brief overview of fire weather considerations used in the Wildfire Threat Analysis; technical documents on fire weather measurements and calculations provide much greater detail for operational and formal reference purposes.[6]

As mentioned above, weather patterns in the Canadian Forest Fire Danger Rating System are modelled using the Fire Weather Index (FWI) System, which tracks several types of weather

British Columbia, 5th edition. Forestry Undergraduate Society, Faculty of Forestry, University of British Columbia, Vancouver, British Columbia. Available online: http://www.cfs.nrcan.gc.ca/pubwarehouse/pdfs/25580.pdf.

[5] Stocks, B. J., B. D. Lawson, M. E. Alexander, C. E. Van Wagner, R. McAlpine, T. J. Lynham, and D. E. Dube. 1989. The Canadian Forest Fire Danger Rating System: an overview. The Forestry Chronicle 65:450-457.

[6] For an overview of fire weather measurements, see Lawson, B. D. and O. B. Armitage. 2008. Weather guide for the Canadian Forest Fire Danger Rating System. Natural Resources Canada, Northern Forestry Centre, Edmonton, Alberta, Canada.

observations throughout the season. These observations include temperature (^{0}C), relative humidity (%), wind speed (km/h), wind direction and precipitation.[7]

The FWI System consists of empirical codes — or indices — that use basic weather observations to track the moisture content of fine and coarse fuels that are present on the landscape. The three main indices are the Fine Fuel Moisture Code (FFMC); Duff Moisture Code (DMC); and Drought Code (DC). These indices have different drying rates and sensitivities to rainfall, as finer (smaller) and more exposed biomass particles tend to become wet or dry more rapidly under changing conditions compared with larger particles. Together, these indices form a mathematical book-keeping system that tracks the changes in available fuel moisture during the course of a fire season.

These fire weather indices form the basis of all subsequent fire weather analyses, and are also used as inputs to the FBP System (along with fuel type and slope variables) when making quantitative estimates of fire behaviour. Daily fire weather indices used in a head fire intensity analysis (see below) are calculated directly from four weather observations (temperature, relative humidity, wind speed and precipitation) that are made daily at 13:00 local daylight time (LDT). These measurements help predict what the moisture content of fuels will be several hours later, during the hottest and driest time of the day (usually around 16:00 or 17:00).

TOPOGRAPHY AND HOW IT INFLUENCES FIRE BEHAVIOUR

Topography and terrain can have both small-scale and large-scale influences on a wildfire and represent a key input to the “head fire intensity” data layer. Topography can affect fire spread and intensity due to several processes: slope, aspect, landform, and various topography-weather interactions, such as elevation effects on temperature and humidity, diurnal effects on winds, and terrain channeling and funneling, which also affect wind patterns.

Fire on a slope will burn faster uphill and slower downhill. This is caused primarily by increased radiation and convection effects on uphill fuels caused by the tilting of the flame angle on the slope. When fire burns uphill, fuels are preheated in front of the fire, causing it to ignite quicker. On very steep slopes, flames can bathe the fuel in front of the fire, leading to very rapid and unpredictable spread. The opposite effects happen when fire is burning downhill.

Weather and topography are often fundamentally linked. Terrain shape and features can contribute to very localized weather influences by trapping heat and air (forming inversions and thermal belts), funnelling winds, and creating eddy effects in the lee of ridges and peaks. Some of these factors are very difficult to model. Software tools that incorporate three dimensional wind effects into fire behaviour models exist, but were not used in developing the current version of the PSTA 2015 Wildfire Threat Analysis; these tools may be explored, if practicable in future versions.

FUEL CHARACTERISTICS AND HOW THEY INFLUENCE FIRE BEHAVIOUR

[7] The FWI system is fully described in Van Wagner, C. E. 1987. Development and structure of the Canadian Forest Fire Weather Index System. Forestry Technical Report 35, Canadian Forest Service, Petawawa National Forestry Institute, Chalk River, ON.

Fuel (structure, loading and availability of biomass) is one of the three elements of the “fire behaviour triangle” and is the element that forest managers can influence the most.

Fuel is live and dead forest vegetation and organic material, viewed from the standpoint of how it affects fire behaviour. The burning of fuel generates energy and contributes to the intensity of a fire. Other important factors that influence fire behaviour (moisture content, wind speed, etc.) must always be considered in relation to fuel. In short, if there’s no fuel, there’s no fire.

From a fire manager’s perspective, fuel is any biomass — in the soil, on the forest floor, elevated in the air— that has the potential to ignite and burn. There are infinite fuel configurations and combinations, depending on the kind, amount, size, shape, position, distribution and arrangement of materials. The structure and volume of fuel and the moisture content of that fuel determine the total available biomass that could be consumed during any given fire. To avoid the problem of having to measure biomass loads and fuel structure on every piece of land, fire modeling systems such as the CFFDRS define categorical fuel types, which are designed to reflect the typical structure and arrangement of fuels in commonly encountered vegetation types.

For fire behaviour prediction across Canada, the Fire Behaviour Prediction (FBP) System categorizes fuel into 17 distinct types. Since fuel is the only fire behaviour driver that can be modified by people and is a critical input of the PSTA 2015 Fire Threat Analysis, considerable time has gone into classifying British Columbia’s ecosystems according to FBP fuel types. These fuel types are listed below:

C-1	spruce-lichen woodland
C-2	boreal spruce
C-3	mature jack or lodgepole pine
C-4	immature jack or lodgepole pine
C-5	red and white pine
C-6	conifer plantation
C-7	Ponderosa pine/Douglas-fir
D-1	leafless aspen
D-2	green aspen[8]
M-1	boreal mixedwood – leafless phase
M-2	boreal mixedwood – green phase
M-3	dead balsam fir mixedwood – leafless phase
M-4	dead balsam fir mixedwood – green phase
S-1	jack or lodgepole pine slash
S-2	white spruce-balsam slash
S-3	coastal redcedar/hemlock/Douglas-fir slash
O-1a/b	matted (a) or standing (b) grass

[8] The D-2 fuel type was not originally part of the FBP System. However, it has now been studied and described sufficiently that most users consider it to be a 17th acceptable fuel type. See Alexander, M. E. 2010. Surface fire spread potential in trembling aspen during summer in the Boreal Forest Region of Canada. Forestry Chronicle 86:200-212.

FIGURE 4: SAMPLE SUMMARY OF A FUEL TYPE, FROM THE CANADIAN FOREST FIRE BEHAVIOUR PREDICTION SYSTEM

C3 - Mature Jack or Lodgepole Pine

This fuel type is characterized by pure, fully stocked (1000–2000 stems/ha) jack pine (*Pinus banksiana* Lamb.) or lodgepole pine (*Pinus contorta* Dougl. ex Loud.) stands that have matured at least to the stage of complete crown closure. The base of live crown is well above the ground. Dead surface fuels are light and scattered. Ground cover is feather moss (*Pleurozium schreberi*) over a moderately deep (approximately 10 cm), compacted organic layer. A sparse conifer understory may be present.

More information about this classification system and fuel types can be found at: http://cwfis.cfs.nrcan.gc.ca/background/fueltypes/c1.

BC WILDFIRE SERVICE PROVINCIAL FUEL TYPE LAYER

The Provincial FBP Fuel Type Layer data provides information on forest fuel types for all of B.C. and for several purposes related to the FBP System and associated fire behaviour prediction models. The identification of fuel types is necessary for any type of fire behaviour prediction modelling or analysis. It is the basis for fire behaviour modelling and forecasting at multiple scales and in different contexts in B.C., including at the wildfire incident level and for larger analysis projects.[9]

The fuel layer data is based primarily on forest inventory data from the provincial Vegetation Resources Inventory (VRI) Layer polygons (minimum 1 hectare) and their respective land cover attributes[10]. The provincial surface area (~95 million hectares) is represented by approximately four million VRI polygons, which are then classified into FBP fuel types (plus 'non-fuel' or 'water'); the classification is based on an

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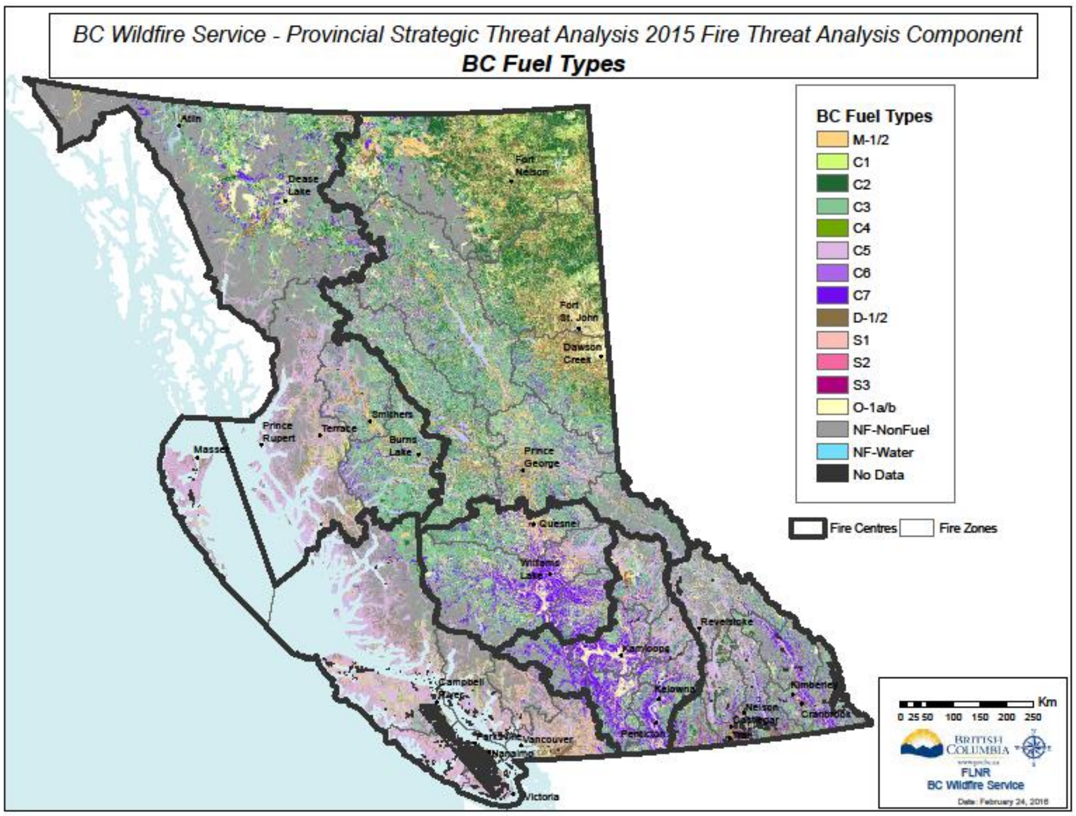
[9] The technical description of the fuel type layer document is Perrakis, D. D. B., and G. Eade. 2016. British Columbia wildfire fuel typing and fuel type layer overview, 2015 version (working paper). BC Wildfire Service, Ministry of Forests, Lands, and Natural Resource Operations, Victoria, British Columbia, Canada. Available online: https://www.researchgate.net/publication/287993537_British_Columbia_wildfire_fuel_typing_and_fuel_type_layer_description .
Note – for the present analysis, an earlier version was used, based on 2014 vegetation inventory data and an earlier draft of the classification scheme.

[10] The Ministry of Forests, Lands and Natural Resource Operations' Forest Analysis and Inventory Branch provides more details about the Vegetation Resources Inventory Layer process on the VRI Data Management website: http://www.for.gov.bc.ca/hts/vridata/

extensive set of decision rules reflecting attributes such as tree species, density, biogeoclimatic zone and other non-forest cover attributes. The fuel layer is updated annually in accordance with updates to the forest inventory data.

For some areas of the province, publicly available Vegetation Resources Inventory Layer data has been supplemented with additional corporate data (obtained from forest licensees) to help fill in the gaps. The 2014 Provincial FBP Fuel Layer used the Vegetation Resources Inventory and Forest Analysis and Inventory Branch Tree Farm Licence (TFL) data available at the time.

FIGURE 5: PROVINCIAL FIRE BEHAVIOUR PREDICTION (FBP) FUEL LAYER



There are still some gaps in the inventory data, most notably from areas of private forest land on Vancouver Island, as well as from smaller areas in the West Kootenays, the Prince George area and in tree farm license areas. In these areas, VRI polygon data were not available, so fuel type data derived by satellite image classification were used instead; these data were provided by Natural Resources Canada as part of their national fuel type product.[11] These TFL data gaps will be mostly eliminated once the 2015

[11] See Nadeau, L. B., D. J. McRae, and J.-Z. Jin. 2005. Development of a national fuel-type map for Canada using fuzzy logic. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre.
A more recent update was provided to BCWS by the Northern Forestry Centre for our purposes.

Provincial FBP Fuel Layer update is applied and subsequent PSTA Wildfire Threat Analysis updates are processed.

Recent examinations have suggested that the areas covered by the national grid were less reliable than the VRI-based classification, likely due to unique vegetation assemblages in BC that are not found in other regions of Canada. The error was deemed too significant for the Private Managed Forest Land areas, and therefore these areas were designated as “no data” for fuel type; no further analysis was performed on the WTA.

FOREST HEALTH CONSIDERATIONS AND FUEL

Forest health issues must be considered at the fire management level, since pests and disease can alter the composition of forest fuels. These factors can change how flammable a forest stand is and can increase the chances of a catastrophic wildfire. Forest health issues are tracked provincially by the Forest Health section of the Ministry of Forest, Lands and Natural Resource Operations (FLNRO). An overview can be found at: https://gww.nrs.gov.bc.ca/flnr/resource-practices/forest-health?pl=mb-flnr-forest_health

The BC Wildfire Service has been researching fire spread in forest stands affected by the mountain pine beetle (MPB). For example, a recent study found that the fire spread rate in pine from central interior BC that has been affected by the mountain pine beetle (red-needle phase) was 2-3 times faster than that for a healthy (unaffected) green pine stand.[12] This research applies to forest stands that were assessed one to five years after an MPB attack. Work is ongoing to describe fire behaviour in gray-phase older post-MPB attack stands which currently dominate central and northern interior regions. The BC Wildfire Service plans to update the Provincial FBP Fuel Layer data in 2016 to reflect fuel types affected by the mountain pine beetle.

2015 WILDFIRE THREAT ANALYSIS PROCESS

Wildland fire risk values were analyzed to provide a better understanding of fire hazard sources (fuel, weather or ignition probability) and the implications for values that already exist on the landscape or are being contemplated for development (risk). The distribution and arrangement of fuels on the landscape (partly determined by resource management activities) is a major component of any hazard analysis, since this component can be managed.

The Wildfire Threat Analysis (WTA) represents the dataset that combines the three inputs described below: fire density, head fire intensity and spotting impact layers.

[12] See Perrakis, D. D. B., R. A. Lanoville, S. W. Taylor, and D. Hicks. 2014. Modeling wildfire spread rates in mountain pine beetle-affected forest stands, British Columbia, Canada. Fire Ecology 10:10-35. Available online: http://fireecologyjournal.org/docs/Journal/pdf/Volume10/Issue02/010.pdf

FIGURE 6: WILDLAND URBAN INTERFACE AT RISK

Fire density represents the ignition and fire spread potential based on historic fire occurrence patterns. Head Fire Intensity (HFI) represents the intensity of the flaming front, which is related to suppression effort and impacts to values. Spotting impact represents the ability of embers from a burning biomass fuel (such as a group of trees) to be sent aloft for some distance over the landscape and start new fires. These three inputs were combined to produce an overall fire threat data layer that integrates many different aspects of fire hazard and risk.[13]

To combine these inputs, each data layer was first normalized by assigning each value to one of 11 discrete classes (zero and 10 separate integer classes). This classification scheme was adopted based on an iterative process, which varied among the three input layers.

[13] Note that "risk" is classically defined as probability x consequences of a negative outcome. This is often calculated as expected loss (a monetary figure) and requires an estimate of the replacement cost of the values at risk (VAR) that would potentially be impacted by fire. The present analysis does not include the VAR data (except as an example at the end of this document) and, as such, only answers the fire portion of the equation. This is termed "fire threat" in this document.

FIRE HISTORY AND DENSITY

The province's fire history database dates back to 1950. This provides a relatively long timespan from a management perspective, but a short one in terms of disturbance ecology and human activity. Fire history tells the story of the relationships between fire behaviour, landscape ecology, management policy (including fire suppression), human development and other land-use changes throughout the province.

The BC Wildfire Service tracks fire history by looking at fire perimeters (for larger fires) and fire start density. Understanding the historical causes of fires, fuel types and weather trends will aid in the development of fuel breaks and in prioritizing fuel treatments or other management activities.

For example, fires that occur close to communities, major highways or developed areas tend to remain small due to effective fire detection and reporting, and rapid fire suppression; this pattern has been apparent for most of the past half-century. Wildfire response to incidents occurring in more remote areas depends on our ability to detect these fires using aircraft, satellites and lightning activity sensors. Detection technologies have varied significantly spatially and temporally, across the province as well as over several decades of the latter 20th and 21st centuries.

The fire density component depends on one major assumption – that variables controlling fire occurrence and spread are geographically distinct. This means that areas that were fire-prone in the recent past will remain fire-prone in the present and in the near future, and vice versa. This can reflect patterns of human activity (such as industrial forestry, recreation, or vehicle use that can cause ignitions), or lightning and weather, as lightning maxima and areas prone to high fire weather indices tend to be geographically distinct. Changing climate patterns will undoubtedly shift these patterns gradually[14] , but in the short-term (~0-20 years from present), we expect fire occurrence to be controlled by similar fire environment factors that presently exist across the landscape.

The potential for very large, destructive and landscape-altering fires is related to the historical fire and fire response patterns within a given planning unit. Fire history is the first input entered into the 2015 Fire Threat Analysis and is represented at the provincial scale by fire start density. Historical fire perimeters are presented on the local planning unit maps only to provide a visual representation of the location of origin of fires larger than four hectares since 1950.

The fire density layer was analyzed using fires with final sizes greater than 4.0 hectares. These were given a weight of one (1) in the analysis, while large fires (> 500 ha) were given a weight of 5, in order to reflect the much greater cost and damage usually associated with larger fires. Further details of the analysis and classification are provided in the Appendix.

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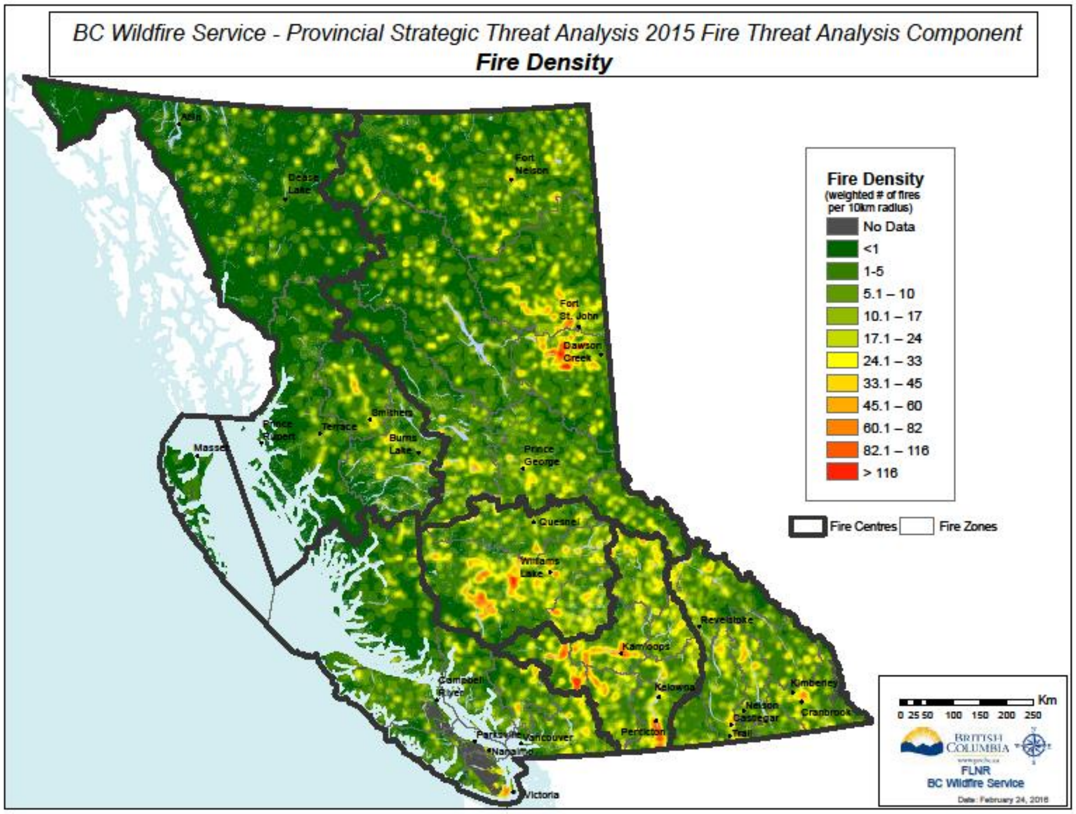
[14] See, for example: Haughian, S. R., P. J. Burton, S. W. Taylor, and C. S. Curry. 2012. Expected Effects of Climate Change on Forest Disturbance Regimes in British Columbia. BC Journal of Ecosystems and Management 13:1-24. See also: Wang, X., M.-A. Parisien, S. W. Taylor, D.D.B. Perrakis, J. Little, and M. D. Flannigan. 2016. Future burn probability in south-central British Columbia. International Journal of Wildland Fire.
Emerging research is informing managers on the anticipated future changes in fire regimes patterns; this is a rapidly-evolving field of research. Some studies lend themselves to down-scaling, while others do not; at the present time, there are few broad conclusions that can be made with confidence, except that fire threat in BC is unlikely to decrease.

FIGURE 7: FIRE DENSITY LAYER

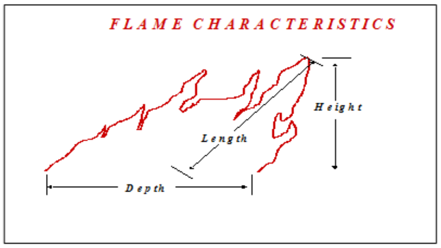


HEADFIRE INTENSITY

As part of the PSTA 2015 Wildfire Threat Analysis, headfire intensity (HFI) data layer was developed. Headfire intensity represents the energy output of the flaming front of a wildfire, measured in kilowatts per metre (kW/m). Headfire intensity is related to fire spread rate and fuel consumption at the leading edge of a wildfire, and has been previously correlated to both fire suppression effort and danger to fire suppression personnel. Head fire intensity is also empirically related to flame length, and is often approximated using the equation shown in Figure 8.

The head fire intensity (HFI) data layer was developed using the 90th percentile fire weather index value for an interpolated and elevation-adjusted analysis of weather station values. This value represents the daily FWI value at which 10% of all interpolated observations at that location exceed the value identified. Additional technical details of this analysis are provided in the Appendix.

FIGURE 8: MATHEMATICAL REPRESENTATION OF FLAME CHARACTERISTICS[15]



$$I=300(L)^2 \quad \text{or} \quad L=\sqrt{\frac{I}{300}}$$

Where,
I = fire intensity (kW/m)
L = flame length (m)

FIGURE 9: EXAMPLE OF CONTINUOUS CROWN FIRE, FORT NELSON ZONE, BC

The head fire intensity (90th percentile) values were classified using accepted thresholds of fire intensity and fire suppression effort.[16]

A brief description of the implied fire behaviour associated with each class is provided below for clarity. The head fire intensity classes used in the final threat layer are different from the defined head fire intensity classes derived from the Fire Behaviour Prediction System because the values need to be

[15] From Fire Behaviour Training Material, Manitoba Conservation, Government of Manitoba, Winnipeg, MB.

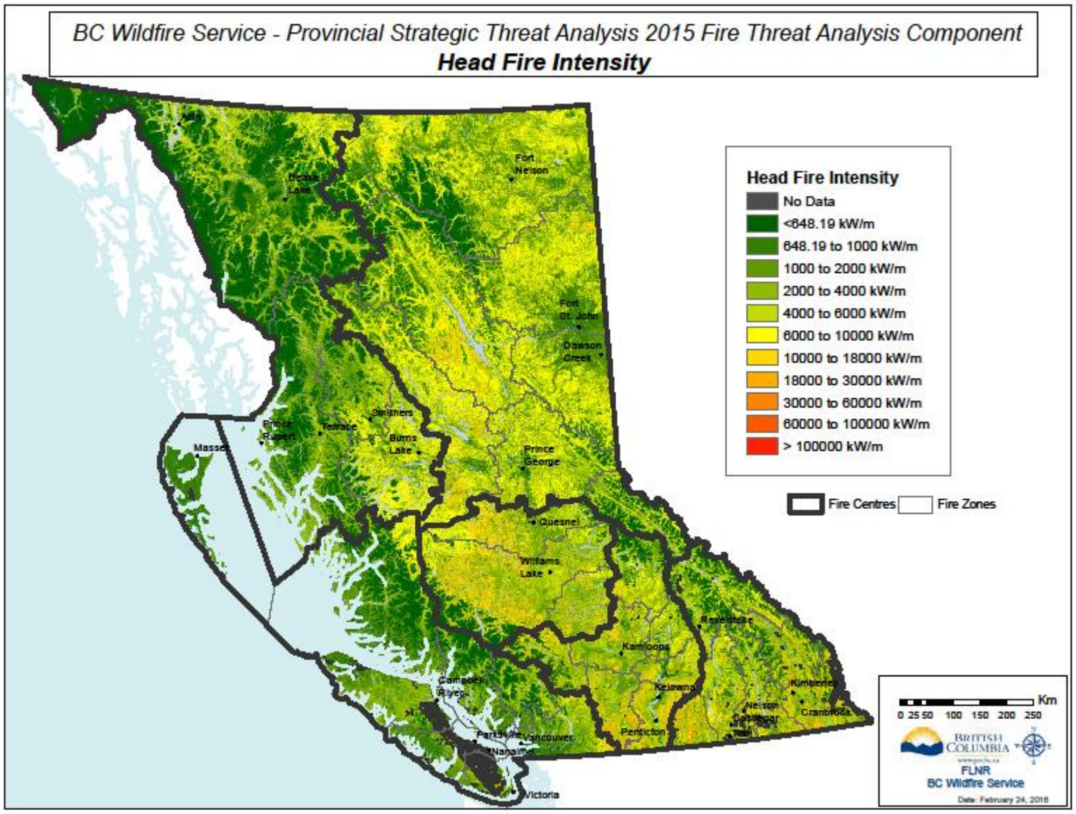
[16] For example, see Hirsch, K.G. and D.L. Martell. 1996. A review of initial attack fire crew productivity and effectiveness. International Journal of Wildland Fire 6:199-215.

spread across 10 categories. Figure 10 shows the relationship between head fire intensity and wildfire suppression considerations for the C-3 fuel type, representing mature jack or lodgepole pine (described as 'green pine' in the Figure).

FIGURE 10: EXAMPLE OF HEAD FIRE INTENSITY RELATED TO WILDFIRE CONSIDERATIONS AND SUPPRESSION OPTIONS (FOR GREEN PINE)

Example of HFI related to Wildfire characteristics and suppression options (green pine)				
	Surface head fire			
Frontal Fire Intensity (kW/m)	Flame Length (m)	Flame Height (m)	Type of fire and fire suppression difficulty	Fire Weather Index (FWI)
<10	<0.2	<0.1	Fire brands that cause an ignition to occur are self-extinguishing (i.e. fire fails to spread). Going fires remain of the smouldering ground or subsurface variety, provided there is a forest floor layer of significant depth and general level of dryness. Extensive mop-up is generally required.	0 - 3
10-500	0.2-1.4	0.1-1.0	Creeping or gentle surface fire. Direct manual attack at the fire's head or flanks by firefighters with hand tools and water is possible. Constructed fireguard should hold.	4 - 13
500-2 000	1.4-2.6	1.0-1.9	Low vigor to moderately or high vigorous surface fire. Hand constructed fireguards likely to be challenged. Heavy equipment (bulldozers, pumpers, retardant aircraft, skimmers, helicopter with bucket generally successful in controlling fire.	14 - 23
2 000 – 4 000	2.6-3.5	1.9-2.5	Very vigorous or extremely intense surface fire (torching common). Control efforts at fire's head may fail.	24-28
>4 000	>3.5	>2.5	Intermittent crown fire to active crown fire development (> 10 000 kW/m). Very difficult to control. Suppression action must be restricted to fire flanks. Indirect attack with aerial ignition (i.e. helitorch or A.I.D. dispenser) may be effective.	>29
*Adapted from poster "Fire Behaviour in Jack Pine Stands – as it relates to the Canadian Forest Fire Weather Index (FWI) System – M.E. Alexander W.J. DeGroot 1988 Northern Forestry Center, Edmonton AB				

FIGURE 11: HEAD FIRE INTENSITY LAYER 90TH PERCENTILE WEATHER



SPOTTING IMPACT

The physical movement of firebrands and embers from a fire's flaming front to areas outside of the fire perimeter is termed spotting. Spotting is most often associated with high intensity crown fires burning in conifer fuels, and in extreme conditions, spot fires have been detected several kilometres downwind from fire perimeters. Spotting activity is known to be strongly affected by wind speed, as well as other atmospheric variables not usually considered in fire behaviour modelling systems, such as instability and the development of convection columns. The main sources of embers are needles, bark flakes and small branchwood.

Spotting has been recognized as a key feature of extreme fire behaviour that is often associated with structure losses. For example, mass spotting into the community was cited as a factor that led to widespread losses in the 2011 Flattop Complex (Slave Lake) in Alberta.[17] In BC, fire personnel have witnessed significantly larger sections of loose bark becoming firebrands in forests that have been attacked by the mountain pine beetle.

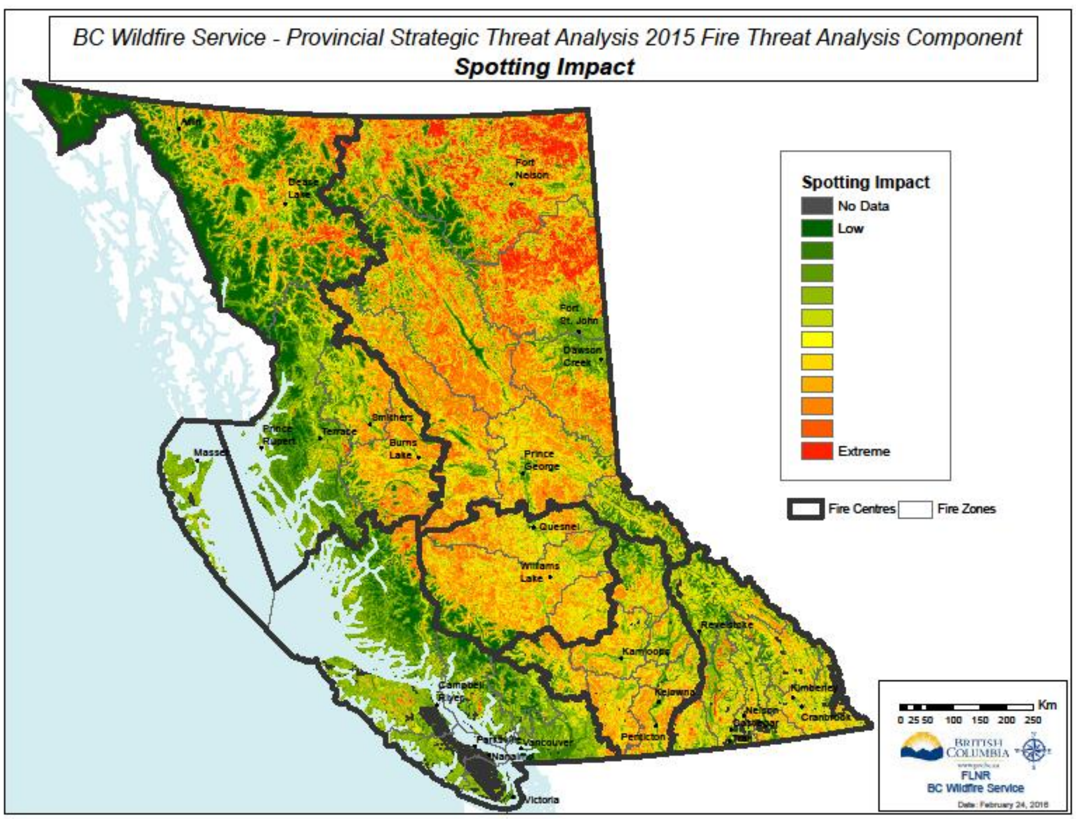
[17] See http://wildfire.alberta.ca/wildfire-prevention-enforcement/wildfire-reviews/documents/FlatTopComplex-WildfireReviewCommittee-A-May18-2012.pdf

In the Fire Behaviour Prediction System, the effects of short-range spotting (less than 400 metres) are accounted for; it is assumed that the flaming front continually overtakes these spot fires before they are able to start independent fires on the landscape. Spotting impact was included as a separate layer in the WTA to account for the risk of ember attack that is distinct from the risk presented by the flaming front itself.

Spotting that occurs over greater distances can breach major fuel breaks such as roads, water bodies, and valleys to ignite independent fires. For fuel types that do not produce extensive lofted embers, spotting activity is lower and spotting distances tend to be much shorter.

The spotting risk analysis conducted as a component of the WTA was based on estimating the threat to a given point on the landscape from the mosaic of fuels surrounding it, up to a distance of two kilometres (for high risk fuel types; see Appendix section for details). The risk of spotting is known to be greater at shorter distances from individual fuel type patches. Distance class categories were analyzed as concentric circles around the target fuel patch, with higher ranking values associated with shorter distances, and with more volatile fuel types. The chance of spotting was considered to be “nil” for distances over two kilometres. Although spotting distances greater than this have been observed on rare occasions, this type of behaviour is neither common nor is it predictable.

FIGURE 12: SPOTTING IMPACT LAYER



FINAL WILDFIRE THREAT ANALYSIS

The three described data layers (fire density, headfire intensity (HFI) and spotting impact) were combined using a weighted averaging process. Weights were assigned as 30% fire density, 60% HFI (90th percentile) and 10% spotting impact. These weighted values were added together to produce a final fire threat analysis value ranging theoretically between zero to 100 (Figure 13).

Areas with a final value of zero consisted of areas that had no record of wildfire, were typed as non-fuel (such as alpine rock, glaciers and ocean areas), and were too distant to be at risk of spotting from nearby fuels. Other very low values could occur due to zero values in one or two of the three categories, such as areas of flammable fuels with no record of a large fire burning nearby (i.e. fire density equals zero) or non-fuel areas that are only at a slight risk of spotting.

Water bodies were overlaid on the final map and assigned to their own class, which is effectively zero. Even though they may be at a certain risk due to the spotting potential, there is no reasonable fire risk considered on open water.

The weighting system integrated the three identified components of fire threat: fire occurrence (fire density); suppression effort and fire impacts (head fire intensity); and spotting. The results of the final Wildfire Threat Analysis were then assigned to 10 classes to produce a detailed map of fire threats throughout British Columbia. These 10 classes represent a subjective best estimate of relative fire threats, taking into account fire occurrence history, predicted fire intensity under extreme conditions, and spotting impact.

The 10 Fire Threat Classes represent increasing levels of overall fire threat. Class 7 (with values from 33.1 to 40) is considered to be a threshold and the most severe overall threat classes are Class 7 and higher. Areas of the province that fall into these higher classes are most in need of mitigation, where it is feasible to do so based on the fuel types present in those areas.

Areas rated as Class 7 or higher are locations where the fire intensity, frequency and spotting risks can be severe enough to potentially cause catastrophic losses in any given wildfire season, if those ratings overlap with significant values at risk. These areas are considered to be particularly prone to wildfires, with a fire density representing approximately 30 or more escaped fires since 1950. They are also susceptible to crown fires (head fire intensity greater than 10,000 kW/m) and are most likely to be affected by spotting impacts.

It is important to note that analyses are limited by the data inputs. The Wildfire Threat Analysis is sensitive to certain factors, most notably the fuel data layer that drives the fire behaviour elements. Important assumptions and limitations include the following:

1. Limited accuracy of the fire history point data; data collected over many years by hundreds of individuals using different standards, technologies (e.g. paper maps vs. GPS) and assumptions will vary in quality regardless of the diligence of technicians or record-keeping.
2. Fuel type classifications are best-fit approximations of biomass structure and are limited by the availability and reliability of Vegetation Resources Inventory (VRI) data; in addition, fuel typing is limited by the small number of FBP fuel types, which tend to represent boreal and sub-boreal species and ecosystems better than BC’s coastal or cordilleran ecosystems.

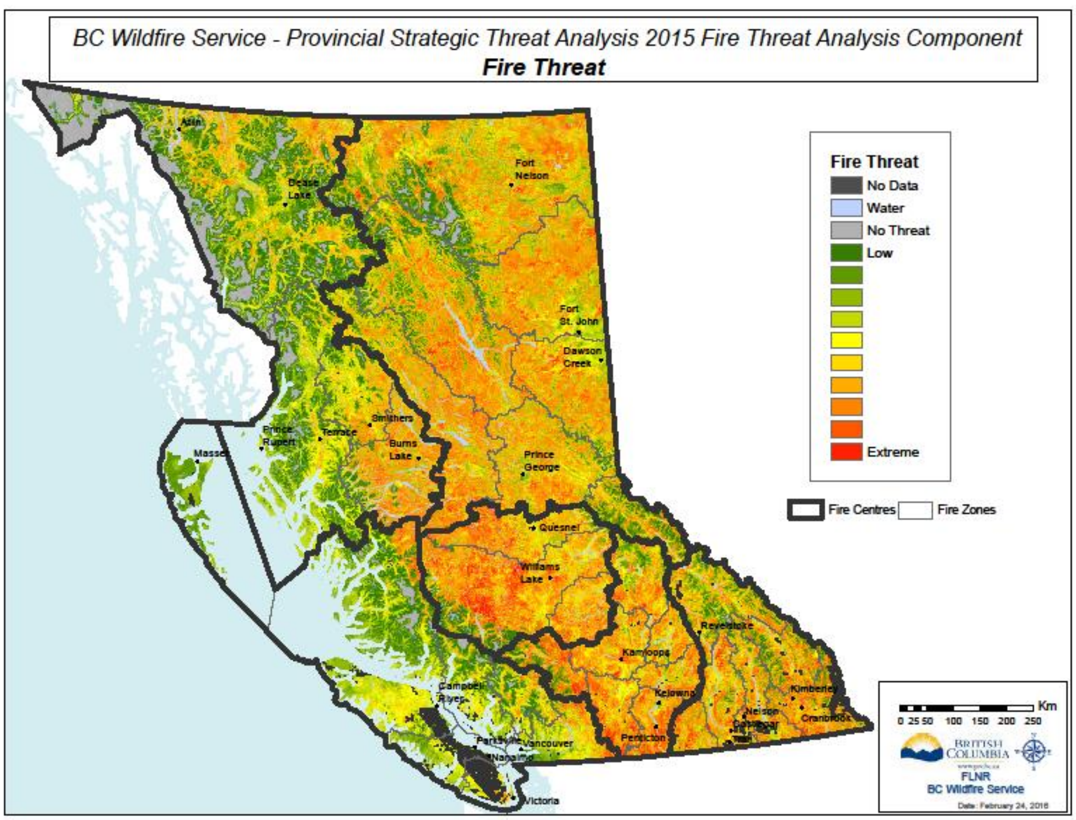
3. The fire threat data layer used the 90th percentile rating for head fire intensity (HFI), which represents a near worst-case scenario that may be artificial in some cases (e.g. slope-wind alignment assumed).

The PSTA 2015 Wildfire Threat Analysis represents an analysis conducted at a single point in time and does not consider future changes to fuels, land use, or climate into account. The BC Wildfire Service is in the process of producing the fire threat model annually with updated inputs, as the distribution and composition of fuels change (due to development, forest harvesting, fires or other landscape changes) and as the current model's assumptions are refined through new research or documented wildfire observations.

The output maps (e.g. Figure 13) are intended to help identify areas of B.C. where the risk to values (including communities) is high, and to help prioritize areas where proactive investment would help mitigate those potential impacts.

Local field inspections will be required to ground-truth the VRI data and verify if fuel type classifications are reasonable; these will help improve confidence in the model's final threat ratings.

FIGURE 13: PSTA 2015 FIRE THREAT ANALYSIS



ANALYSIS AT THE PLANNING UNIT LEVEL

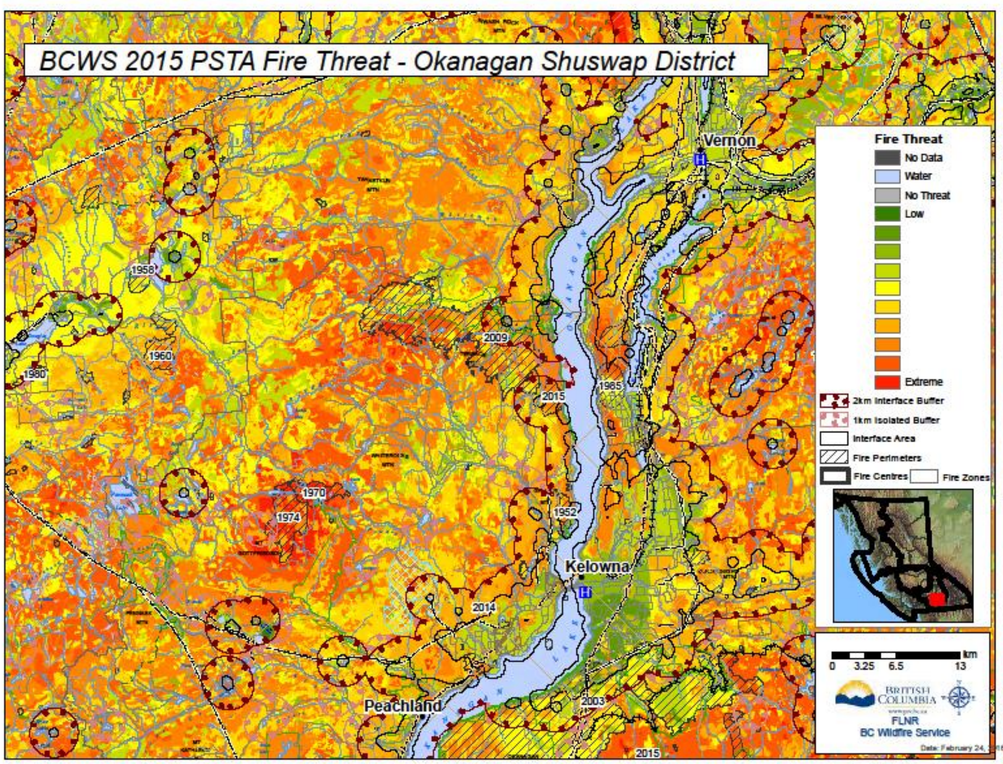
In British Columbia, Fire Management Plans are designed to support decisions related to integrated wildland fire response and resource management activities. The landscape section of a Fire Management Plan is the operational component where values at risk are prioritized, fire management objectives are described and mitigation treatment plans are developed. It also identifies strategies for fire use, where appropriate, to accomplish forest management goals and other land use objectives.

Fire management planning at the planning unit level provides an opportunity to co-ordinate a wide array of management actions to mitigate the potential impacts of wildfire on communities and other values at risk, including ecological restoration, modified wildfire response, modified stocking standards, species composition and other silviculture and harvest treatments.

The 2015 Wildfire Threat Analysis is a crucial part of the local fire management planning process. The next step is to evaluate the Wildfire Threat Analysis as it relates to values at risk in the area, to determine the most appropriate management actions.

Figure 15 shows an example of how the 2015 Wildfire Threat Analysis data can be combined with wildland urban interface (WUI) data (showing a two-kilometre buffer zone depicting the WUI) to identify and prioritize areas for potential fuel modification. This approach is being used at the planning unit level and in Landscape Fire Management Plans that are currently being developed (historic fire perimeter data is also shown in this example.)

FIGURE 14: OKANAGAN SHUSWAP PLANNING UNIT EXAMPLE



ACCESS TO INFORMATION

The Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis is available as provincial-scale PDF maps and as digital spatial data in the ArcGIS grid format.

The pdfs can be accessed from the following website: http://bcwildfire.ca/prevention

CONTACT INFORMATION

For more information about the 2015 Wildfire Threat Analysis data layer of the Provincial Strategic Threat Analysis, please contact:

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APPENDIX: PSTA FIRE THREAT CALCULATION DETAILS

This section describes additional details of how the different layers of the Wildfire Threat Analysis were calculated. It will be updated as the methods are further refined in subsequent analyses.

FIRE DENSITY

Fires larger than four hectares were captured as data points for the last 65 years (1950-2014). A kernel density analysis was conducted to represent the historic fire data as a seamless surface representing fire occurrence across the province; a 10 km search radius was chosen, and the pixel size was 50 m.

The ArcGIS kernel density function (v. 10.1; ESRI, Redlands, California, USA) fits a smooth surface to a spatial point frequency dataset, representing actual fire origin points as random samples from a smooth probability surface. The analysis search radius was 10 kilometres and this distance was reflected in the mapped output classes; thus, the fire density at any point on the landscape is a modeled probability value reflecting the number of historic fires found within a radius of 10 kilometres, or within a 314 km^2 circle around the point of interest. Note that this is different from a simple point density, and the values in the fire density layer classes do not represent the exact numbers of historic fires within the search radius; closer and more clustered fires are weighted higher within that circle, and this can result in significantly higher values than may be expected compared with a simple point search.[18]

The threshold of four hectares has, by convention, discriminated between small “initial attack” fires and larger “escaped” fires. An additional weighting category for larger, project-class fires was developed to give greater influence to these historically costly and high-impact events. Fires larger than 500 hectares were weighted five times more than those fires covering between four and 500 hectares.

The output values therefore represent a modeled probability approximately representing the number of nearby fires (4 ha and greater, treating 500+ ha fires as 5 individual events) since 1950. Using this as an input to the WTA layer is based on the premise that areas that were prone to multiple larger fires in the past are likely prone to larger fires in the present and near future.

Final class limits are shown below, based on the weighting scheme described above: fires from 0 to 4 hectares (not counted, weight of 0); fires from 4.001 to 500 hectares (weight of 1**)**; fires 500.001 hectares or larger (weight of 5**)**. Units are approximate weighted fire frequency within a 10 km radius, 1950-2014:

1. 1 - 5
2. 5.1 – 10
3. 10.1 – 17

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[18] For more information on kernel density calculation, see the ArcGIS help page for kernel density analysis: http://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/how-kernel-density-works.htm .

For the formal statistical reference, see Silverman, B. W. 1986. Density Estimation for Statistics and Data Analysis. New York: Chapman and Hall.

4. 17.1 – 24
5. 24.1 – 33
6. 33.1 – 45
7. 45.1 – 60
8. 60.1 – 82
9. 82.1 – 116
10. > 116

HEADFIRE INTENSITY

As described in the text, headfire intensity (HFI) values were analyzed based on the 90th percentile fire weather indices. These were calculated by interpolating daily weather records from the network of active and archived BC Wildfire Service and other (e.g. Environment Canada, BC Ministry of Environment SnowPillow, etc.) weather stations.

To be included in the analysis, individual weather stations needed to have a minimum of 5 years of data and have been active within the past 20 years (since 1995). To calculate the 90th percentile indices, station data were first adjusted to sea level (zero elevation), then spatially interpolated to a 50 m grid across the province using inverse distance-weighting. Zero-elevation HFI values were calculated using the C-2 fuel type for ranking purposes; associated 90th percentile FWI values were then adjusted to actual elevation, and used to calculate 90th percentile HFI values using actual fuel types from the provincial fuel type layer. Much more detailed methodology is described in a summary report available from BC Wildfire Service HQ in Victoria.[19]

The intensity values in the HFI data layer therefore represent daily peak burning headfire intensity values representative of a small number of days (~ 1-15) in an average year based on the fuels identified in provincial inventory in early 2014. By definition, these represent high to extreme values for any given location.

It is important to remember the modelling assumptions associated with this analysis: the assumptions behind the provincial fuel type layer; aligned wind-slope interactions (i.e. assuming that the wind always blows uphill, the worst-case scenario); and the use of broad average environmental lapse rates to account for elevation effects, among others.

The final classification scheme for the HFI (90th percentile weather) layer was chosen to represent accepted fire intensity thresholds (in kW/m) associated with suppression difficulty, along with some additional classes added to further discriminate between intensity levels at the high end (i.e. crown fires):

1. 0.01 – 1,000
2. 1,000.01 – 2,000
3. 2,000.01 – 4,000

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[19] See B.A. Blackwell and Associates and Pacific Phytometric Consultants. 2015. Spatial head fire intensity coverage, final report. Presented to Ministry of Forests, Lands, and Natural Resource Operations. On file at BC Wildfire Service HQ, Victoria, BC.

4. 4,000.01 – 6,000
5. 6,000.01 – 10,000
6. 10,000.01 – 18,000
7. 18,000.01 – 30,000
8. 30,000.01 – 60,000
9. 60,000.01 – 100,000
10. ≥ 100,000

SPOTTING IMPACT

As described in the text, spotting was modeled by fuel type and by distance class from a given fuel type pixel. The risk of spotting within a given pixel was analyzed based on the risk presented by the surrounding fuel pixels, with distance radii based on fuel type.

Spotting values therefore represent the estimated threat associated with 12 relevant fuel type-distance classes. The relative threat associated with each fuel type-distance class was ranked (“Spotting Rank”), based on expert opinions on the most frequent spotting concerns observed during wildfires.

FIGURE 15: SPOTTING DISTANCE POTENTIAL BY FUEL TYPE

Spotting Distance Potential By Fuel Type Chart

Fuel Type Categories:	Fuel Type Spot Potential	Spotting Distance	Spotting Distance Potential	Spotting Rank	Weighting Factor
1: C1, C2, C4 M1-M4 (>75% C/DF)	**High**	0-500m	Very Likely	1	400
	High	501-1000m	Likely	4	40
	High	1001-2000m	Possible	8	7
	High	>2000m	Unlikely	0	0
2: C3, C7, M1-M4 (50-75% C/DF)	**Moderate**	0-500m	Very Likely	2	300
	Moderate	501-1000m	Likely	5	30
	Moderate	1001-2000m	Possible	9	5
	Moderate	> 2000	Unlikely	0	0
3: C5, C6, O1a/b, S1- S3[1] M1-M4 (26-49% C/DF)	**Low**	0-300m	Very Likely	3	250
	Low	301-600m	Likely	6	25
	Low	601-1000m	Possible	10	3
	Low	> 1000m	Unlikely	0	0
4: D1, D2, M1-M4 (<26% C/DF)	**Very Low**	0-300m	Very Likely	7	10
	Very Low	301-600m	Likely	11	1
	Very Low	601-1000m	Possible	12	0.1
	Very Low	> 1000	Unlikely	0	0
5: All non-fuels	**N/A**	N/A	N/A	N/A	N/A

1. Spotting in O1/ S-types is dependant/ enhanced by standing timber within the fuel type
* Spotting distance is based on the type/size of the spotting material (needles, twigs, bark flakes or cones), the height that the material is lofted above the canopy and the general wind speed above the canopy.
** Spotting distance must be corrected for mountainous terrain (i.e. Spots lofted from a height of land can travel further than a spot lofted from a source in a valley bottom.

The rank values were assigned risk scores (weighting factor), which were adjusted to normalize the areas (since the larger concentric circles cover much more area than smaller ones). Each raster pixel (50 metre resolution) was then assigned a total score based on the sum of risk values contributed by all pixels within a radius of 1-2 kilometres. Based on this total score, the landscape was categorized into 10 spotting classes ranging from low to extreme.

The classes were created by automatic classification, using the "natural breaks (Jenks)" setting of the ArcGIS 10.1 Spatial Analyst extension. Differences are caused by fuel type classes and distances, with no consideration given at this time to elevation or dominant wind direction. Future versions of this analysis will likely address both of these factors.

The spotting impact data layer is experimental and has not been tested extensively. It is meant to only represent the threat posed by spotting (ember lofting) from a nearby wildfire (upwind), regardless of the impact of the actual flaming front of the fire.

Spotting impact class limits are approximate and represent dimensionless relative values:

1. 1 – 15,757.4
2. 15,757.41 – 33,765.9
3. 33,765.91 – 54,775.8
4. 54,775.81 – 76,536.0
5. 76,536.01 – 96,045.2
6. 96,045.21 – 115,554.4
7. 115,554.41 – 133,562.8
8. 133,562.81 – 152,321.6
9. 152,321.61 – 171,830.8
10. 171,830.81 – 191,340

FINAL FIRE THREAT CALCULATION AND CLASSIFICATION

As described in the text, the three components were combined in a weighted average as follows:

- 60% HFI (90^{th} percentile)
- 30% fire density
- 10% spotting impact

The 10 Fire Threat Classes are presented below; class limits represent the weighted average of three input layers described above:

Class 1	0.1 - 5 (lowest threat)
Class 2	5.1 - 10
Class 3	10.1 - 15
Class 4	15.1 – 20
Class 5	20.1 – 27
Class 6	27.1 – 33
Class 7	33.1 – 40
Class 8	40.1 – 47
Class 9	47.1 – 55
Class 10	55.1 – 81 (highest threat)

Although the classification scheme theoretically ranged from zero to 100, the highest value in the data was 81. The classes were then scaled to balance out the distribution of values while still maintaining meaningful thresholds of fire density, HFI, and spotting at higher levels.

Although the final map only displays the 10 overall Fire Threat Classes, raw data from the three input layers (fire density, head fire intensity and spotting impact) can be provided by request. Contact BC Wildfire Service staff for details.