City of Fernie
Community Wildfire Protection Plan Update

Submitted By:
B.A. Blackwell & Associates Ltd.
270-18 Gostick Place
North Vancouver, BC V7M 3G3

Submitted To:
City of Fernie
501 3rd Ave
Fernie, BC V0B 1M0

September 2018

B.A. Blackwell & Associates Ltd.

ACKNOWLEDGEMENTS

The authors would like to thank City of Fernie staff, particularly: Ted Ruiter, Fire Chief; Bruce Lennox, Director of Planning; Lisa Janssen, Engineering Technologist and GIS Administrator; Patrick Sorfleet, Planner; and Derek Cimolini, Planning Technician, for their input and support. Municipal staff invested substantial time in meetings, answering questions, reviewing and commenting on the contents of this document. Their input and recommendations were invaluable to the development of the strategy.

In addition, the authors would like to thank Mike Morrow, BC Wildfire Service Fuels Management Specialist Southeast Fire Centre; Andre Chalabi, Forest Protection Technician Cranbrook Fire Zone; Mike Daigle, Stewardship Forester and Steve Jablanczy, Resource Manager, Rocky Mountain Natural Resource District; Kelly Johnston, Executive Director, Partners in Protection FireSmart Canada; Don Mortimer, Fireline Consulting; and Tom Boechler, Office of the Fire Commissioner, and Alan Westhaver, ForestWise Environmental Consulting for their cooperation, expertise, input, and insight.

Community input and engagement was a key component to formulating this plan. The following community members / stakeholders graciously donated their time and input, which is much appreciated: Travis Abbey, Regional District of East Kootenay; Andy McCuaig, Jemi / Canwel; Ryland Nelson, Wildsight; Kori Vernier; Reto Barrington; Simon Howse, Parastone; Chuck Shoesmith, Shoesmith Construction; Steve Thomson; Chrisy Hill, Columbia Basin Alliance for Literacy; Tim Hicks, Columbia Basin Trust; Patrick Major, Fernie Alpine Resort; and Patty Vadnais, Fernie Chamber of Commerce.

Appreciation goes out to the Ktunaxa Nation Council for their review and input into this document.

This report would not be possible without the Strategic Wildfire Prevention Initiative (SPWI) Program and funding from the Union of British Columbia Municipalities (UBCM).

EXECUTIVE SUMMARY

The Community Wildfire Protection Plan (CWPP) process was created in British Columbia (BC) as a response to the devastating 2003 wildfire in Kelowna. As an integral part of the Strategic Wildfire Prevention Initiative (SWPI), managed and funded through the Union of British Columbia Municipalities (UBCM), CWPPs aim to develop strategic recommendations to assist in improving safety and to reduce the risk of damage to property from wildfires. In 2005, a CWPP for the City of Fernie hereinafter referred to as the "City" or "Fernie", was completed to help guide the City in wildfire risk reduction and mitigation activities.

This document intends to update the 2005 CWPP and assess the threat of wildfire within and around the municipality. This update examines the effectiveness of completed work, identifies opportunities for improvement within existing programs, and describes potential future initiatives.

The strength and effectiveness of a CWPP are founded in working across a wide range of disciplines to capture and integrate proven FireSmart® principles, practices and programs for mitigating wildfire losses.[1] A CWPP addresses wildfire risks at all spatial scales, across multiple disciplines, on private and public lands and recommends a coordinated mix of synergistic actions towards reducing wildfire losses.

Since the development of the last CWPP in 2005, the City has made progress at reducing wildfire risk by implementing recommendations from the CWPP and embarking on additional positive mitigative measures not outlined in the 2005 CWPP. The most notable actions include the following[2]:

- Update of the website to include wildfire specific links, including to the BC Wildfire Service (BCWS) and FireSmart information (Recommendation #2);
- Working with Chamber of Commerce to educate local business community on FireSmart preparation and planning (Recommendation #3)
- FireSmart initiatives such as distributing FireSmart information at public events and throughout prioritized neighbourhoods (Recommendation #5);
- Maintaining a high level of wildfire and interface fire-specific training for emergency response (Recommendation #13);
- Fuel treatment on approximately 10 hectares (ha) of municipally owned land in the Ridgemont area (Recommendation #16);
- Fuel treatment prescriptions completed by a qualified professional (Recommendation # 22); and,
- Formal recognition of wildfire as a natural hazard and a threat to public life and safety; commitment to implementation of risk reduction efforts in the Official Community Plan.

The main objective for the City should not be wildfire exclusion, but instead ensuring public safety and mitigating or avoiding wildfire loss. Because of the complexity of land ownership within and surrounding the City, the City

[1] FireSmart is the registered trademark name for a comprehensive set of principles, practices and programs for reducing wildfire losses held by held by the Partners in Protection Association

[2] A full enumeration of recommendations and implementation status from the 2005 CWPP can be found in Appendix A.APPENDIX A: STATUS OF 2005 CWPP RECOMMENDATIONS

must place a strong emphasis on communicating, educating, and engaging with the public to increase the sense of home, business, and land owner responsibility and the role that they play in reducing the vulnerability of their land and structures to wildfire. The ultimate goal is to spur landowners and residents to put wildfire mitigation principles into action using their own resources. Risk communication, education on the range of available mitigative activities, removal of barriers to action, and prioritization of activities should help homeowners to feel empowered to complete simple risk reduction activities on their property.

Wildfire management requires a multi-faceted approach for greatest efficacy and risk reduction. A total of 35 strategic recommendations in five different categories are outlined as part of this CWPP update. Because the study area extends outside the City boundary and therefore outside City jurisdiction, and the vast majority of forested land within the study area is owned privately, the City's role may be limited to the role of an 'influencer', while other recommendations can be directly implemented by the City. The recommendations are displayed in totality in Table 1. Ultimately, the recommendations within this strategy should be considered a 'buffet' of options to help reduce the wildfire threat to the community. There is not one combination or course of action which is the answer; the City will have to further prioritize based on resources, strengths, constraints, and availability to funding and regularly update the prioritization and course of action as variables change through time.

Table 1. Wildfire mitigation recommendations for the City of Fernie.

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
Communication and Education (Section 8.1)			
Objective: To improve public understanding of fire risk and personal responsibility by increasing resident and property owner awareness of the wildfire threat in their community, to establish a sense of responsibility for risk mitigation among property owners, and to empower them to act.			
1	High	This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings, workshops and conferences.	1 – 6 hours, depending on method of distribution
2	High	Periodical updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. The frequency of updates is highly dependent upon major changes which would impact the City's wildfire threat assessment or the rate at which wildfire risk reduction efforts are implemented. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.	UBCM/ SWPI funding/ Municipal funding (SWPI funds up to 75% of update cost)

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
3	High	Continue to expand and facilitate the FireSmart Canada Community Recognition Program with the ultimate goal of achieving FireSmart recognition status for 15 neighbourhoods. Specific actions to enhance the FSCCR Program should include: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.	$5,000 / neighbourhood and an additional 40 hours / initiative UBCM / SWPI grant(s) available
4	High	Develop several small (i.e. <1.0 ha.) FireSmart demonstration sites within the community to exemplify and showcase recommended FireSmart guidelines for appropriate vegetation/ fuel management; engage local property owners to assist as volunteers in creating these sites. Advertise and sign these locations to maximize educational and learning value to the community. Invite BCWS crews to assist with FireSmart demonstration sites with falling, pile burning, and other operational skills. Some potential locations eligible for UBCM / SWPI funding are identified in Section 8.5.1.	UBCM / SWPI grant(s) available, depending on land ownership Cost for work on private land depends on time donated/ level of participation Project management is ~40 hours per site
5	Moderate	Review current social media effectiveness and create a social media strategy to ensure that the full power of social media is leveraged to communicate fire bans, high Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information. Consider pursuit of social media 'champions', with large, established networks and a high level of community and social media engagement, to amplify the City's messaging regarding wildfire mitigation strategies and to endorse the FireSmart message.	~20 hours to review. ~40 hours to create strategy. ~20 hours to identify partners, initiate relationship, and gain strategy support. Additional daily/weekly hours to implement, depending on strategy.
6	Moderate	Explore potential partnership with Columbia Basin Alliance for Literacy (CBAL) to either include FireSmart and emergency preparedness into currently existing programs or to facilitate development of a FireSmart and emergency preparedness specific program for their clients.	~20 hours to gather information, meet, and discuss programming

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
7	Moderate	Encourage all local schools (private and public) to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/ value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (Cranbrook Zone), as well as local fire officials and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary (and/or secondary) schools.	20 - 40 hours
8	Moderate	Aim to increase wildfire danger (Fire Danger) rating awareness throughout the community during the fire season. Options include: 1) providing updated fire danger rating on City homepage during the fire season. The danger rating could be updated on the right-hand 'Important Messages' section, or 2) engaging BCWS Cranbrook Zone to install a fire danger rating sign in a strategic location in the City (Chamber of Commerce, for example). For both strategies, maintenance by the City is key to the success and effectiveness of the initiative. Signs that are not kept updated may foster apathy or disbelief. (Physical sign maintenance would likely be on the higher side of weekly estimates, whereas website update would be on the lower side.)	2 - 4 hours per year initial set up (engage BCWS; add Fire Danger section to website, for example). ~2 - 4 hours per week (daily check and update, as required) throughout the fire season.
9	Moderate	Supply FireSmart materials to homeowners in the interface. FireSmart informational materials could be mailed out annually with tax assessments or in the quarterly utility bill mail out to ensure they get to homeowners, both full-time residents and second-home owners.	~4 hours. May be eligible for UBCM/ SWPI grant.

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
Communication and Education (Section 8.1)			
Objective: To enhance the awareness of, and participation by, elected officials and all Wildland Urban Interface (WUI) stakeholders regarding the proactive WUI risk mitigation activities.			
10	Very High	Develop and work with all key stakeholders (adjacent jurisdictions, governments, provincial agencies, utilities, recreational groups, City staff, major land developers, etc.) to establish an Interface Steering Committee. Initial invitees should consider, but not be limited to, the potential partners outlined in Section 2.4. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) The complexity of land ownership within the study area and development of a coordinated approach to fuel management and hazard reduction within and adjacent to the City by member stakeholders. 2) Development of large, landscape level fuelbreaks. 3. Public education and awareness needs. 4) Multi-disciplinary, multi-jurisdictional fuel treatment projects/ hazard abatement projects. 5) Development of a funding strategy. 6) Reduction of human-caused fires, fire prevention and right of way management.	~40 hours to initiate group; an additional ~50 hours/ year to plan, advertise/ communicate, attend, and debrief meetings; additional hours required depending on implementable actions and potential sub-committees developed
Communication with Industry (Section 8.1.1)			
Objective: To reduce the risk of ignition from industrial sources.			
11	Moderate	Work with industrial operators to ensure that right-of-ways do not contain fine fuel accumulations (easily cured) prior to the fire season and further are maintained in a low hazard state. Work with industrial operators to ensure that high risk activities, such as right of way mowing, do not occur during high or extreme fire danger times to reduce chance of ignitions. Industrial operators include CP Rail, BC Hydro, and private land holders.	2 - 4 hours
12	Moderate	Work with BC Hydro to ensure that hazard trees along distribution lines are assessed regularly. Work with BC Hydro to ensure that transmission line right-of-ways are maintained in a moderate hazard state and dead, fine fuel accumulations do not occur. Generally, ensure the transmission right-of-ways are in moderate or low hazard state and serve as fuelbreaks.	2 - 4 hours

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
Structure Protection and Planning (Section 8.2)			
Objective: Improve the FireSmart conditions of the City by encouraging home and property owners to voluntarily increase FireSmart compliance and improve suppression abilities for interface areas.			
13	Moderate	Consider working with local distributors on improving education of homeowners and removing some of their barriers to action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include: 1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions / advice for homeowners. These distributors can be educated upon which supplies are FireSmart and in what configuration they can be used (for example, external sprinkler system equipment, aggregates and ground cover, wire mesh for vents, deck skirting). 2) Advocating for a FireSmart branding in the retail outlets (could be stickers on shelf pricing or a FireSmart-specific section) to increase public exposure to projects that can be done at a relatively low cost. 3) Compile a database of local service providers and retailers who can help to install or complete FireSmart home improvements. These providers may be able to further partner to flesh out a list of FireSmart options for various home improvements, based upon a range of variables (for example, price, time to deliver, installation costs, and aesthetics).	~60 hours
14	Moderate	Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood and green waste removed from their property. Programs may include scheduled community chipping opportunities, free wood/ yard waste drop-off in Fernie, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends.	Time dependent upon program. May be eligible for UBCM/ SWPI grant. Additional time for advertisement of program availability will be required.
Objective: Enhance protection of critical infrastructure from wildfire.			
15	High	Complete a vulnerability assessment of all critical infrastructure, including water supply, in interface areas (secondary power sources, FireSmart compliance) and mitigate/ upgrade as required. FireSmart projects on City-owned structures or assets can be used as public-education/ demonstration projects to display the practices and principles of FireSmart and the City's commitment to wildfire threat reduction. Prioritization of projects can be based upon immediate reduction of fire hazard and vulnerability to fire, cost efficiency, and/or visibility to public.	~60 hours to complete vulnerability assessment and FireSmart upgrading dependent upon project(s) chosen
16	Moderate	Consider identifying areas of poor hydrant placement and/or spacing and development of a prioritized list for improvements and upgrades. Hydrant placement and/ or spacing could be improved and updated, for identified areas, during paving projects, which would improve suppression capabilities within the City gradually over time. Area identification could be based upon the compliance/ non-compliance with the amended Subdivision and Development Servicing Bylaw 1727, 1998 around hydrant spacing and placement (see recommendation #31).	3 hours to create prioritized list of areas. Cost of improvements dependent upon project.

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
17	Moderate	Work to increase awareness of, and define, post-wildfire risk levels, particularly regarding potential hydrological impacts post-burn. Consider developing response plans for stabilization and rehabilitation of burn areas which may have a lower threshold for precipitation and are vulnerable to post-wildfire debris flows, landslides, avalanche and/ or flooding. Explore the option of avalanche and flood risk assessments considering the potential hydrologic and geomorphic impacts of wildfire on the watershed in future assessments.	Outsource ($5,000 - $15,000)
Emergency Response and Preparedness (Section 8.3)			
Objective: To improve structural and wildfire equipment and training available to Fernie Fire Rescue.			
18	High	The City of Fernie to work on continuing and regularizing frequency of annual cross training opportunities with BCWS. Interface training could include completion of a mock wildfire simulation in coordination with BCWS and instruction on early detection and reporting of wildfires, in addition to current meeting agenda of confirming capabilities and roles of the Zone and Fire Rescue on interface fires. Training could be coordinated with other fire departments in the area (RDEK: Baynes Lake, Elko, Hosmer, Jaffray) to enhance regional firefighting capabilities. It is recognized that BCWS crew resources are limited and their availability is highly dependent upon the current fire season and other BCWS priorities.	Within current operating budget
19	High	Engage in regular cadence of communication with the BCWS Cranbrook zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities. Twice per year is likely sufficient cadence, unless a cooperative opportunity is recognized, which would require additional hours to implement.	4 hours
20	High	Ensure that the City maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain Fire Rescue member certifications (career and paid-on-call) with Structure Protection Program – Wildland Firefighter Level 1 (SPP-WFF 1) certification, currently offered internally by certified trainers. Consider additional training to improve wildfire preparedness. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural fire fighters on the use of wildfire pumps and hose, and fire service hose and hydrants, in the application of sprinkler protection units (SPU). The OFC is currently developing additional wildfire-specific Officer-level training courses; the City should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources / budget allow.	Within current training budget (SPP-WFF 1 currently implemented; SPP 115 course is 8 hours)
21	High	In light of the 2017 fire season, it is recommended to review the local application of fire bans, motorized vehicle and back country bans (on Crown and private land) and the communications and enforcement of the bans. Identify successes, lessons learned, and potential improvements for future application.	~2 – 6 hours

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
22	Moderate	Review web-based applications to assist Fire Rescue in personnel / resourcing organization and planning. Consider implementing web-based application supported by dispatch.	10 hours to review applications/ application subscription ~$1,000 annually
23	Moderate	Coordinate with the RDEK to provide or encourage the use of visible house numbers and furthermore to provide instructions about how and where best to affix them to facilitate emergency response (RDEK jurisdiction currently covered by the Fernie Fire Rescue through a Fire Service Agreement). Visible addressing is included in both the RDEK CWPP, as well as the Fire Service Agreement (Bylaw 2203, 2013).	2 – 4 hours
Objective: To improve ability to enforce FireSmart compliance on private lands.			
24	High	Review and amend Bylaw No. 2029, Fire Protection Life and Safety, to explicitly include items prohibiting hazardous accumulations of combustible materials on private property and allow the City the ability to issue an order to reduce any combustible accumulations identified as unsafe. Bylaw 1587 may be an additional, or alternative, vehicle to accomplish the objective.	~20 hours
Emergency Response (Section 8.3.1)			
Objective: To improve access and egress and enhance emergency preparedness.			
25	High	The City should identify areas of inadequate emergency response access/ resident egress. Areas identified as lacking secondary access or inadequate access for the purpose of fire suppression and wildfire evacuation should be prioritized and assessed for feasibility for improving access over the long-term. It is recognized that this will not always be possible. However, where secondary routes could potentially be established as development grows or on existing right-of-ways, these opportunities should be further investigated. Gated secondary access for emergency responders may be an option in some areas. FAR and the Lodge Trail Lane area are initial priority areas for review.	~20 hours to create a prioritized list and assess feasibility
Objective: To expand the view of the trail system to include one with a wildfire lens.			
26	Moderate	Work with the Fernie Trails Alliance (FTA) to develop standards for the abatement of residual activity fuels associated with trail building and trail maintenance. Ensure trail crews are aware of mitigation of fuels accumulations that may result from regular maintenance activity. Standards should include fuel disposal or mitigation methods (scattering, chipping, burning, or removal, dependent upon location, amount of material, and access). Fuels from trail maintenance and trail building should not be allowed to accumulate trailside. FTA volunteers should be knowledgeable of their obligations under the Wildfire Act and Wildfire Regulations.	2 - 4 hours of outreach

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
27	Moderate	Develop a Total Access Plan to map and inventory back roads and trail network in and around the City for suppression planning, identification of areas with insufficient access, to aid in strategic planning and, if necessary, evacuation and/or area closure efforts in non-residential/ recreational areas in the event of a wildfire in the area. The Fernie Trails Master Plan (TMP) identified the need for consolidation of multiple data sources to create comprehensive trail mapping for the City of Fernie. The Total Access Plan can build upon currently available trails mapping, including back country roads, and specific access attributes, such as width, surfacing, and clearance. Identify and prioritize trails with potential to act as surface fuel breaks and provide access for suppression crews (for example long portions of the Trans Canada Trail are sufficient to currently serve as surface fuel breaks, as well as provide emergency access via ATV or pick-up truck); establish standards for trails to meet those objectives. The plan should be updated periodically, as needed to incorporate additions or changes; data can be supplied by Fernie Trails Alliance as trails are built, upgraded, or decommissioned. Leverage, or build upon, the currently existing database; potential partnership with Fernie Trails Alliance may help to offset costs.	~80 – 100 hours ($5,000 - $10,000)
Planning and Development (Section 8.4)			
Objective: To utilize regulatory and administrative tools to reduce wildfire hazard on private land and increase number of homes compliant with FireSmart guidelines (with low ignition potential).			
28	Very High	Review the Official Community Plan (OCP); consider including wildfire as a natural hazard development permit (DP) area. Review similar DPs established in other jurisdictions and use as models for various aspects of the DP process. The first step is to establish DP objectives (e.g. minimize risk to property and people from wildland fires; minimize risk to forested area surrounding Fernie; conserve the visual and ecological assets of the forests surrounding Fernie; reduce the risk of post-fire landslides, debris flows, avalanches, and erosion, etc.). To meet objectives, consider including the following elements: 1) minimum setbacks from forested edge based on FireSmart guidelines, 2) fuel management completed by qualified professionals and based upon FireSmart guidelines, 3) landscaping to an established standard, 4) building materials and design based on NFPA 1144 or FireSmart standards, 5) underground servicing, 6) prompt removal of combustible construction materials or thinning/ fuel management waste, 7) minimum lot size/ housing density, 8) allowing the City to require designation of a coordinating professional for DP applications that are deemed to be particularly complex and which fall into overlapping and possibly partially conflicting DP areas.	~200 hours

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
29	High	Consider engaging the development/ building community (may include developers, builders, landscapers, and architects) in DP development process. This can be accomplished through a series of workshops/ informational sessions to: 1) increase awareness of wildfire risk in Fernie, 2) demonstrate that there are a variety of actions which can be undertaken to immediately and measurable reduce the risk to the homeowner and community, 3) discuss various strategies and actions which could be implemented to meet DP objectives, 4) educate and inform regarding the DP process and expectations.	~40 hours
30	Moderate	Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, and reduce wildfire hazard. Consider including the landscaping standard as a requirement of Development Permits within the DP area, as well as making it publicly available for residents and homeowners outside of the DP area (can be provided at issue of building permit and made available at City Hall or other strategic locations).	10 - 12 hours or $2,000 - $3,000 to outsource. Alternatively, general FireSmart landscaping information is available free of charge, but is not climate/ plant hardiness zone specific
Objective: To consider wildfire mitigation in the development of new subdivisions.			
31	High	Review Subdivision and Development Servicing Bylaw No. 1727, 1998, with consideration towards: 1) Sufficient emergency access and egress. New subdivisions should be developed with access points that are suitable for evacuation and the movement of emergency response equipment. The number of access points and their capacity should be determined during subdivision design and be based on threshold densities of houses and vehicles within the subdivision (NFPA 1141 is one recognized standard for subdivision design in wildland, rural and suburban areas which can be used as a reference). Two routes for access / egress are recommended. 2) Emergency response access, specifically working towards minimizing long cul-de-sacs, and allowing emergency vehicle turn around. Options include: requiring a secondary access point, either gravel or paved, to allow for emergency vehicle access and resident egress into and out of longer cul-de-sacs; and, requiring turnarounds with sufficient radius to allow for emergency vehicle turnaround on City and private access cul-de-sacs. 3) Hydrant placement to ensure that the Bylaw includes hydrant placement (and spacing) standards acceptable to the City and to allow for effective fire suppression. 4) Prohibition of accumulation of combustible construction materials during the main construction / fire season (currently the bylaw stipulates clean-up requirements specific to construction materials; consider adding language specific to combustible accumulations and its impact on wildfire hazard).	~30 – 40 hours

Item	Priority	Recommendation	Estimated Cost ($) or Person hours
32	High	Ensure that privately maintained hydrants are maintained at similar standards as those maintained by the City. Consider a Bylaw which mandates maintenance and flow testing for privately maintained hydrants and that testing records are provided to the City on a regular (annual) basis. Alternatively, consider an option in bylaw requiring City-provided hydrant testing for privately maintained hydrants. Cost recovery can be collected from strata, as determined by the City.	~30 – 60 hours, plus legal fees if required
Fuel Management (Section 8.5)			
Objective: Reduce wildfire threat on public lands through fuel management.			
33	High	Proceed with detailed assessment, prescription development and treatment of hazardous fuel units and FireSmart fuel treatment demonstration treatment areas identified and prioritized in this CWPP.	UBCM SWPI Funding / Municipal Funding (UBCM funds up to 75% of prescription development cost)
Objective: Maintain previously treated areas under an acceptable level of wildfire fire threat (moderate).			
34	High (no immediate action required)	Complete monitoring and maintenance every 5 – 7 years on previously treated areas. Treated areas should be assessed by a Registered Professional Forester, specific to actions required to maintain treated areas in a moderate or lower hazard. **Assessment of treated areas occurred as part of the CWPP Update**; the next scheduled monitoring is in 2022 – 2024 and fuel treatment activities to maintain the effectiveness of the treatment should be expected at that time.	UBCM SWPI Funding/ Municipal Funding
Objective: Reduce the wildfire threat to the City of Fernie with a cooperative approach.			
35	Moderate	Explore opportunities to complete larger-scale fuel management projects with Jemi Fibre Corp (Canwel); start a conversation regarding fire risk and mitigation in land / timber management decisions.	~10 hours

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

COMMONLY USED ACRONYMS

BCWS	British Columbia Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
CBT	Columbia Basin Trust
CFFDRS	Canadian Forest Fire Danger Rating System
CWPP	Community Wildfire Protection Plan
FAR	Fernie Alpine Resort
FSCCRP	FireSmart Canada Community Recognition Program
FESBC	Forest Enhancement Society of British Columbia
FMP	Fire Management Plan
HIZ	Home Ignition Zone
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
PSTA	Provincial Strategic Threat Analysis
RDEK	Regional District of East Kootenay
SWPI	Strategic Wildfire Prevention Initiative
TSA	Timber Supply Area
UBCM	Union of British Columbian Municipalities
WUI	Wildland Urban Interface

INTRODUCTION

In 2016, B.A. Blackwell and Associates Ltd. was retained to assist the City of Fernie (the City or Fernie) to develop an update to the Community Wildfire Protection Plan (CWPP).[3] City staff recognized that there have been significant changes within and around the City since the original CWPP was developed and furthermore, that these changes would have a direct impact on the threat of wildfire within the City, as well as the ability of the City to develop and implement strategies to reduce wildfire risk. Among these changes are: municipal boundary amendments, new development (residential, recreational, and commercial), changes to forest health in and around the City, and change in land ownership, directly impacting the key partners involved in any wildfire risk reduction initiatives.

Since the initial CWPP was developed, the provincial strategic threat analysis (PSTA data) has been updated by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD). Additionally, threat analysis methodology has been improved and solidified considerably since 2005, when CWPP risk assessment methodology was in the initial stages of development.

The aim of this CWPP update is to build upon, and where needed amend, the original 2005 CWPP. To that end, duplicate information will not be provided. Background information integral to the comprehension of the strategy is provided as an appendix.

Although forest fires are both inevitable and essential to the health of forested ecosystems, the 2003, 2004, 2009, 2010, 2015, and 2017 BC wildfire seasons resulted in significant economic, social and environmental losses. Recent wildfire disasters like those experienced in Slave Lake, Alberta (2011), Washington State (2014 and 2015), Fort McMurray, Alberta (2016) and the entire 2017 BC wildfire season are evidence of the vulnerability of communities and the potential toll of wildfires on families, neighbourhoods and the economy of entire regions. These events, along with critical lessons learned and important advances in knowledge and loss prevention programs have spurred the need for greater consideration and due diligence with respect to fire risk in the wildland/urban interface[4] (WUI).

Closer to home, the 1908 destruction of the City of Fernie by wildfire left scars still visible throughout the forests surrounding town, which help to serve as reminders of the need to be prepared well in advance. The expanded wildland/urban interface increases values at risk and the potential magnitude of wildfire losses; the extent of homes and businesses established in the valley is far greater now than it was 100 years ago. As well, other key determinants of extreme wildfire intensity, such as fuel conditions, have increased the wildfire risk substantially.

[3] A complete enumeration of the recommendations from the 2005 CWPP and status of implementation is found in APPENDIX A: STATUS OF 2005 CWPP RECOMMENDATIONS.

[4] Wildland/urban interface is defined as the presence of structures in locations in which conditions result in the potential for their ignition from flames and firebrands/embers of a wildland fire (National Fire Protection Association).

Each community has a unique risk profile. This CWPP update provides a reassessment of the level of risk with respect to changes in the area that have occurred since 2005 and gives the City of Fernie a current and accurate understanding of the threats faced by their community.

Specifically, the objectives of this update are to:

- Provide the City with an updated threat assessment considering new development, changes in forest health and fuels, and mitigative actions taken by the City and various actors within the study area.
- Refresh and prioritize mitigative action recommendations to address communication and education, structure protection, emergency response, planning and development, and fuel management.
- Ensure that new information, programs and initiatives pertaining to FireSmart goals are incorporated and integrated into an effective overall program of pro-active wildfire risk reduction for the City of Fernie.
- Assist the City of Fernie and its residents become better adapted to wildfires that may occur, and be more resilient (*i.e.* able to bounce back more quickly) when they do.

1.0 COMMUNITY PROFILE

The City of Fernie, hereinafter referred to as the 'City', is a community of approximately 5,250 residents[5] geographically located in the Elk Valley in southeastern British Columbia, near the Alberta border. Fernie is a member municipality of Area A of the Regional District of East Kootenay (RDEK). Fernie is renowned for its world class recreation and outstanding mountain environment. The City has deep roots in the coal mining industry and was incorporated as a municipality more than 100 years ago.

According to the 2016 Census, there are 3,032 private dwellings within the municipal boundary, approximately 800 of which are vacation or second homes which are occupied on a part-time basis. With anticipated inclusion of West Fernie into the City of Fernie limits, population and number of private dwellings are expected to increase.

Since the 2005 CWPP, the principal changes in the community are: substantial municipal boundary changes, significant population growth (18% since the 2011 census) and land subdivision and development. The economy of Fernie remains primarily based on natural resource extraction industries; however, the City has also established itself as a year-round recreation-based tourist destination.

An overview of the study area is illustrated below in Figure 1. The study area includes the municipal boundary and a 2 kilometer (km) buffer, Fernie Alpine Resort, and the Fire Services Area, which is currently serviced by Fernie Fire Rescue.

[5] Statistics Canada. 2017. *Fernie, CY [Census subdivision], British Columbia and Newfoundland and Labrador [Province]* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released February 8, 2017.
http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed April 3, 2017).

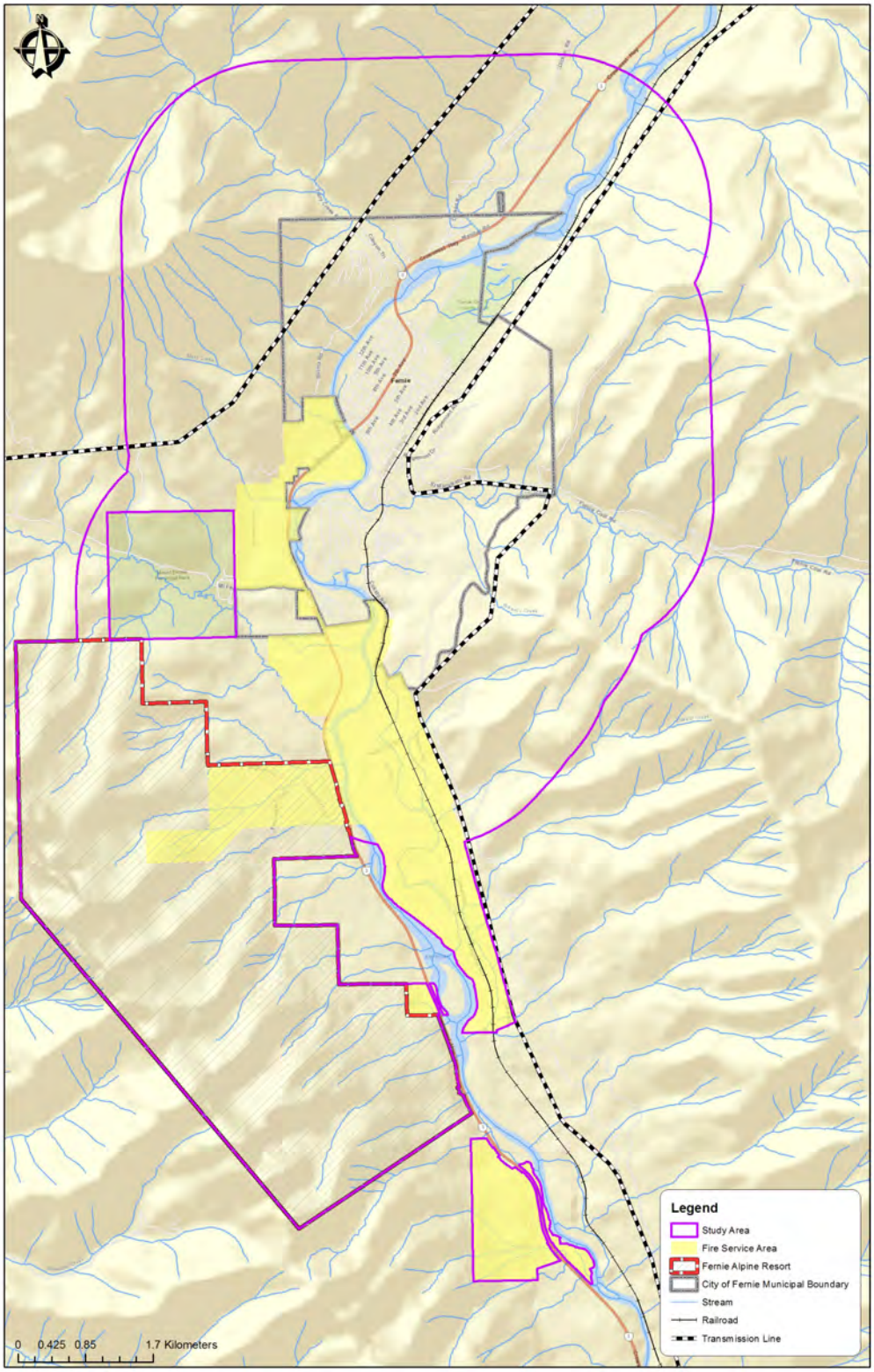


Figure 1. Overview of the Community Wildfire Protection Plan Update study area. [6]

[6] All mapping in this document uses projected coordinate system NAD 1983 UTM Zone 11N.

2.0 VALUES AT RISK

2.1 CRITICAL INFRASTRUCTURE

Protection of infrastructure during a wildfire event is important to ensure that emergency response is as effective as possible, to ensure that coordinated evacuation can occur if necessary, and essential services in the study area can be maintained and/or restored quickly. Critical infrastructure includes emergency and medical services, electrical service, transportation, water, and communications infrastructure.

The 2005 CWPP identified infrastructure critical to the function of the community. Table 2 details updates and additional infrastructure identified since the 2005 CWPP.

Table 2. Outlines critical infrastructure updates or infrastructure

Critical Infrastructure Type	Status – 2005 CWPP	Status – CWPP Update
Elk Valley Hospital	Identified	No change
Fernie Fire Rescue Hall	Identified	No change
Water supply	Surface water from a single watershed (Fairy Creek)	Primary source continues to be surface water from Fairy Creek, development of secondary source: James White Park well site. Additional infrastructure includes: water distribution control room, northwest reservoir, Fairy Creek Dam, 1st Street and Parkland PRV stations, and Alpine Trails booster station.
Electrical service	Distribution lines are primarily a network of wood poles.	Service from regionally integrated transmission network. Distribution is combination of wood poles and underground servicing.
Sanitary sewer system	Not identified	Seven main lift stations, two crossings (one river, one rail)
Power grid	Not identified	BC Hydro sub-station and Fortis Gas pressure station
BC Ambulance	Not identified	1301 6th Avenue
RCMP Detachment	Not identified	1302 5th Avenue
Fernie Search and Rescue	Not identified	102 Commerce Road
City Hall	Not identified	501 3rd Avenue
Emergency Operations Centre	Not identified	102 Commerce Road
Emergency Social Services Supplies	Not identified	Curling Club - 1062 Highway 3
Evacuation Centre	Not identified	Fernie Community Centre - 901 6th Avenue
Public works yards	Not identified	1492 Railway Avenue
Sewage lagoons	Not identified	South of study area on Cokato Road. Included in RDEK CWPP study area and mapping.[7]

[7] See Figure 9 for more information.

2.2 ENVIRONMENTAL AND CULTURAL VALUES

Environmental, cultural and recreational values are high throughout the study area. The area offers a range of outdoor activities for both tourists and residents, including motorized and non-motorized front and backcountry recreational pursuits. The City is surrounded by a vast network of trails, for both motorized and non-motorized use. Many of the trails are four-season, although usage spikes upon snow-melt in the spring and does not subside until the fall rainy season.

The study area is rich in biodiversity and includes no less than twelve tree species in variable forest types and seral stages, ranging from immature pure pine to old growth western redcedar stands. The study area provides habitat (seasonal, migratory, and yearlong) for a wide range of wildlife; a hike within this area often includes animal sightings of bear (grizzly or black), cougar, mule deer, mountain goats, moose, and elk. The study area also includes very high conservation value landscape linkages and wildlife connectivity corridors, which are vital to the movement and safe passage of wildlife. Fernie to Morrissey, Lizard Basin to South Elk Valley, Coal Cree to Elk Valley, and the Mount Fernie slopes are identified linkage areas that allow carnivores to move through and around the human development in the Elk Valley.[8]

The study area largely overlaps with spatially explicit ungulate winter range (UWR) u-4-006, which is designated as habitat for white-tailed deer, mule deer, moose, elk, bighorn sheep, and mountain goat as a Government Actions Regulation (GAR) order. General Wildlife Measures (GWMs) guide forest practices in these areas.

The City of Fernie is within Ktunaxa Nation traditional territory and within the Ktunaxa BC Treaty Area. Historically, the Ktunaxa people seasonally migrated throughout their traditional territory to obtain food, medicine, and materials for clothing and shelter from the land.[9] This practice occurred for thousands of years.

The City of Fernie is rich in post-settlement and mining history; values within the study area include historically significant structures such as the Heritage Library, City Hall, Court House, Catholic Church, Fernie Arts Station, and Fernie Museum, to name a few.

Other values within the study area include Crown and private forest lands managed for timber, and land that is administered by the Provincial Agricultural Land Commission (ALC) and therefore part of the Agricultural Land Reserve (ALR). The ALR lands, which include farmed, forested, or vacant lands, are extremely valuable to the community and the Province.

2.2.1 ENVIRONMENTAL VALUES

The Conservation Data Centre (CDC), which is part of the Environmental Stewardship Division of the Ministry of Environment, is the repository for information related to plants, animals and ecosystems at risk in BC. To identify species and ecosystems at risk within the study area, the CDC database was referenced. Two classes of data are

[8] Apps, C. D., J. L. Weaver, P. C. Paquet, B. Bateman and B. N. McLellan. 2007. Carnivores in the southern Canadian Rockies: Core areas and connectivity across the Crowsnest Highway. Wildlife Conservation Society Canada Conservation Report No. 3. Toronto, Ontario, Canada.

[9] http://www.ktunaxa.org/.

kept by the CDC: non-sensitive occurrences for which all information is available (species or ecosystems at risk and location); and masked, or sensitive, occurrences where only generalized location information is available.

There is one occurrence of Red-listed species and three occurrences of Blue-listed species within the study area (Table 3). There are no overlaps with masked occurrences. Through consultation with the CDC and a biologist or qualified professional, site level operational plans must determine if these occurrences will be impacted by fuel management or other wildfire mitigation activities. All future fuel treatment activities or those associated with recommendations made in this plan should consider the presence of, and impact upon, potentially affected species. Additionally, all site level operational plans should consult the most recent data available to ensure that any new occurrences or relevant masked occurrences are known and considered in the operational plan to mitigate any potential impacts on species at risk.

Consultations with a Ktunaxa biologist revealed that there are known occurrences of species at risk in the study area that are not available in the CDC database. For this reason, site level operational plans should consider the need for consultation with a qualified professional in wildlife biology.

Table 3. Publicly available occurrences of Red and Blue-listed species recorded within the study area. Data current as of date accessed: September 2, 2016. [10,11]

Species	Scientific Name	Category	BC List	COSEWIC
American badger	*Taxidea taxus*	Mammal	Red	Endangered
Booth's willow	*Salix boothii*	Vascular Plant	Blue	No status available
Canada anemone	*Anemone canadensis*	Vascular Plant	Blue	No status available
magnum mantleslug	*Magnipelta mycophaga*	Gastropod	Blue	Special Concern
Olive-sided flycatcher*	*Contopus cooperi*	Bird	Blue	Threatened
Western toad*	*Anaxyrus boreas*	Amphibian	Yellow	Special Concern
Western screech owl*	*Megascops kennicottii macfarlanei*	Bird	Red	Threatened
Fringed myotis*	*Myotis thysanodes*	Bat	Blue	Data Deficient

[10] * Information provided by Ktunaxa biologist as occurrences in the Fernie area, but which are omitted from the Provincial Conservation Data Centre database.

[11] B.C. Conservation Data Centre. 2017. BC Species and Ecosystems Explorer. B.C. Minist. of Environ. Victoria, B.C. Available: http://a100.gov.bc.ca/pub/eswp/ (accessed Oct 31, 2017).

2.2.2 ARCHAEOLOGICAL VALUES

Archaeological sites in the Province of British Columbia that pre-date 1846 are protected by the *Heritage Conservation Act* (HCA), which applies on both private and public lands. Sites that are of an unknown age that have a likelihood of dating prior to 1846 (e.g. lithic scatters) as well as Aboriginal pictographs, petroglyphs, and burial sites (which are likely not as old but are still considered to have historical or archaeological value) are also automatically protected. Under the HCA, protected sites on Crown, federal, and private land may not be damaged, altered, or moved in any way without a permit. It is a Best Practice that cultural heritage resources such as Culturally Modified Tree (CMT) sites be inventoried and considered in both operational and strategic planning.

Due to site sensitivity, the locations of archaeological sites may not be made publicly available. The City of Fernie has direct access to Remote Access to Archaeological Data (RAAD), which allows the City to look up or track any archeological sites in the area.[12]

Prior to stand modification for fire hazard reduction, and depending on treatment location, preliminary reconnaissance surveys may be undertaken to ensure that cultural heritage features are not inadvertently damaged or destroyed. Pile burning and the use of machinery have the potential to damage artifacts that may be buried in the upper soil horizons. Above ground archaeological resources may include features such as CMTs, which could be damaged or accidentally harvested during fire hazard reduction activities. Fuel treatment activities should include consultation with the Ktunaxa Nation and Shuswap Indian Band at the site level and with sufficient time for review and input regarding their rights and interests prior to prescription finalization or implementation.

2.3 COMMUNITY SUPPORT AND ENGAGEMENT

Community awareness of wildfire risk is moderate within the community. In 2010, the City completed one fuel treatment project within the study area; there was no known opposition to the project. [13] There have been various private initiatives, such as those implemented by Handshake Holdings Inc. in 2008. These projects included thinning and clearing on two separate private parcels southeast of the City core. The activities were driven by objectives based upon forest health, aesthetics, and wildfire risk reduction objectives.[14] More recently, FireSmart fuel management projects were completed by members of the Castle Mountain neighbourhood, with assistance from City Operations.

The City has heard concerns from citizens regarding smoke emissions from burning. While these projects were not directly related to wildfire management projects, it is clear that air quality is of considerable concern to the community.

City staff recognizes the City's wildfire risk and are looking for implementable risk reduction efforts. This strategy is another step in the process of gaining more widespread participation and support.

[12] https://www.for.gov.bc.ca/archaeology/accessing_archaeological_data/obtaining_access.htm

[13] For additional details regarding the City completed fuel treatment, please see Section 5.0.

[14] Personal communication, Reto Barrington, July 3 and 10, 2017.

Community engagement through the CWPP development process was a key objective of the City. To that end, during CWPP development, the following local stakeholders were engaged in initial consultation, in addition to the provincial and City staff consultation: Jemi Fiber Corp, Wildsight, Canfor, Fernie Alpine Resort, Ktunaxa Nation Council, Fernie Chamber of Commerce, RDEK, Fernie Trails Alliance, Columbia Basin Alliance for Literacy, Parastone, Shoesmith Construction, Capisiti Consulting, and ForestWise Environmental Consulting. The input received from these consultations helped to formulate the CWPP update, but implementation of various recommendations and risk reduction efforts will require additional discussions and ongoing collaboration with a variety of stakeholders and community members, as well as exploration of new partnerships with business and organizations listed above and others not yet contacted. Recommendations to help foster good communications and collaborative risk mitigation efforts are contained later in this plan.

2.3.1 KTUNAXA NATION COUNCIL

The Ktunaxa Nation Council provided input during the draft stage of this document; results of this consultation are incorporated into the document. The following is a summary of their key comments:

- Identification of existing or potential biodiversity values within potential fuel treatment areas and the study area is integral to protecting or enhancing those values.
- Protection of biodiversity values should be emphasized within fuel treatment prescriptions and operations (retention of large-diameter trees, protecting or enhancing shrub communities, and maintaining intact riparian areas).
- Invasive species are a concern for increased fire hazard and impact on native species and ecosystems. Invasive species management should be a component of fuel management prescriptions, with recognition of fuelbreaks and staging areas as particularly high risk areas for invasive species spread.
- Recognition of additional vulnerable or threatened species which are not within the Provincial CDC database, but which are known to locally exist.

2.4 KEY CONTACT, PARTNERSHIP AND FUNDING OPPORTUNITIES

A list is provided below to guide future activities regarding fire and fuels management, including the development of an interface steering team. This should not be considered an exhaustive list, and investigations should be made at the time of project development to confirm contacts and programs.

- **Provincial Government**
    - Union of BC Municipalities (UBCM) – funding opportunities through the SWPI program. These funding opportunities are limited to areas within 2 km of communities. Funding opportunities include CWPPs and CWPP updates, fuel management prescriptions, operational fuel treatments and maintenance treatments, fuel management demonstration projects, and FireSmart planning activities.

- Forest Enhancement Society of BC (FESBC) – funding opportunities for wildfire risk reduction and FireSmart activities that are not eligible under the UBCM funding structure may be available through the Forest Enhancement Program.
    - It should be noted that there is opportunity for joint SWPI/ FESBC funded projects to: allow applicants to access funding more than the annual SWPI funding maximums ($400,000 for municipalities), allow for operationally logistical treatments for areas which are both inside and outside the 2 km WUI area, and to allow for treatment around unincorporated areas within regional districts that may not have access to the required community contribution due to fiscal constraints.
- Rocky Mountain Natural Resource District – Ministry of Forests, Lands, Natural Resource Operations and Rural Development
    - BC Wildfire Service (BCWS) Cranbrook Zone– support is already established with the zone. This relationship will be integral for any prescribed burning or fuel management activities. Additionally, the BCWS is an excellent resource for FireSmart education and cross training opportunities, as their time allows.
    - Future landscape level fire management planning at the Natural Resource District level (Fire Management Plan) has the potential to impact activities undertaken by the City, adjacent jurisdictions (RDEK), and present new funding opportunities, particularly for landscape level fuelbreaks which would benefit the region.

- **Licensees**
    - Canfor holds the license to operate on Crown land surrounding the City (the western flank of the valley)(Figure 2)
    - There is no active harvesting in this area at the time of CWPP development. There may be opportunity to work with Canfor on operational fuel treatment projects; Canfor has completed harvesting with fuel treatment objectives in interface areas (Fire Management Stocking Standards, managing for hardwoods / deciduous, variable retention levels) in the Cranbrook and Kimberly areas. There may exist an opportunity for partnerships in commercial harvest of hazardous areas that may not qualify under the SWPI program (i.e., too far from infrastructure, but which may still pose a spotting risk to the community or to create more resilient landscapes in the event of a wildfire). A cooperative effort for areas which may require merchantable volume to be removed to meet wildfire hazard objectives is another potential opportunity. Additionally, there may be potential for harvesting / fuel management activities to meet multiple objectives, such as wildfire hazard reduction and recreation (trails establishment).
- **Adjacent municipalities and governments** – RDEK and the Ktunaxa Nation Council – a regional approach to wildfire management has been successful in other areas. There may be an opportunity to create a steering committee to help guide and implement strategic wildfire initiatives.

- **Industrial Operators** – CP Rail and BC Hydro have infrastructure and right of ways which should be maintained in a low hazard state (free of cured fine-fuel accumulations). Communication with industrial operators may help to maintain right-of-ways and other infrastructure in a low hazard state, as well as minimize potential ignitions.

- **Key study area stakeholders / potential partners –** each stakeholder mentioned below should be considered as a stakeholder or potential partner for a variety of risk reduction efforts. Their inclusion on the list does not signify or represent their level of commitment to any specific projects. Further exploration and engagement is required.

    - Jemi Fibre Corp (Division of CanWel Building Materials Group Ltd) – The City of Fernie is surrounded by large tracts of private land, much of which is owned by Jemi Fibre Corp and managed for timber (Figure 2). Potential partnerships exist to work with Jemi regarding future harvesting activities to reduce the wildfire risk posed to the community from their land. The City can work to ensure that operations within or near to study area are complying with fire hazard abatement and assessment requirements.

    - Columbia Basin Trust (CBT) – potential funding opportunities exist for wildfire risk reduction projects in the valley. CBT has initiated a three-year Climate Action Program to help communities adapt to climate change impacts, such as wildfire.

    - Wildsight Elk Valley– Wildsight Elk Valley works regionally on conservation initiatives. Opportunities may exist for partnership, particularly on larger-scale fuel management or development projects which may have the potential to impact the WUI and community wildfire risk, as well as impact or potentially enhance wildlife values, particularly in areas recognized as landscape linkages and travel corridors.

    - Fernie Alpine Resort (FAR) – support from, and partnership with, FAR is recommended. The risk to wildfire between the City and FAR cannot be separated; a cooperative approach would be beneficial to effectively reduce the risk.

    - Development community – Support from, and action by, the development community is key to becoming a FireSmart community and reducing the overall threat to the community. The development community can include a variety of sub-groups including, but not limited to: builders, developers, architects, and landscapers. Key to the development community is the Rocky Mountain Homebuilders Association.

    - Recreational stakeholders – Fernie Trails Alliance and their member clubs (Fernie Mountain Bike Club, Fernie Nordic Society, Fernie Trails and Ski Touring Club, and Island Lake Lodge) builds and maintains the non-motorized trail access surrounding Fernie on both private and Crown lands. The communications network and integration into the community is ubiquitous. Potential partner activities include: communications support and trails maintenance standards (with wildfire lens) and consolidating and updating spatial data of the trails network in and surrounding the City.

- Other large private land holders – Large areas of private land within the interface are owned by various development companies (Figure 2). Due to their proximity to developed portions of the City, it is imperative that they are maintained in an acceptable range of wildfire hazard, particularly within proximity to values at risk. Communications with landowners regarding expectation and actions they can take to reduce the wildfire threat posed by their property are important.

- City of Fernie Chamber of Commerce – Commercial development and businesses are vulnerable to interface fires. The Chamber of Commerce can help to deliver the FireSmart message and increase awareness of wildfire risk to valley businesses.

- Teck Coal – As the largest single employer in the Elk Valley, Teck Coal has significant regional influence and may be a valuable contributor in a steering committee.

- Literacy programs - Columbia Basin Alliance for Literacy (CBAL) (Elk Valley) and Fernie Heritage Library. Opportunities may exist to spread FireSmart messaging and increase wildfire risk awareness to participants through environmental literacy programming.

- FireSmart Canada - In conjunction with corporate sponsors, FireSmart Canada offers $500.00 grant to neighbourhoods participating in National FireSmart Preparedness Day.

- Local businesses – retailers of landscaping plant materials and/or FireSmart building materials, such as hardware stores, garden centers, and landscaping service firms should be viewed as potential public education partners.

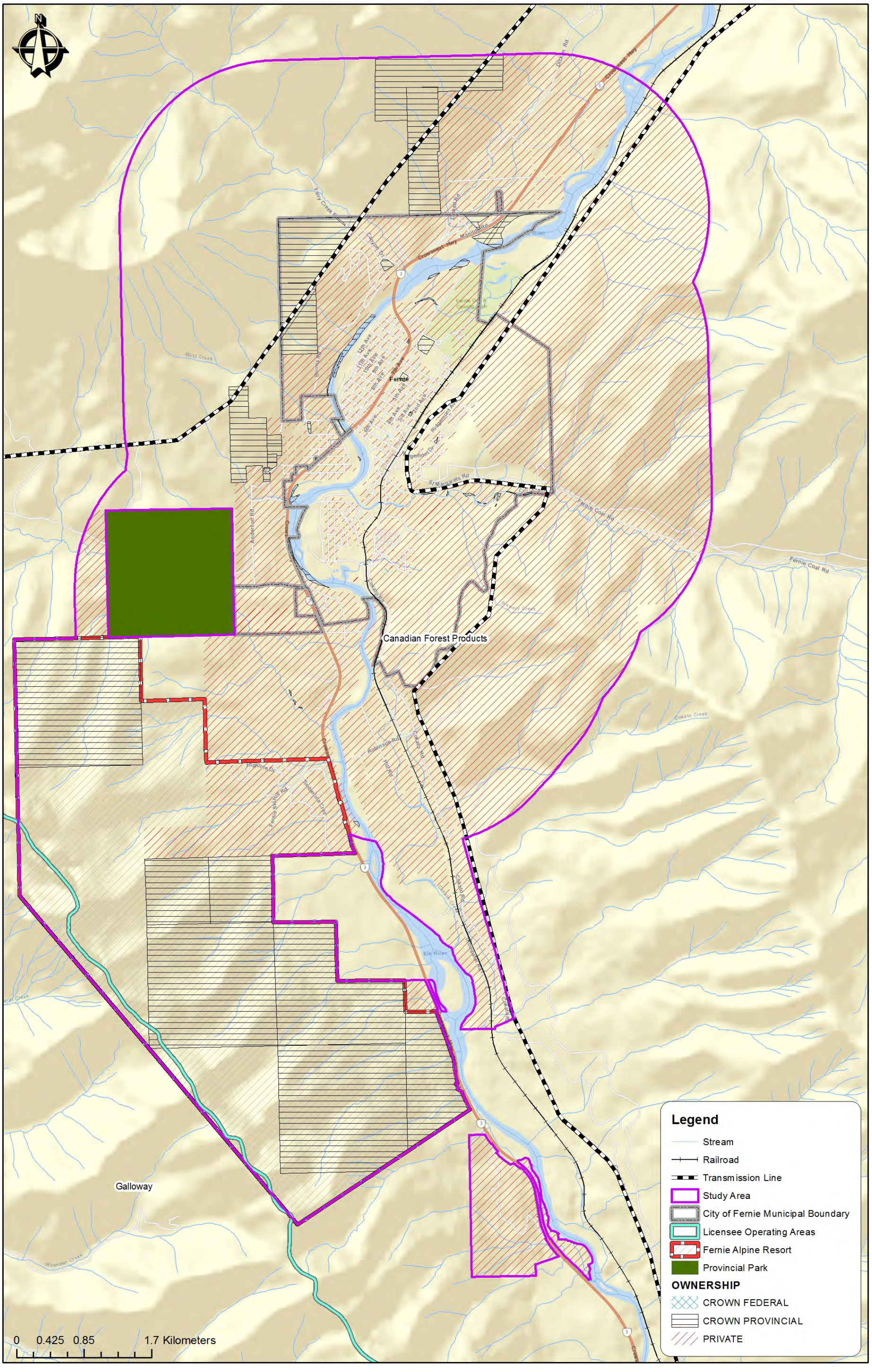


Figure 2. Display of land ownership within and surrounding the CWPP study area.

2.5 FOREST FUEL AND PAST WILDFIRE INFORMATION

2.5.1 BIOGEOCLIMATIC UNITS AND NATURAL DISTURBANCE TYPES

The Biogeoclimatic Ecosystem Classification (BEC) system describes zones by vegetation, soils, and climate. Regional subzones are derived from relative precipitation and temperature. The following section is synthesized from information found on MFLRNORD's Research Branch BECWeb.[15]

Biogeoclimatic subzones are categorized into natural disturbance types (NDTs) based on the size and frequency of natural disturbances (largely fire) that historically occur within the subzone. BEC zones have been used to classify the Province into five NDTs. NDTs have influenced the vegetation dynamics and ecological functions and pathways that determine many of the characteristics of our natural systems. The physical and temporal patterns, structural complexity, vegetation communities, and other resultant attributes should be used to help design fuel treatments, and where possible, to help ensure that treatments are ecologically and socially acceptable.[16]

2.5.1.1 INTERIOR CEDAR HEMLOCK MOIST COOL – NATURAL DISTURBANCE TYPE 3

The study area is predominantly within the Interior Cedar Hemlock Moist Cool (ICH mk) BEC subzone; the entirety of the City of Fernie, all surrounding developed areas, and the base area of Fernie Alpine Resort are all within the ICH mk subzone. The ICH mk lies in the Rocky Mountains along the Lower Elk River between the elevational bands of 750 – 1550 meters, depending on slope aspect. This subzone is characterized by warm and wet summers; soils generally dry out for a moderate amount of time in the late summer.

The ICH mk is categorized as NDT3 – ecosystems with frequent stand-initiating events. Historically, these ecosystems experienced frequent wildfires, ranging in size from very small to extensive. This NDT experiences the largest wildfires in the province, often exceeding 100,000 ha in size. The ICH ecosystems in this NDT experience a mean disturbance interval of approximately 150 years.[16] Practically speaking, all, or almost all, of mitigative efforts and focus will be within this subzone and NDT 3.

2.5.1.2 ENGELMANN SPRUCE SUBALPINE FIR WET MILD – NATURAL DISTURBANCE TYPE 2

The elevational band above the ICH mk is the Engelmann Spruce Subalpine Fir BEC zone wet mild variant (ESSF wm). This is a high elevation subzone characterized by more precipitation than that received in the ICH mk. Within the study area, the mid-slopes of the Fernie Alpine Resort and Mount Fernie are in the ESSF wm subzone.

The ESSF wm 1 is categorized as NDT2 – ecosystems with infrequent stand-initiating events. Major stand initiating events are rare, resulting in large tracts of old seral stage forests with complex stand structures. The mean disturbance return interval for these ecosystems is approximately 200 years. Although the fire frequency is not

[15] https://www.for.gov.bc.ca/HRE/becweb/resources/classificationreports/subzones/index.html

[16] Province of British Columbia, 1995. Biodiversity Guidebook, s.l.: s.n.

high and fires are not large (20 – 1,000 ha), pre-planning and preparation are essential to reduce the negative impacts of a wildfire.[16]

2.5.1.3 ENGELMANN SPRUCE SUBALPINE FIR WET MILD WOODLAND – NATURAL DISTURBANCE TYPE 1

The ESSF wet mild woodland (ESSF wmw) covers the highest elevations within the study area and is categorized as NDT1. NDT 1 includes ecosystems with rare stand-initiating events with a mean disturbance return interval of 350 years in the ESSF BEC zone. Fires, when occurring, are generally small. Mitigative efforts should not be focused in this subzone; suppression is the appropriate response.

Table 4. Biogeoclimatic Ecosystem Classification (BEC) zones and corresponding Natural Disturbance Types of the study area.

BEC Zone	Subzone Name	% of study area	Natural Disturbance Type	Mean Disturbance Return Interval
ICH mk	Interior Cedar Hemlock Moist Cool Kootenay	86%	NDT 3	150
ESSF wm	Engelmann Spruce Subalpine Wet Mild	12%	NDT 2	200
ESSF wmw	Engelmann Spruce Subalpine Fir Wet Mild	2%	NDT 1	350

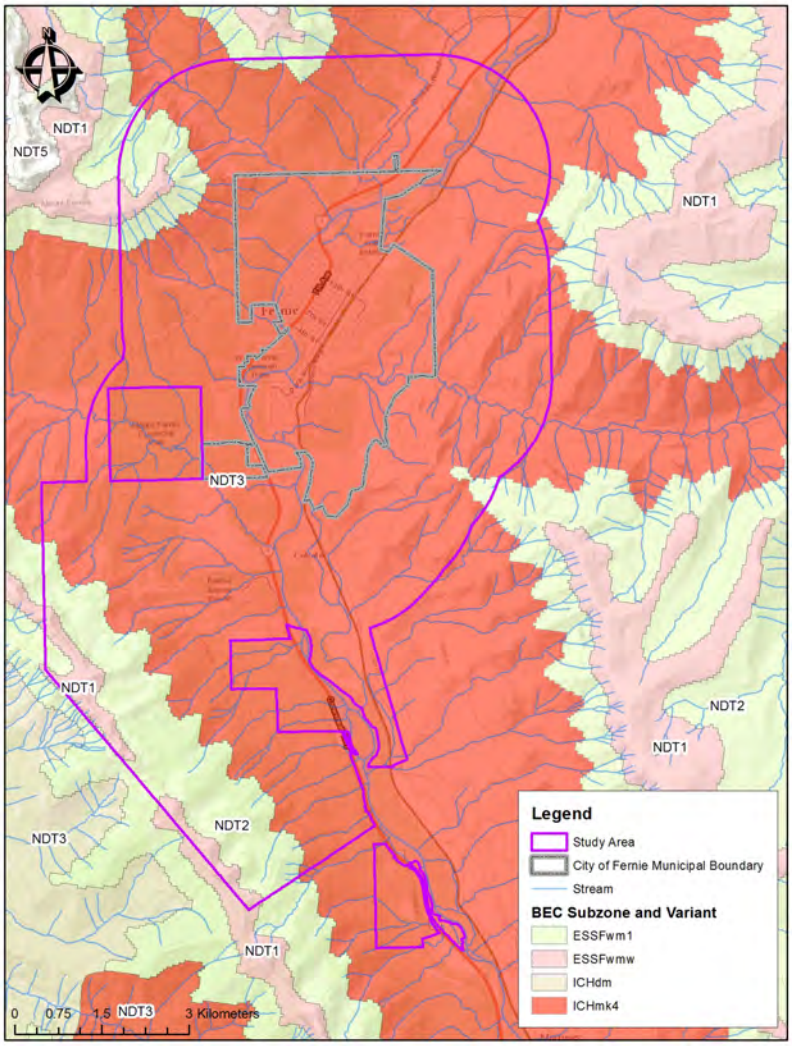


Figure 3. Biogeoclimatic Ecosystem Classification (BEC) subzones found within the study area.

2.5.2 TIMBER HARVESTING LANDBASE

The study area is within the Cranbrook Timber Supply Area (TSA) which covers approximately 1.48 million hectares. The Crown forest managed land base (CFMLB) covers 782,474 hectares while the Timber harvesting landbase (THLB) is 351,773 hectares or 44.96% of the CFMLB. [17] The dominant tree species are lodgepole pine (*Pinus contorta)*, *Engelmann* spruce (*Picea engelmannii*), and Douglas-fir (*Pseudotsuga menziesii*). Minor species are balsams (true firs), larch, cedar, and deciduous species. The current Allowable Annual Cut (AAC) is 898,210 m^3 and was set October 1, 2009. A new AAC determination is currently underway with the discussion paper released September 8th, 2016.[17,18] Much of the managed forested land within the study area is privately held; the AAC is not applicable to these areas.

[17] Ministry of Forests, Lands, and Natural Resource Operations Forest Analysis and Inventory Branch. 2016. *Cranbrook Timber Supply Area Timber Supply Analysis Discussion Paper*.

[18] Information within this paragraph is applicable to the entirety of the TSA; breakdowns specific for the study area not available.

2.6 FOREST HEALTH

Armillaria root disease (*Armillaria ostoyae*) is the most common disease in the ICH areas of the Cranbrook TSA. It is an important driver of structural diversity and contributor to wildlife habitat. It can be exacerbated by partial cutting and thinning, common operational strategies in fuel management activities. Stumping combined with thinning activities may be a potential control strategy to reduce root to root contact.

The 2005 CWPP identified the mountain pine beetle as a potential to be a major threat to the City's wildfire risk, due to increased fuel loading from pine beetle mortality (for detailed information on the relationship between pine beetle, fuel loading, and fire hazard, see APPENDIX D). Since 2005, there have been 21 new polygons identified with mountain pine beetle mortality: a total of 441 ha. Of this 441 ha, 350 ha were identified as trace or light mortality (trace is <1% of trees in polygon recently killed, light is 1 – 10% of trees in polygon recently killed).[19] There are some polygons within the study area which have high fuel loading due to fallen pine beetle mortality; these polygons are assessed as high hazard; surface fuel loading and standing mortality (single-tree and patches) should be considered when completing fuel management activities (detailed site assessments prescription development).

Other forest health agents identified within the study area are larch needle cast (defoliating insect), other root diseases (pathogens), and Douglas-fir beetle (bark beetle). Larch needle cast rarely results in mortality in mature trees; however, it can predispose trees to damage by other forest health agents.[20] The incidence of Douglas-fir beetle in the study area is minor. Root rots are usually limited to single tree or small patch distribution.

Forest health is dynamic through time; there is potential for new or recurring outbreaks, impacting the fuel types, distribution, and ultimately the fire threat within the study area. All forest health outbreaks should be noted, and the CWPP may need updating to reflect changed fuel types if outbreaks are extensive. Furthermore, forest health factors should be considered during detailed site-level assessments for fuel treatment prescriptions.

3.0 WILDFIRE BEHAVIOUR AND WUI THREAT ASSESSMENT

3.1 FUEL TYPE SUMMARY

The Canadian Forest Fire Behaviour Prediction (FBP) System outlines five major fuel groups and sixteen fuel types based on characteristic fire behaviour under defined conditions.[21] Fuel typing is recognized as a blend of art and science. Although a subjective process, the most appropriate fuel type was assigned based on research, experience, and practical knowledge; this system has been used within BC, with continual improvement and

[19] Maclauchlan, L. and Buxton, K. 2016. *2016 Overview of Forest Health Conditions in Southern British Columbia.* Ministry of Forests, Lands, and Natural Resource Operations.

[20] Henigman, J., T. Ebata, E. Allen, J. Westfall, A. Pollard. 2001. Field Guide to Forest Damage in British Columbia – 2nd ed. Joint Publication Canadian Forest Service and BC Ministry of Forests.

[21] Forestry Canada Fire Danger Group. 1992. Development and Structure of the Canadian Forest Fire Behavior Prediction System: Information Report ST-X-3.

refinement, for 20 years.[22] It should be noted that there are significant limitations with the fuel typing system which should be recognized. Major limitations include: a fuel typing system designed to describe fuels which do not occur within the study area, fuel types which cannot accurately capture the natural variability within a polygon, limitations in the data used to create initial fuel types, and identified uncertainties and knowledge gaps specific to the study area (mixed-conifer stands of the interior wet belt).[22] Details regarding fuel typing methodology and limitations are found in Appendix E. There are several implications of the aforementioned limitations, which include: fuel typing further from the developed areas of the study has a lower confidence, generally; and, fuel typing should be used as a starting point for more detailed assessments and as an indicator of overall wildfire threat, not as an operational or site-level assessment.

Table 5 summarizes the fuel types by general fire behaviour. In general, the fuel types considered hazardous in terms of fire behaviour and spotting potential are C-2, C-3, and C-4. C-3 is the most common hazardous fuel in the study area. C-5 and C-7 can sometimes represent hazardous fuels, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth, respectively. C-5 fuel types have a moderate potential for active crown fire when wind-driven.[22] An M-1/2 fuel type can sometimes be considered hazardous, depending on the proportion of conifers within the forest stand; conifer fuels include those in the overstory, as well as those in the understory. An O-1b fuel type often can support a rapidly spreading grass or surface fire capable of damage or destruction of property, and jeopardizing human life, although it is recognized as a highly variable fuel type dependent upon level of curing.[23] These fuel types were used to guide the threat assessment.

Forested ecosystems are dynamic and change over time: fuels accumulate, stands fill in with regeneration, and forest health outbreaks occur. Regular monitoring of fuel types and wildfire threat should occur every 5 – 10 years to determine the need for threat assessment updates and the timing for their implementation.

[22] Perrakis, D. and G. Eade. 2015. BC Wildfire Service. Ministry of Forests, Lands, and Natural Resource Operations. *British Columbia Wildfire Fuel Typing and Fuel Type Layer Description* 2015 Version.

[23] Ibid.

Table 5. A summary of fuel types and associated hazard.

Fuel Type	FBP / CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level
C-2	Boreal spruce	As identified by PSTA data	Almost always crown fire, high to very high fire intensity and rate of spread
C-3	Mature jack or lodgepole pine	Fully stocked, late young forest, crowns separated from the ground	Surface and crown fire, low to very high fire intensity and rate of spread
C-4	Immature jack or lodgepole pine	Dense pole-sapling forest and young plantations, heavy standing dead and down, dead woody fuel accumulations, continuous vertical crown fuel continuity	Almost always crown fire, high to very high fire intensity and rate of spread
C-5	Red and white pine	Well-stocked mature forest, crowns separated from ground. Moderate understory herbs and shrubs. Often accompanied by dead woody fuel accumulations.	Moderate potential for active crown fire in wind-driven conditions. Under drought conditions, fuel consumption and fire intensity can be higher due to dead woody fuels
C-7	Ponderosa pine and Douglas-fir	Open, uneven-aged forest, crowns separated from the ground except in conifer thickets, understory of discontinuous grasses, herbs	Surface fire spread, torching of individual trees, rarely crowning (usually limited to slopes > 30%), moderate to high intensity and rate of spread
O-1a/b	Grass	Matted and standing grass communities. Continuous standing grass with sparse or scattered shrubs and down woody debris. Vegetated, non-treed areas dominated by shrubs or herbs in dry ecosystems. Areas of very scattered trees. Hay fields.	Rapidly spreading, high- intensity surface fire when cured
M-1/2	Boreal mixedwood (leafless and green)	Moderately well-stocked mixed stand of conifers and deciduous species, low to moderate dead, down woody fuels.	Surface fire spread, torching of individual trees and intermittent crowning, (depending on slope and percent conifer)
D-1/2	Aspen (leafless and green)	Deciduous stands	Always a surface fire, low to moderate rate of spread and fire intensity
S-1/2/3	Slash (jack / lodgepole pine, white spruce / balsam, and coastal cedar / hemlock/ Douglas-fir, respectively)	Jack or lodgepole pine slash, white pine/ balsam slash, coastal cedar/ hemlock/ Douglas-fir slash	Moderate to high rate of spread and high to very high intensity surface fire
W	N/A	Water	N/A
N	N/A	Non-fuel: irrigated agricultural fields, golf courses, urban or developed areas void or nearly void of forested vegetation.	N/A

There have been three fuel typing exercises completed for the study area: one for the 2005 CWPP, one in 2015 for the PSTA dataset, and one for this update. The fuel typing within the study area has some notable differences, depending on the data source, as listed above. Table 6 describes the percent of the study area and total hectares for each fuel type, by data source. The most notable differences are outlined below.

- The 2015 PSTA data shows considerably more C-5 fuel typing within the study area than either the 2005 CWPP or the CWPP Update. This is due to private land with patchy or non-existent vegetation resources inventory data (VRI) being typed as C-5. Field visits of these areas confirm that C-5 is not the appropriate fuel type. A combination of field visits, orthophotography, and data gathered from private land holders allowed delineation of polygons and fuel type changes with a high level of confidence. Fuel typing was changed / refined to C-3, M-1/2, C-4, D-1/2, and slash fuel types, depending on the polygon.

- The 2015 PSTA data shows considerably more non-fuel (N) area than the CWPP Update. This is mostly due to PSTA data typing ski runs and avalanche paths non-fuel areas. For lower elevation areas, site visits showed the ski runs to be largely tall grasses; avalanche tracks are dominated by deciduous herbs and shrubs. They were re-typed O-1a/b and D-1/2, respectively. Higher elevation areas and areas with sparser vegetation or rock were retained as non-fuel.

- C-2 has significantly decreased within the study area. This is largely due to a change in fuel-typing practices. Dense pole-sapling conifer plantations with interlocking crowns and continuous vertical crown continuity were historically typed as C-2, but evidence indicates that C-4, while not a perfect match, is a more representative fuel type call.[22,24]

Table 6. Fuel type percent and total area in hectares within the study area from the 2005 CWPP, the 2015 PSTA data and the CWPP update (this document).

Fuel Type	CWPP 2005: % of study area (total ha)	PSTA 2015: % of study area (total ha)	CWPP Update: % of study area (total ha)
C-2	5% (412)	0% (18)	0% (0)
C-3	12% (1,065)	3% (280)	17% (1,473)
C-4	10% (900)	0% (0)	6% (525)
C-5	0% (0.0)	30% (2,593)	4% (322)
C-7	7% (566)	4% (302)	5% (460)
D-1/2	22% (1,935)	14% (1,221)	16% (1,385)
M-1/2	18% (1,576)	15% (1,316)	20% (1,750)
N	0% (17)	31% (2,629)	17% (1,454)
O-1a/b	11% (969)	1% (94)	11% (937)
S-1/2/3	0% (0)	0% (0)	0% (0)
W	2% (161)	2% (154)	2% (181)

[24] Personal communication, Peter Laing, BCWS.

Fuel Type	CWPP 2005: % of study area (total ha)	PSTA 2015: % of study area (total ha)	CWPP Update: % of study area (total ha)
U	3% (271)	0% (0)	0% (0)

Figure 4 displays the fuel types, as provided in the 2015 PSTA data package, and Figure 5, the CWPP update fuel types. The CWPP Update fuel type map should be the City's go-to map for future WUI planning and the starting point for operational activities (Figure 5).

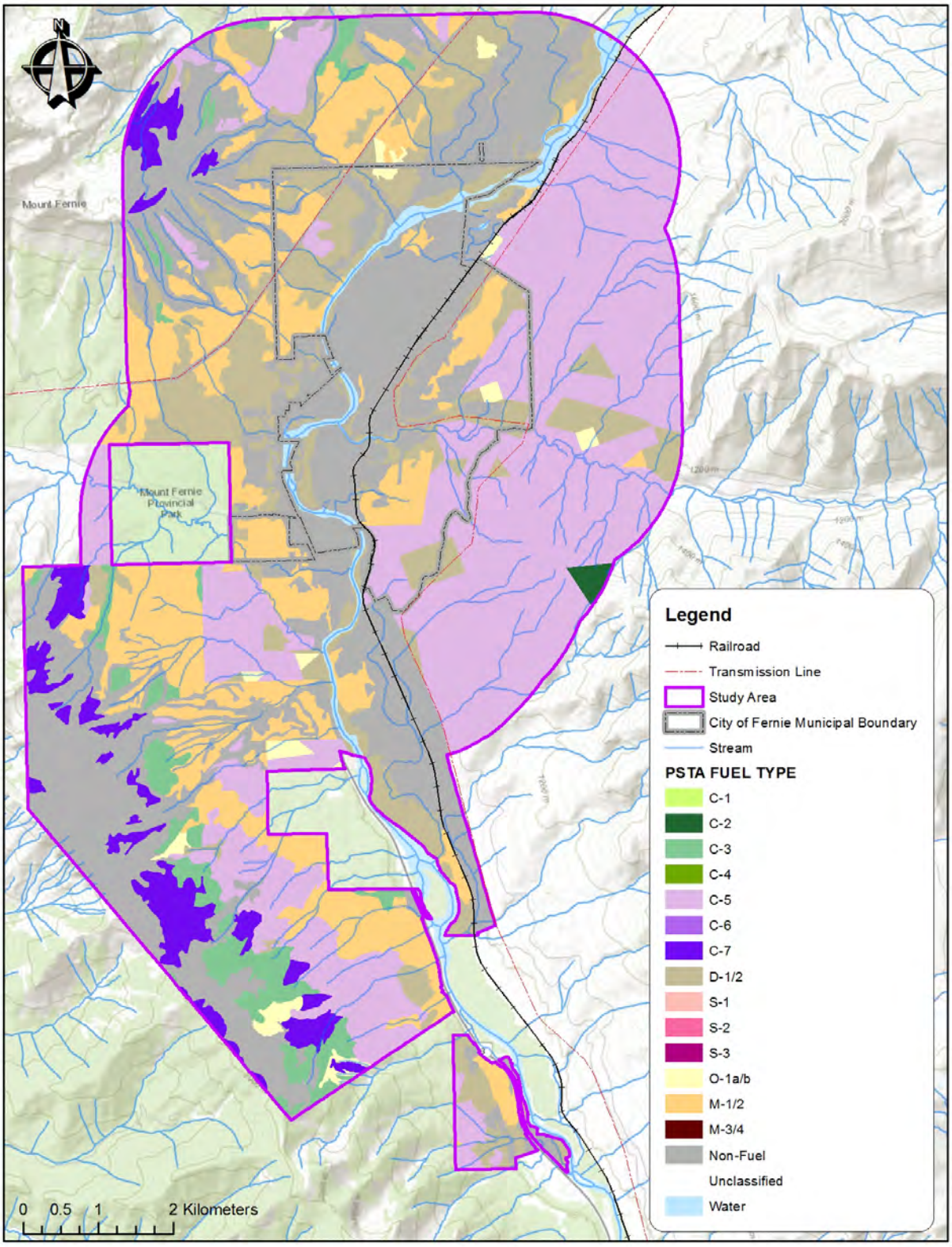


Figure 4. 2015 PSTA data fuel types, as provided by BCWS. Note the eastern flank of the valley with very little variation in fuel types and linear and blocky polygons.

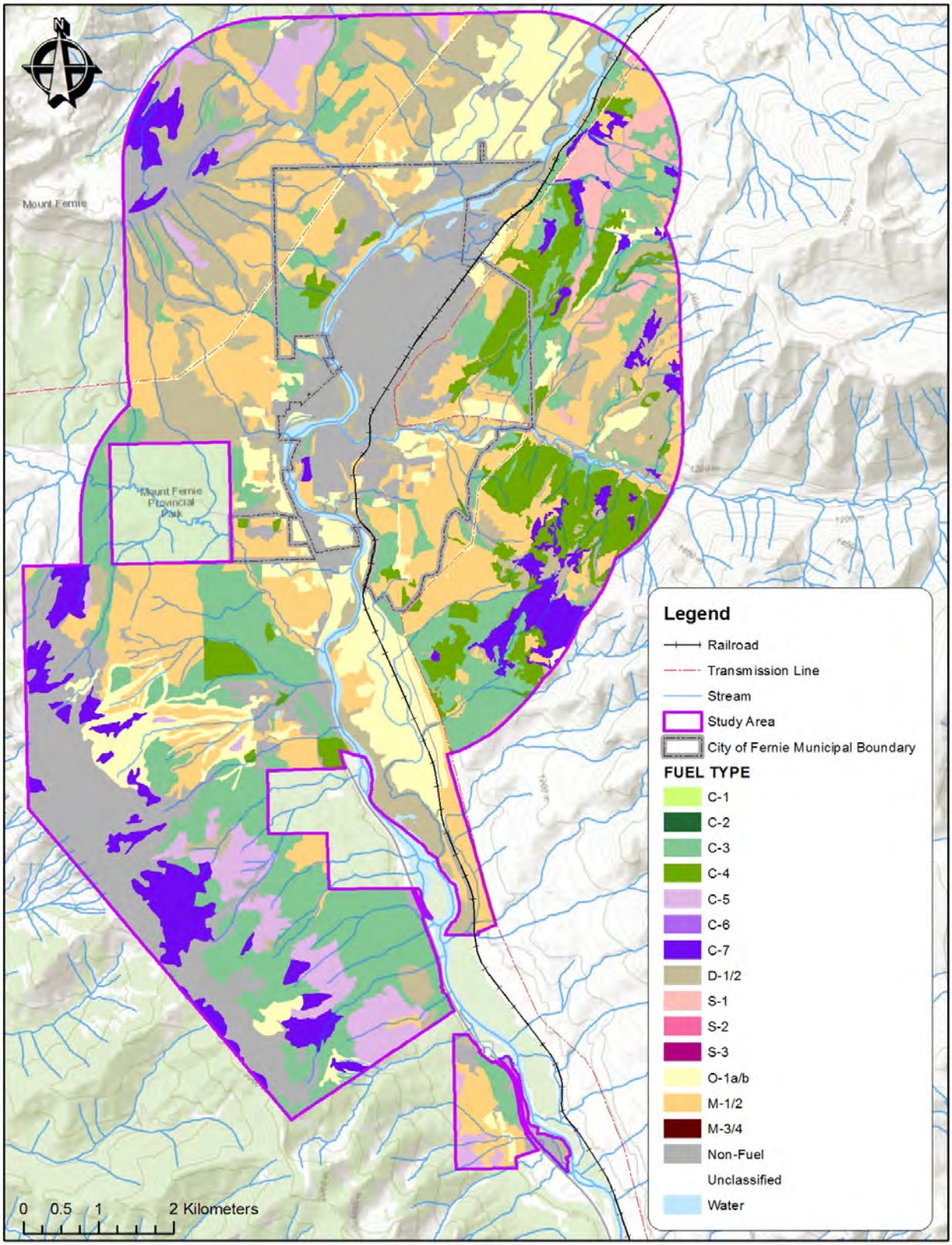


Figure 5. Updated fuel typing for the study area. Note: eastern slopes of valley with considerable updating.

3.2 WILDLAND URBAN INTERFACE THREAT ASSESSMENTS

Since the development of the 2005 CWPP, there has been an evolution in the definition of the Wildland Urban Interface (WUI). Previously, the WUI was almost exclusively defined as a geographic location: where the forest meets the community. Recently, the WUI is now defined now both by geographical area and a set of conditions. The two most accepted definitions in BC are:

- *Any area where combustible wildland fuels (vegetation) are found adjacent to homes, farm structures, other outbuildings or infrastructure. More specifically, the area within 2 kilometers of a community with a minimum density of 6 structures per square kilometer.*[25]
- *The presence of structures in locations in which conditions result in the potential for their ignition from flames and firebrands/embers of a wildland fire.*[26]

Additional information and details can be found in Appendix F.

WUI Threat Assessments were completed over five field days in October and November of 2016 and May and July of 2017, in conjunction with verification of fuel types. WUI Threat Assessments were completed in interface (*i.e*. abrupt change from forest to urban development) and intermix (*i.e*. where forest and structures are intermingled) areas of the study area to support development of priority treatment areas, and in order to confidently ascribe threat to polygons which may not have been visited or plotted, but which have similar fuel, topographic, and proximity to structure characteristics to those that were.

A total of 19 WUI threat plots were completed and more than 225 other field stops (qualitative notes, fuel type classifications and/or photograph documentation) were made across the study area (Figure 6). A complete enumeration of plots can be found in Appendix G.

[25] Strategic Wildfire Prevention Initiative.

[26] National Fire Protection Association.

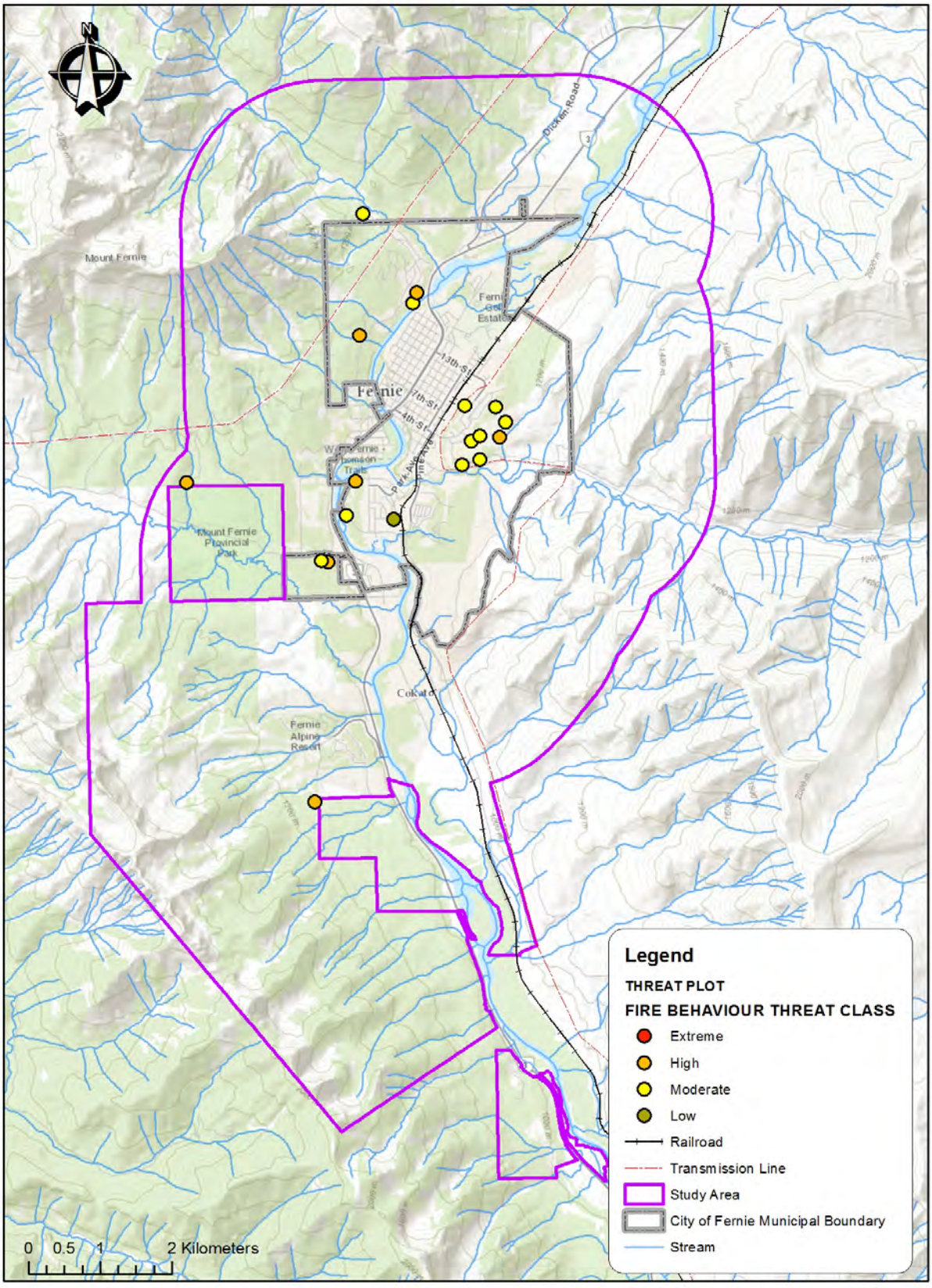


Figure 6. WUI threat plot locations by Fire Behaviour Threat Class.

3.2.1.1 STUDY AREA THREAT RATING

There are two main components of the threat rating system: the wildfire behaviour threat class (fuels, weather and topography sub-components) and the WUI threat class (structural sub-component). Figure 7 displays the fire behaviour threat ratings and WUI threat class ratings within the study area, as mandated by SWPI which does not include threat assessments on private land.

Although the threat assessment does not include land privately held, the study area can be very roughly assessed as 30% high and extreme threat classes, 30% moderate threat class, and 40% low threat class. The following statements are based upon field observations:

- The valley bottom is largely agricultural fields, developed non-fuel area, and deciduous trees and therefore is best classified as a low wildfire threat class, although there are some isolated and outlying valley bottom areas classed as moderate wildfire behaviour. The moderate wildfire behaviour areas in the valley bottom are characterized by long grass or hay fields which cure in the summer (O-1a/b) and isolated stands of conifer trees.

- The areas within the study area that represent the highest wildfire behaviour threat to the City are the slopes on the eastern side of the valley, the area including and surrounding the Fernie Alpine Resort (north and south), and on either side of Mount Fernie Park Road. There are smaller areas of high and extreme threat class on the southern aspect slopes of Mount Proctor, north of the municipal boundary.

The slopes on the eastern side of the valley, and much of the area surrounding Fernie Alpine Resort, are held privately, and therefore ineligible for UBCM/SWPI or FESBC funding for fuel management. Complex land ownership issues underscore the need for collaborative efforts between multiple provincial agencies, and landowners, as well the importance of reducing wildfire threat on private land to reduce the overall risk profile of the City. The City continues to work with BC Parks to build a cooperative relationship, complete threat assessments in Mount Fernie Provincial Park, and to explore future projects to protect BC Parks and City values at risk.

The PSTA threat rating and local threat assessments utilize different components and therefore cannot be directly compared. A very general comparison will show the basic differences between the coarser, provincial data set (PSTA) and the locally assessed threat (CWPP Update) ((Table 7). It is worthy to note that neither the 2015 PSTA data nor the local threat assessment provide threat ratings for areas of privately managed forest land. Future threat assessments on privately held or BC Parks land, if completed, will be included in an addendum to this document.

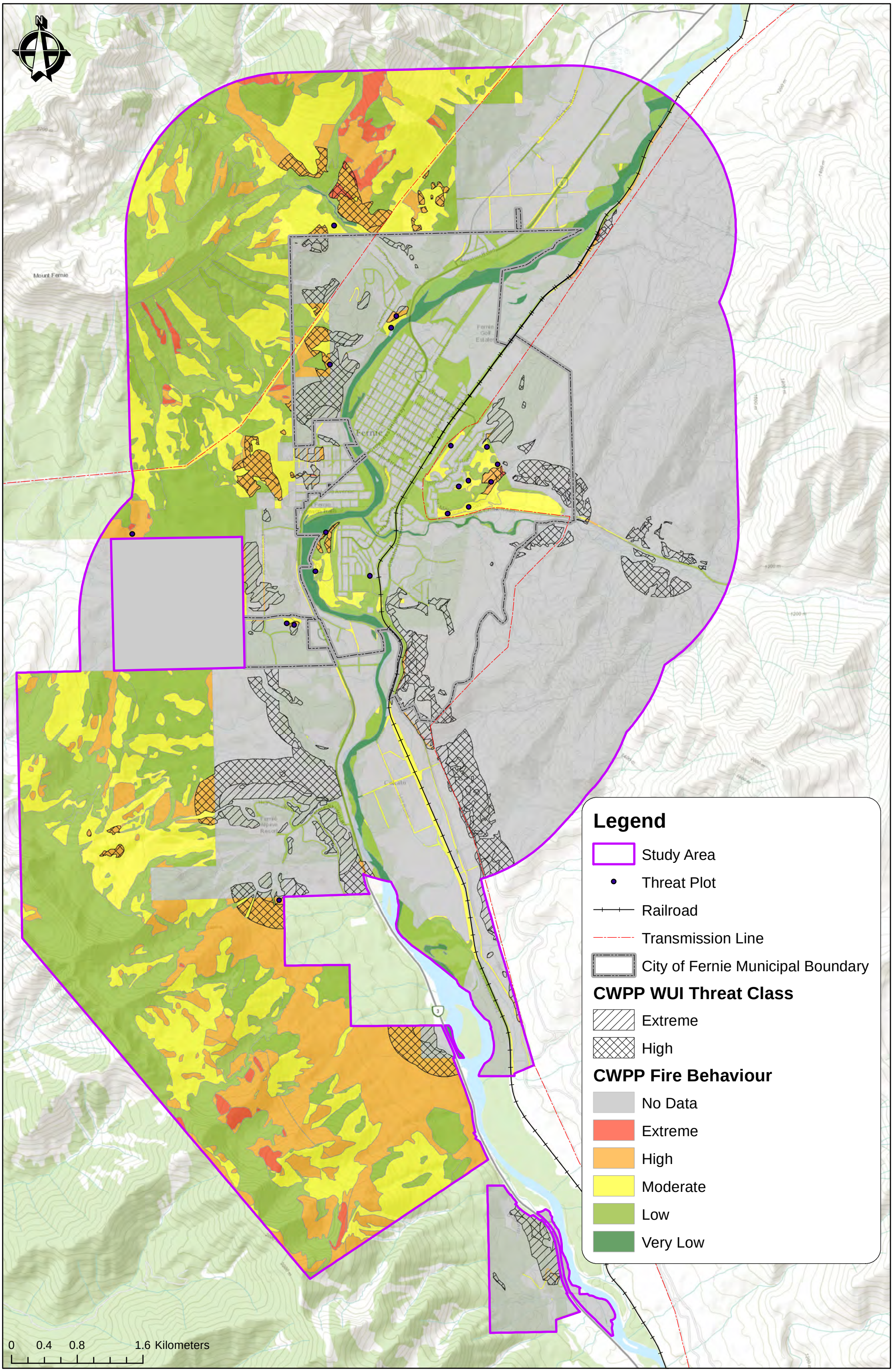


Figure 7. Wildfire behaviour threat class (fuels, topography, fire weather) and WUI threat class (structure / values at risk) for the study area. WUI threat class is only assigned to areas of high or extreme wildfire behaviour threat class; all other wildfire behaviour threat classes are assigned a WUI threat class of N/A. Areas of moderate and low WUI threat class are not mapped.

Table 7. A table comparing 2015 PSTA data for wildfire behaviour threat class and the CWPP Update local fire threat within the study area (area is rounded to the nearest hectare).

	2015 PSTA Data		CWPP Update (local threat assessment)	
Wildfire Behaviour Threat Class	Area (ha)	Percent of study area	Area (ha)	Percent of study area
Extreme	389	5%	72	<1%
High	1559	18%	812	9%
Moderate	2084	24%	1176	14%
Low	2631	31%	2085	24%
Very Low (Water)	161	2%	141	2%
No Data (Private Land)	1782	21%	4321	50%
Total	8607	100%	8607	100%

Beyond the study area in all directions there are continuous forested areas outside the scope of this threat assessment. Although these areas were not part of the local threat assessment, field observations, PSTA data, publicly available CWPP data from adjacent jurisdictions[27] and orthophotos are available for these areas. This is of importance for the hillside directly south of Fernie Alpine Resort base area, as well as the area south of the southern extent on Cokato Road where City-owned sewage lagoons are located. Figure 8 shows the threat ratings specific for these outlying areas which are of interest to the City of Fernie.[28] The threat rating for these areas ranges from moderate to extreme; there are no significant areas of low wildfire behaviour threat class.

[27] B.A. Blackwell and Associates Ltd. 2012. Community Wildfire Protection Plan: Considerations for Wildland Urban Interface Management for the RDEK Electoral Area A.

[28] The threat ratings displayed in Figure 8 display threat classes from PSTA data (2015) and the Regional District of East Kootenay Electoral Area A CWPP, developed in 2010.

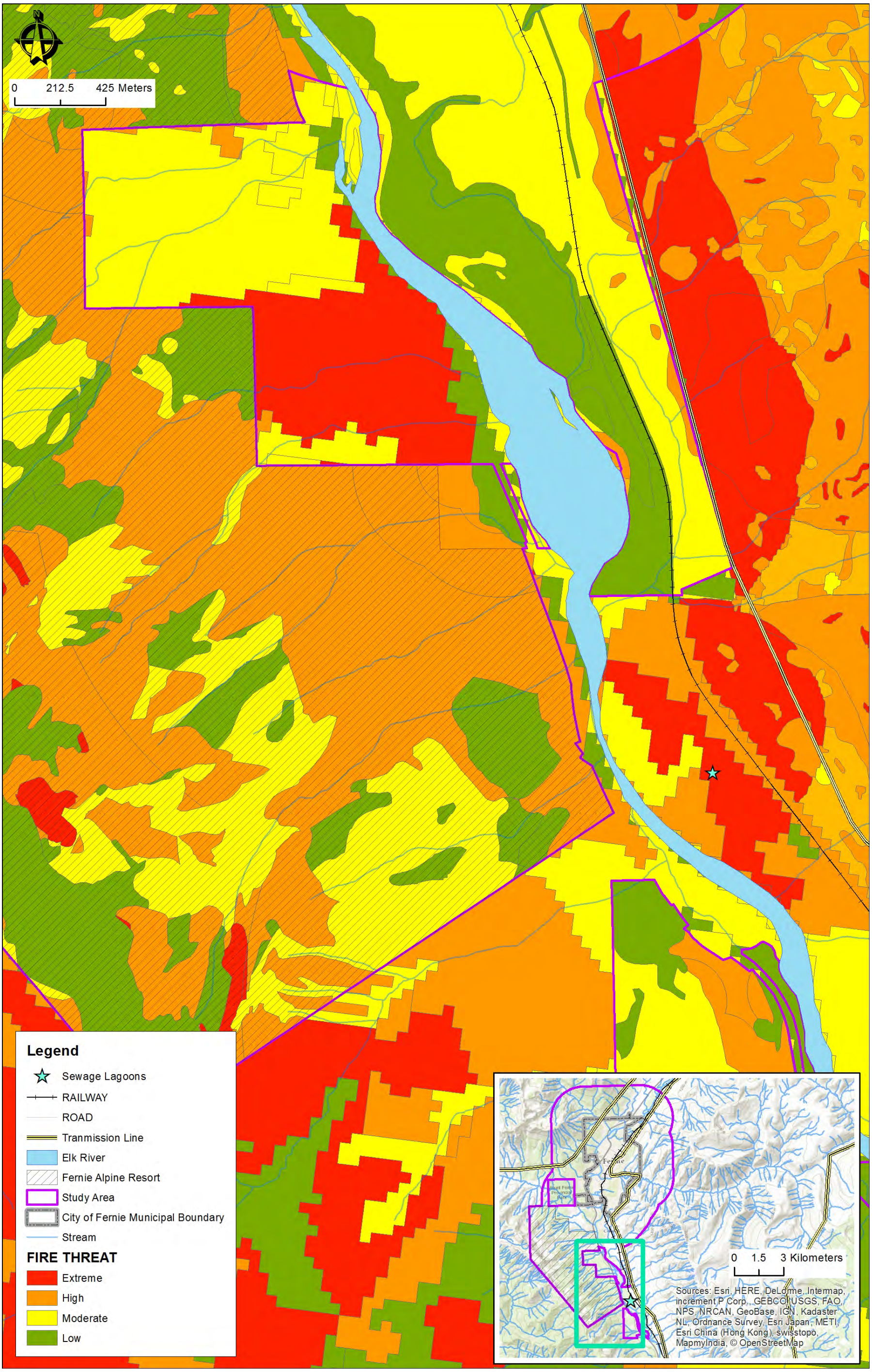


Figure 8. A synthesis of threat class ratings for areas outside the study area, but of interest to the City of Fernie. The threat for the hillside south of the base of Fernie Alpine Resort is pulled from 2015 PSTA data; the threat for the area around the sewage lagoons on Cokato Road is a combination of RDEK CWPP data (2010) and 2015 PSTA data.

3.2.1.2 WUI THREAT ASSESSMENT METHODOLOGY

Threat assessment for the study area was completed using the WUI threat plots and methodology outlined in the Wildland Urban Interface Wildfire Threat Assessments in BC handbook.[29] Detailed methodology can be found in Appendix H.

3.3 LOCAL WILDFIRE HISTORY

Two major historical fires destroyed much of the City of Fernie: one in 1904 and one in 1908. The 1908 was a wildfire event during which embers ignited spot fires ahead of the fire front and destroyed the City of Fernie, save for 37 buildings. Analysis of historical ignition data from 1950 – 1999 (completed as part of the 2005 CWPP) shows that:

- 66% of all wildfires during this period were ignited by human activity (human-caused).
- 100% of wildfires greater than 10 ha in size were human-caused.
- The two largest fires, 46 ha and 38 ha, were ignited by an errant cigarette and a non-compliant campfire, respectively.

The MFLNRORD fire reporting system was used to compile a database of fires that occurred within the study area. This database provides an indication of fire history for the area, but should not be considered comprehensive. Since 1999 (this excludes the period previously analyzed in the 2005 CWPP), there have been 8 ignitions within the study area, 5 of which have been ignited by lightning. The three human-caused ignitions were due to: juveniles experimenting with fire, arson, and a non-compliant campfire (campfire escape). Figure 9 displays the ignitions and perimeters of historical fires in the area (1910 – 2015) and shows the extent to which fire has shaped the landscape over the last century. Fires occurring prior to 1910, including the great fire of 1908, are not included in the data set or displayed on the map.

[29] Morrow, B., K. Johnston, and J. Davies. 2013. Wildland Urban Interface Wildfire Threat Assessments in BC.

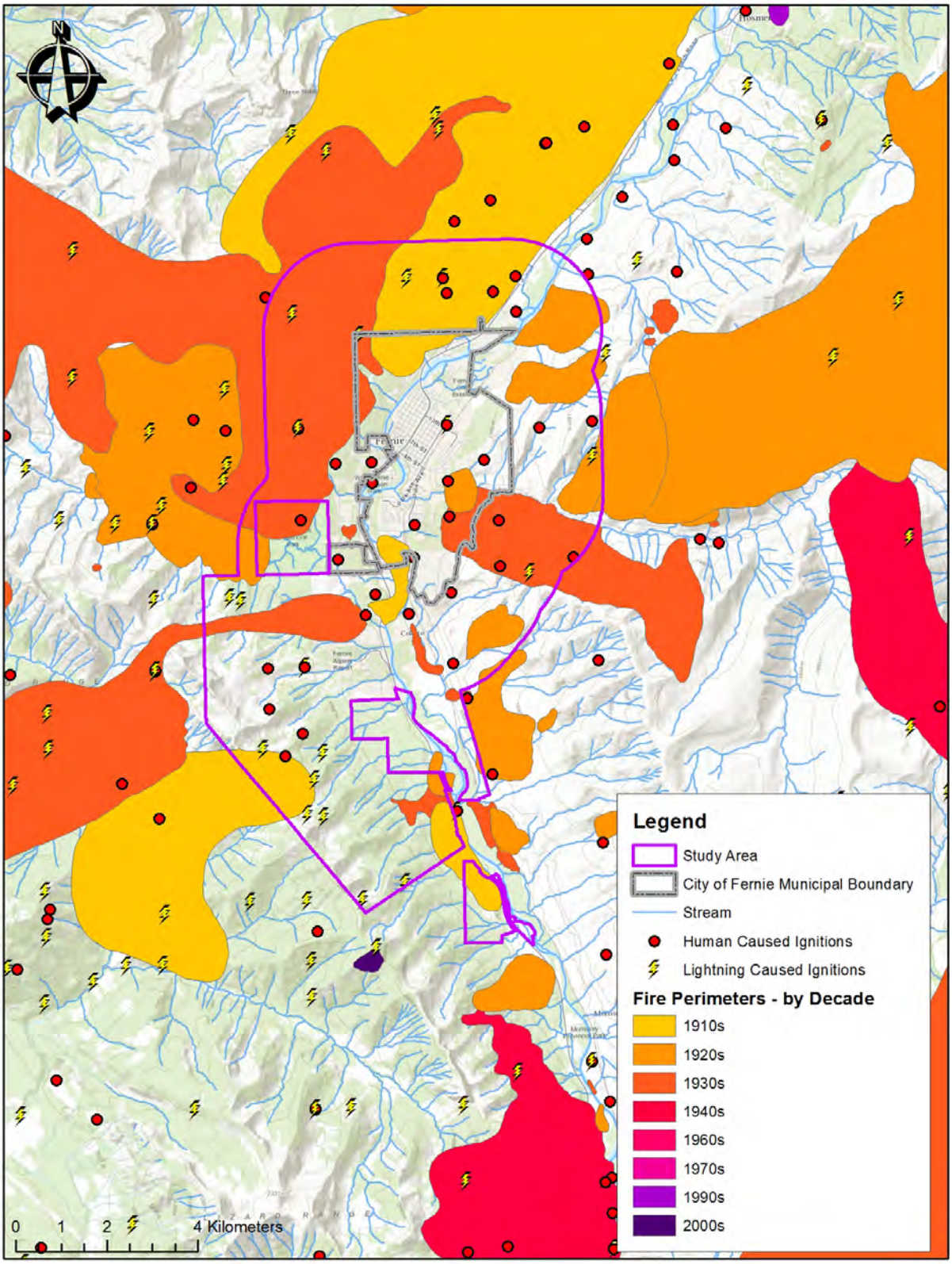


Figure 9. Ignitions and area burned by wildfire in the Elk Valley: a display of how fire has helped to shape the landscape. The map shows all BCWS-data for ignitions (1919 – 2015) and fire perimeters (1910 – 2015).

3.3.1 FIRE WEATHER DATA

The Canadian Forestry Service developed the Canadian Forest Fire Danger Rating System (CFFDRS) to assess fire danger and potential fire behaviour. Fire Danger Classes provide a relative index of how easy it is to ignite a fire and how difficult control is likely to be. A network of fire weather stations is maintained during the fire season by MFLNRORD and the recorded data are used to determine fire danger, represented by Fire Danger Classes, on forestlands within a community. The information can be obtained from the BCWS and is most commonly utilized by municipalities and regional districts to: monitor fire weather; restrict high risk activities when appropriate; and to determine hazard ratings associated with bans and closures. Full definitions of Danger Classes can be found in Appendix I.

Data was provided from the BCWS and comes from the two weather stations closest to, and most representative of the weather conditions of, the study area: Goathaven and Sparwood weather stations (Table 8). Due to the distance from the study area and location of the available weather stations, direct application of weather data may not be possible, although weather data will be able to provide a rough indication of the average number of high fire danger days that can be expected within the study area.

Table 8. Fire weather station details for Goathaven and Sparwood weather stations.

Weather Station	BEC Zone	Years of Data	Appx. Distance from Study Area(s) (km)
Goathaven	ICH mk 4	**37** (1980 - 2016)	17
Sparwood	MS dk 1	**12** (2005 - 2016)	25

Figure 10 and Figure 11 represent the frequency of Fire Danger Classes between the months of April through to October. The Forest Danger class days are summarized below to provide an indication of the fire weather in the study area. For the study area, there are about three months in the summer where there is a high risk for a significant wildfire event (July, August, September), peaking in August. Although highest fire danger is within these three months, it should be noted that there are Danger Class 4 and 5 days (high fire danger) which start in May and extend through October.

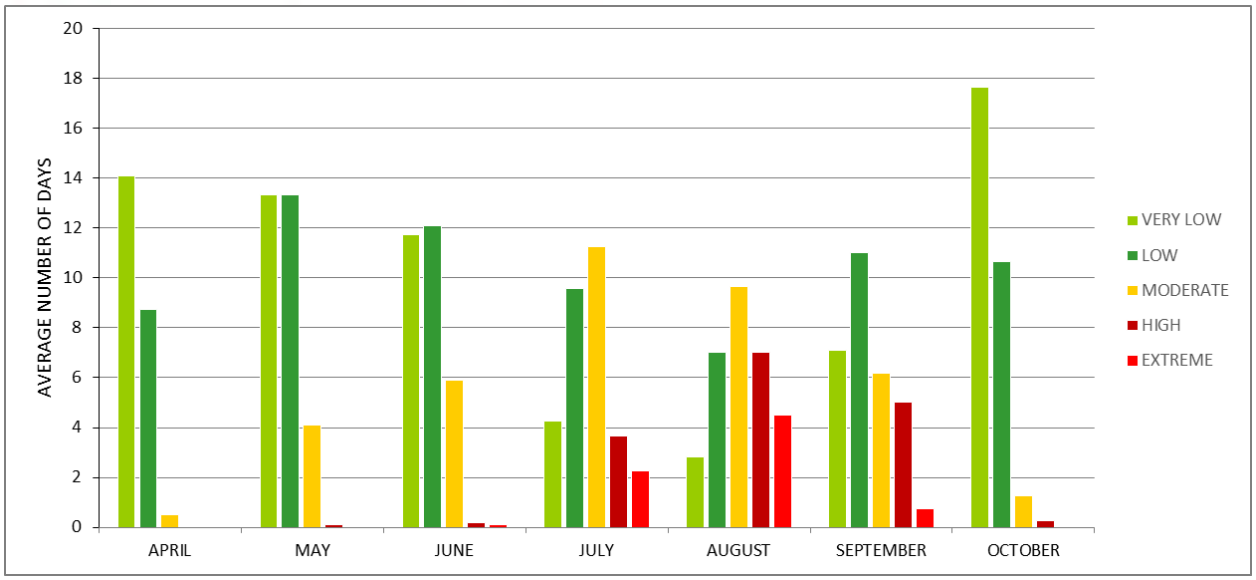


Figure 10. Average frequency of Fire Danger Class ratings by month over a 12-year period (2005-2016) from the Goathaven weather station.[30]

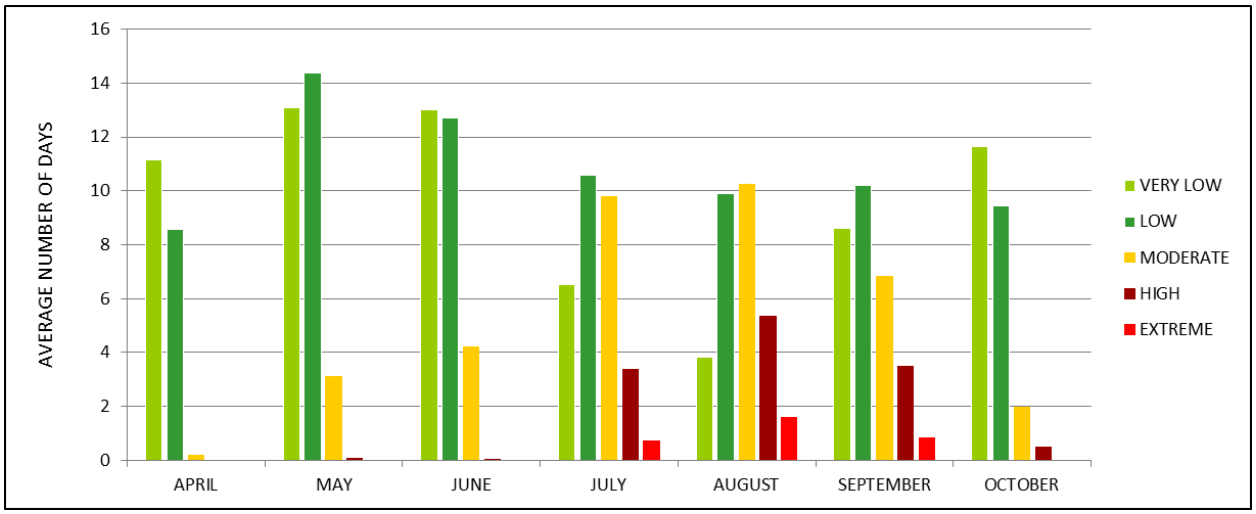


Figure 11. Average frequency of Fire Danger Class ratings by month over a 37-year period (1986-2016) from the Sparwood weather station.[31]

[30] Note: Goathaven weather station data was collected between 2004 -2016, however the data collected in 2004 was not sufficient enough to conduct an analysis of fire danger classes in the spring and summer, and was therefore excluded from the study.

[31] Note: Sparwood weather station data was collected between 1986 -2016, however during 1992-1993 there was no data collected for the month of April. Although the significance of this missing data is minor it should still be considered when analyzing fire weather averages for April.

Wind plays a predominant role in fire behaviour and direction of fire spread. Hourly wind readings were available for the Goathaven weather station (Figure 13). Local knowledge of the study area confirms that the predominant wind direction during the fire season is south to southwest, although there are occasionally strong northerly winds.

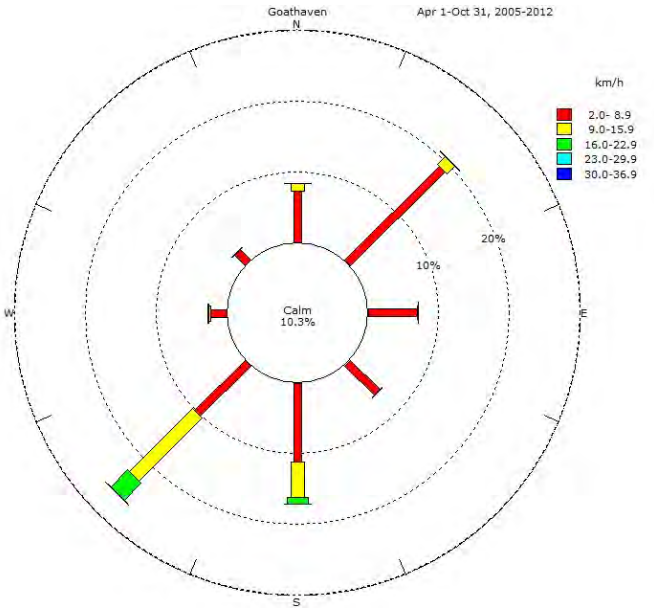


Figure 12. Windrose showing hourly wind readings during the fire seasons 2005 – 2016 for the Goathaven weather station.

4.0 EXISTING POLICIES AND GUIDELINES

Following, is a summary of municipal and provincial policies and guidelines that relate to strategic wildfire management, wildfire threat reduction, and operational fuel treatments.

4.1 CITY OF FERNIE

The following municipal bylaws are relevant to wildfire planning in the City of Fernie.

Bylaw No. 2231, 2014: Official Community Plan

The OCP provides guidance for land use and development within the City of Fernie. Section 4-A sets forth policies and guidance around public health, safety, and community wellbeing; section 4-B gives direction specific to fire and life safety. The following points are directly applicable to wildfire mitigation reduction efforts and the City of Fernie.

- 4-A.1 Continue to update hazard area mapping wherever and whenever required to ensure that mapping for Hazard Area Development Permit Areas remains current and the highest levels of public safety and health are maintained.
    - Although the City does not currently have a Development Permit Area for wildfire hazard, this document serves to provide the City a current and accurate understanding of the threat wildfire poses to the City and their interests. Furthermore, should the City implement a wildfire hazard development permit area, this point will guide regular hazard mapping updates.

- 4-A.3 Work with local and regional governments and provincial partners (Districts of Elkford and Sparwood, RDEK, Interior Health Authority) to maintain high regional air quality standards, monitoring and systems to protect public health.
    - Demonstrates the City's commitment to regional air quality and is relevant for potential fuel management projects, specifically open air burning of biomass.
- Section 4-B provides the following guidance, specific to wildfire and public safety:
    - Implement recommendations from the 2005 CWPP;
    - Integrate FireSmart standards into the design of new subdivision developments;
    - Update fire hazard mapping (a component of this document);
    - Consider a Development Permit Area specific to wildfire hazard;
    - Review and update the Fire Protection and Life Safety Bylaw No. 2029 (see below); and,
    - Include climate and hydrological changes, trends, and risks in environmental risk assessments.
- Section 4-B also provides guidance for emergency planning, preparedness, public communication, and Fire Service.

Other sections within the OCP which are relevant to wildfire threat reduction include:

- 6-E Urban Forest – guides plans and stewardship for urban forested areas, particularly areas of mature trees. This section includes mid-term recommendations to develop a *Tree Preservation Bylaw* to inventory and protect or replace mature trees during development. If a *Tree Preservation Bylaw* is enacted, it is important to consider any existing or planned Development Permit areas; a tree protection bylaw and wildfire development permit area can co-exist, but impacts of one on the other should be considered.
- 8-B Inter-governmental Collaboration – documents City commitment to maintaining and enhancing relationships with regional and local government partners, including the RDEK, Fernie Alpine Resort, and Ktunaxa Nation. Specifically, to 'ensure open and transparent engagement and referral system for development and planning matters'.
- 9-B.15 Forest Reserve – provides direction for a forested portion of the Ridgemont neighbourhood called the East Bench. This section of the OCP would be applicable to review prior to any fuel treatment or hazard reduction efforts in this area.
- 9-C Development Permit Areas – sets process and details around the current eight Development Permit Areas within the City.

Bylaw 2029: Consolidated Fire Protection and Life Safety Bylaw

Section 3 outlines the City's Fire Service Operations level (Full Fire Service) and the minimum training standards required for Full Fire Service Operations Level Fire Suppression. It also sets forth the limits of Fernie Fire Rescue jurisdiction.

Section 5 outlines burning restrictions for open air fires; a Fire Permit is required for all open-air fires (fires for land clearing, hazard reduction, or other). Furthermore, Section 5.4 allows the Director of Fire and Emergency Services to cancel any fire permit and requires permittees to extinguish fires with cancelled permits.

Section 6 regulates backyard fire pits by limiting size, stipulating acceptable fuels, requiring supervision, requiring a Fire Permit, directing design of fire pits (non-combustible surrounding, spark arrestors), and limiting timing of fires.

Bylaw 2029 allows the Fire Chief to refuse to issue, or cancel any fire permits if burning is determined to be hazardous to personal safety, jeopardizes values at risk, or creates a nuisance.

Section 7 regulates the use of fireworks; it is unlawful to set off or explode any firework without the issuance of a Fireworks Permit by the City. Furthermore, fireworks are banned during all times of open fire bans, and Fireworks permits will not be issued during an open fire ban.

Section 9 controls building addressing for all commercial, multi-residential, and single family dwellings. For all addresses, numbers must be a minimum of 100 mm in height and a colour which contrasts with the surface on which they are mounted.

Bylaw 1727: Consolidated Subdivision and Development Servicing Bylaw

Bylaw 1727 and its amendments set forth regulations and requirements of works and services in respect of the subdivision and development of land. This includes, but is not limited to: lot size, shape, and dimensions; level of servicing required; servicing requirements for water systems, sewer, gas, telephone, and electrical distribution, and other public services and utilities; and road access

Section 4.15 addresses clean-up requirements specific to construction materials, which may be usable to require construction areas to be regularly maintained free of accumulations of combustible building materials.

Bylaw 1587: Unsightly Property Prevention Bylaw Consolidated Version

Although not developed to address wildfire hazard reduction, this bylaw prohibits persons from collecting or accumulating unsightly, noxious, or offensive materials on their property. This includes the following combustible materials, which are directly applicable to wildfire hazard: paper, cardboard, building materials, leaves, wood, and bedding, among other items. Additionally, it prohibits the accumulation and uncontrolled growth of vegetation including weeds, brush and trees. It allows the City to require the property owner to address the accumulations, and gives the City authority to enforce any order, as well as collect on expenses incurred.

Bylaw 2203, 2013: Fernie Rural Fire Protection Authorization Bylaw

This bylaw sets forth the Fire Service Area terms and conditions agreed upon by the RDEK and the City. Section 8.2 requires that the RDEK provide a water tender to provide service to those areas not serviced by fire hydrants. Section 11.2 requires residential and commercial properties within the Fire Service Area display address numbers that are visible from the road, year-round. The contract is valid through December 31, 2018.

Bylaw 1946: Building Bylaw

This bylaw may be considered as a vehicle for maintaining construction sites free of combustible building materials. Currently, there is no similar restriction or requirement in the bylaw.

4.2 PROVINCIAL

4.2.1 KOOTENAY BOUNDARY HIGHER LEVEL PLAN ORDER (KBHLPO)

The KBHLPO is the higher-level planning document for the Kootenay Region; it establishes Resource Management Zones and objectives for each zone. The plan provides general resource management direction, as well as defined objectives: Biodiversity Emphasis, Old and Mature Forest, Caribou, Green-up, Grizzly Bear Habitat, Consumptive Use Streams, Enhanced Resource Development Zones, Fire Maintained Ecosystems, Visuals, and Social and Economic Security. There are several specific, spatially explicit ministerial orders pertaining to ungulate winter range (UWR) and visual quality objectives (VQO) in the study area which may impact potential activities.

These plans and spatially explicit ministerial orders must be reviewed, considered, and addressed during the site-level planning phase. Fuel management within these areas should aim to enhance these values, whenever possible and the land manager (Rocky Mountain Natural Resource District) must be consulted regarding any overlapping values at risk, spatially explicit ministerial orders, or other notable values on the land base, during prescription development.

4.2.2 ROCKY MOUNTAIN RESOURCE DISTRICT FIRE MANAGEMENT PLAN

The Rocky Mountain Resource District has completed a Fire Management Plan (FMP) to identify values at risk and prioritize broad categories of values as ‘themes’ for categorizing response through the Resource Strategic Wildfire Allocation Protocol (RSWAP). Through consultation with the land manager (MFLNRORD Rocky Mountain Resource District), it was determined that there are no landscape level fuel breaks recommended within, or near to, the study area. Similarly, Fernie was not chosen for a more detailed Fuel Treatment Opportunity Report.

4.3 ADJACENT JURISDICTIONS/ GOVERNMENTS

CWPPs have been developed for the RDEK Electoral Area A, the area that surrounds and partially overlaps with the study area. This document has been reviewed for synergistic project opportunities, as well as to confirm that there are no conflicting recommendations. The City may wish to initiate or cooperate on projects recommended within this CWPP: projects which may benefit the City, or the region. Should this be the case, the appropriate CWPP and government should be consulted for implementation recommendations and funding opportunities.

4.4 OTHER

The eastern side of the Elk Valley within the study area is privately-held timber management areas. Forest management in these areas is legislated under the Private Managed Forest Land Act [SBC 2003] Chapter 80. The Crown land portion of the western slopes are within Canfor's operating area, although there is no active harvesting by Canfor in this area.

Forest management within the WUI should consider wildfire risk and include wildfire management objectives. For this reason, WUI-specific fire management stocking standards have been developed by the province. [32] It is recommended that forest activities include a post-harvest commitment to appropriately abate any hazard created as result of harvesting or land clearing (plans may include pile burning or mulching wood waste). Field visits of recent harvesting activities identified that hazard abatement was, in general, completed.

The area around the City of Fernie is abundant in wildlife habitat; much of the surrounding area has been identified as high-value carnivore linkage landscapes and travel corridors.[33] Non-legislated values, such as minimizing impact to, or enhancing, wildlife habitat (security, connectivity, etc.), should be included in fuel management prescription objectives.

5.0 PAST WILDFIRE RELATED PROJECTS

Since 2005, the City has been working to improve their community wildfire planning and to enhance the level of wildfire risk mitigation. The most notable actions are below; actions which addressed recommendations from the 2005 CWPP are found in parentheses.

- Inclusion of 2005 CWPP implementation as a City priority and official recognition of wildfire hazard in the Official Community Plan (adopted June 2014).
- Update of City website to include FireSmart information and wildfire links (recommendation #2).
- Completion of fuel treatments on 10.2 ha of municipally owned land in the Ridgemont area in 2011 (recommendation #16).
- Implementation of a FireSmart program. This program was initiated in 2016 with a SWPI FireSmart Grant and continues its work into 2017. Activities have included the following achievements and ongoing planning and initiatives.
    - Two Fernie Fire Rescue members trained as Local FireSmart Representatives.
    - City-hosted ½ day workshops to assist Community Champions implement program.

[32] https://www.for.gov.bc.ca/hfp/silviculture/stocking_stds.htm

[33] Apps, C. D., J. L. Weaver, P. C. Paquet, B. Bateman and B. N. McLellan. 2007. Carnivores in the southern Canadian Rockies: Core areas and connectivity across the Crowsnest Highway. Wildlife Conservation Society Canada Conservation Report No. 3. Toronto, Ontario, Canada.

- Established and maintained FireSmart Fernie Facebook page.
- Developed/deliver FireSmart public information and Community Champion recruiting presentations.
- Developed and/or distributed significant print, video, and other FireSmart materials/ information.
- FireSmart booth and association information provided at multiple community events throughout the year.
- Providing support and information to FireSmart Boards in preparation of FireSmart Community Plans and implementation of neighbourhood FireSmart events.
- Conducting neighbourhood hazard assessments and preparing FireSmart Assessment Reports.
- Participated in the national "Wildfire Community Preparedness Day" in May 2017.
- Facilitation of FireSmart fuel management project in Castle Mountain neighbourhood.
- Identified FireSmart demonstration sites and developing content for FireSmart landscaping workshops for local landscapers and land managers
- Currently collaborating with major landowners/property developers.

Future successes in wildfire threat reduction activities will benefit from continued intra-department communication and cooperation, as well as exploration of external partnerships to continue to achieve measurable success in wildfire mitigation efforts, to share costs, and to help empower community members and stakeholders to take responsibility for risk reduction efforts within their community.

6.0 FIRESMART

FireSmart® is the comprehensive nationally accepted set of principles, practices and programs for reducing wildfire losses.[34] FireSmart spans the disciplines of hazard/threat assessment; regional planning and collaboration; policy and regulations; public communication and education; vegetation/fuel management; training and equipment; and, emergency preparedness and response. FireSmart concepts provide a sound framework for advancing the goal of wildfire loss reduction, as it is a common goal shared with CWPPs.

The FireSmart approach and concepts, including recommended FireSmart guidelines[35], have been formally adopted by almost all Canadian provinces and territories, including British Columbia in 2000; FireSmart has become the d*e facto* Canadian standard. FireSmart is founded in standards published by the National Fire

[34] FireSmart is the registered trademark held by the Partners in Protection Association.

[35] FireSmart guidelines first published in the 1999 manual "*FireSmart: Protecting Your Community from Wildfire*", with a second edition published in 2003.

Protection Association. The objective of FireSmart is to help homeowners, neighbourhoods, whole communities and agencies with fire protection and public safety mandates to work together and to prepare for the threat of wildfire in the WUI. Coordinated efforts between all levels of planning and action are integral to effectively and efficiently reducing the risk to communities.

The following are key principles of FireSmart:

- Wildland fires are a natural process and critical to the health of Canadian ecosystems.
- Wildfires do not recognize or respect jurisdictional boundaries, thus mitigation and response efforts must be carefully coordinated through all stages of planning and implementation.
- Threats and losses due to wildfires can be reduced by working together. Responsibility for effectively mitigating hazards must be shared between many entities including homeowners, industry, businesses and governments.[36]
- FireSmart encompasses seven broad disciplines to help address the threat of wildfire: education, vegetation management, legislation and planning, development considerations, interagency cooperation, emergency planning, and cross training.[36]
- Solutions are required at all scales from individual backyards, to communities and the wider landscape. In order to succeed, these efforts must be integrated across a mosaic of land ownership (Figure 13).
- The ultimate root of the WUI interface problem is the vulnerability of structures and homes to ignition during wildfire events, in particular by embers. This leads to an emphasis on risk mitigations on private properties.

The highest level of planning within the FireSmart program is strategic direction, such as that provided in CWPPs.

[36] https://www.firesmartcanada.ca

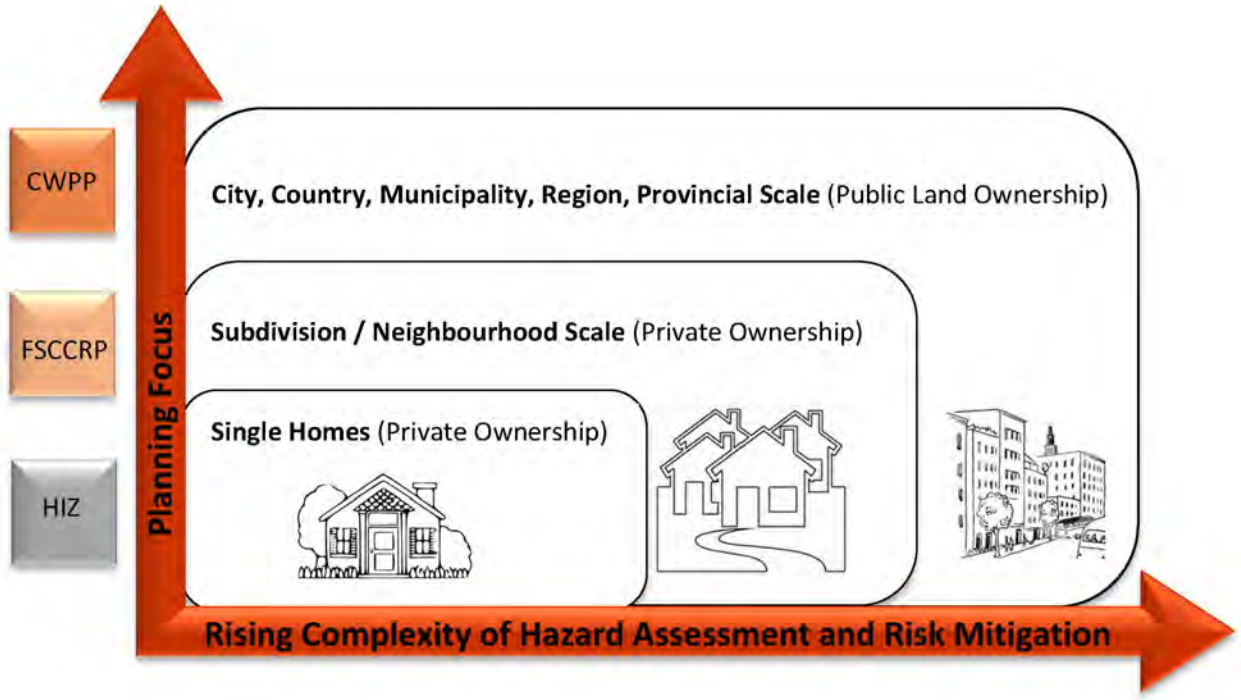


Figure 13. Diagram of the various, coordinated levels of the FireSmart program.[37] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.

HOME IGNITION ZONE

Multiple studies have shown that the principal determining factor regarding home loss to wildfire is the structure's characteristics and immediate surroundings; the area that determines the ignition potential is referred to as the Home Ignition Zone (HIZ). [38,39] The HIZ includes the structure itself and three concentric, progressively wider Priority Zones. HIZ Priority Zones are based upon distance from structure: 0 – 10 m (Priority Zone 1), 10 – 30 m (Priority Zone 2), and 30 – 100 m (Priority Zone 3). These zones help to guide risk reduction activities, with Recommended FireSmart Guidelines being most stringent closest to the structure. The likelihood of home ignition is mostly determined by the area within 30 m of the structure (Priority Zones 1 and 2). Recommended FireSmart guidelines address a multitude of hazard factors within the HIZ: building materials and design; vegetation (native or landscaped materials); and the presence of flammable objects, debris, and vulnerable ignition sites. More detail on priority zones can be found in Appendix J.

It has been found that, during extreme wildfire events, most home destruction has been a result of low-intensity surface fire flame exposures, usually ignited by embers. Firebrands can be transported long distances ahead of the

[37] Figure and content developed by A. Westhaver. Adapted by A. Duszynska, 2017.

[38] Reinhardt, E., R. Keane, D. Calkin, J. Cohen. 2008. Objectives and considerations for wildland fuel treatment in forested ecosystems of the interior western United States. Forest Ecology and Management 256:1997 - 2006.

[39] Cohen, J. Preventing Disaster Home Ignitability in the Wildland-urban Interface. Journal of Forestry. p 15 - 21.

wildfire, across fire guards and fuel breaks, and accumulate on horizontal surfaces within the HIZ in densities that can exceed 600 embers per square meter. Combustible materials found within the HIZ combine to provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

For example, an investigation of home destruction from the 2016 Fort McMurray, Alberta fire found that the vast majority of home ignitions in the interface (outer edges of urban neighbourhoods) were attributable to embers alighting on combustible material (home or adjacent areas).[40] Similarly, reports from the 2010 Fourmile Canyon fire outside Boulder, Colorado, found that only 17% of the 162 homes destroyed were attributed to crown fire.[41, 42] Instead of high intensity flames or radiant heat, the majority of homes ignited as a result of firebrands (or embers), which ignited lower-intensity surface fires adjacent to structures or the home directly.[42] Post-fire studies have shown that it is uncommon for homes to be partially damaged by wildfire; survivability is based upon whether or not the home, or area adjacent to the home, ignites.

Because ignitability of the HIZ is the main factor driving structure loss, the intensity and rate of spread of wildland fires beyond the community has not been found to necessarily correspond to loss potential. For example, FireSmart homes with low ignitability may survive high-intensity fires, whereas highly ignitable homes may be destroyed during lower intensity surface fire events.[39] Increasing ignition resistance would reduce the number of homes simultaneously on fire; extreme wildfire conditions do not necessarily result in WUI fire disasters.[41] It is for this reason that the key to reducing WUI fire structure loss is to reduce home ignitability; mitigation responsibility must be centered on homeowners. Risk communication, education on the range of available activities, and prioritization of activities should help homeowners to feel empowered to complete simple risk reduction activities on their property.

FIRESMART CANADA COMMUNITY RECOGNITION PROGRAM

In the case of adjacent homes with overlapping HIZs, a neighbourhood (or subdivision) approach is the most effective method of reducing ignition potential for all homes within the neighbourhood. The FireSmart Canada Community Recognition Program (FSCCR Program) is an 8-step resident-led program facilitated by trained Local FireSmart Representatives designed for this purpose. It provides groups of residents with critical information and a means of organizing themselves to progressively alter hazardous conditions within their neighbourhood. The program also facilitates FireSmart knowledge and practices to quickly filter downwards onto the property of

[40] Westhaver, A. 2017. *Why some homes survived. Learning from the Fort MacMurray wildland/urban interface fire disaster*. A report published by the Institute for Catastrophic Loss Reduction – ICLR research paper series – number 56. https://www.iclr.org/images/Westhaver_Fort_McMurray_Final_2017.pdf

[41] Calkin, D., J. Cohen, M. Finney, M. Thompson. 2014. *How risk management can prevent future wildfire disasters in the wildland-urban interface*. Proc Natl Acad Sci U.S.A. Jan 14; 111(2): 746-751. Accessed online 1 June, 2016 at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/.

[42] Graham, R., M. Finney, C. McHugh, J. Cohen. D. Calkin, R. Stratton, L. Bradshaw, N. Nikolov. 2012. Fourmile Canyon Fire Findings. Gen. Tech. Rep. RMRS-GTR-289. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 110 p.

individual residents to further mitigate wildfire hazards at the single-home scale, also known as the Home Ignition Zone (HIZ). Beginning in 2016, implementation of the FSCCR Program was initiated by the Fernie Fire Rescue.

WUI DISASTER SEQUENCE

Calkin et al (2014) coined the 'WUI disaster sequence', a six-step sequence which has been used to describe the situation in which the firefighting capacity of a community is overwhelmed by wildland/ interface fires in highly ignitable communities: 1) extreme wildfire behaviour weather combined with, 2) a fire start, which 3) exposes numerous homes with high ignition potential, and results in numerous structures burning, which 4) overwhelms suppression efforts and capabilities, and 5) leads to unprotected homes, and therefore 6) considerable structure loss (Figure 14).

Once multiple homes are ignited in an urban area, there is increasing potential for fire to spread from structure to structure, independently of the wildland vegetation. This is known as an urban conflagration. Effective fire protection depends on ignition resistant homes and properties during extreme wildfire events.[41] It is for this reason, that FireSmart implemented across the various levels in an integrated fashion should be the key objective for the City.

Overall, FireSmart leads to communities that are better adapted to wildfire, more resilient and able to recover following wildfires by sustaining fewer losses and disruption, and safer places to live and recreate. Action by homeowners is the number one priority for reducing structure loss in the event of a WUI fire, but the overall adaptation of the community to wildfire is multi-pronged and the landscape should not be ignored.[41]

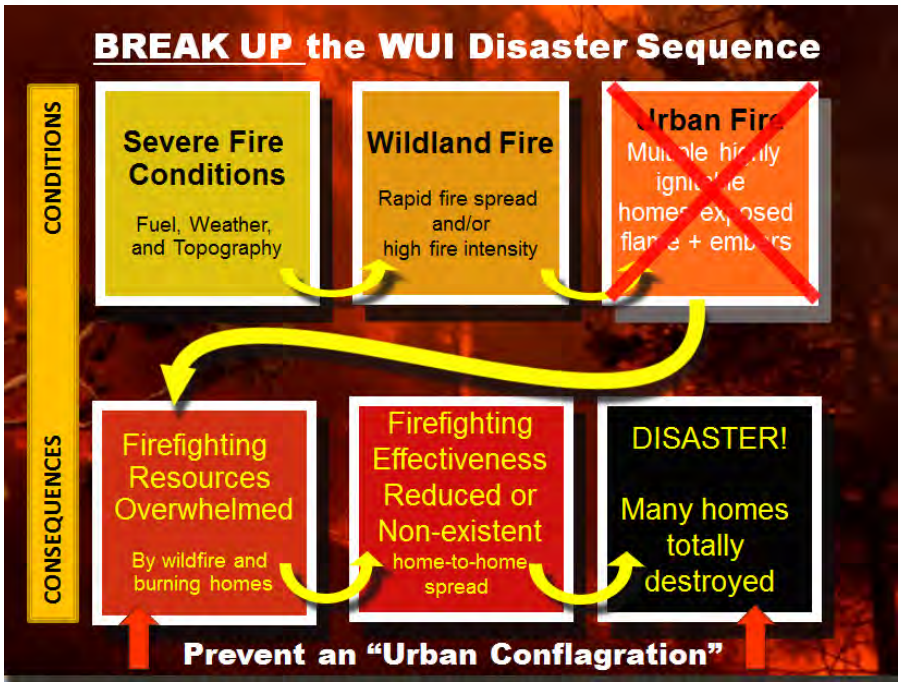


Figure 14. Wildland/urban interface disaster sequence.[43] It is possible to break up the disaster sequence by decreasing the number of highly ignitable homes exposed to embers, therefore reducing the number of homes ignited and removing the consequences of multiple structures lost.

6.1 FIRESMART STRUCTURE PROTECTION

Four main categories of hazard factors contribute to the vulnerability, or ignition potential, of structures located in the WUI. There are twenty (20) hazard factors in all, pertaining to:

1. Structural vulnerabilities related to building materials or design features
2. Hazards arising from nearby vegetation (both residual native vegetation and planted landscaping
3. Topographic features related to slope that enhance fire behavior
4. Ignition sites that trap fine fuels or embers, or provide other sources of combustible material

Hazard assessments conducted for individual homes and entire neighbourhoods address these same hazard factors but focus on different scales. Recommended FireSmart guidelines have been developed to resolve or avoid each of these individual hazard factors. Compliance with them increases the chance that homes can withstand an interface fire event.

Structural guidelines are designed to increase the fire resistance of roofing, exterior siding, windows and doors, eaves, vents, openings, balconies, decks, and porches, which are all primary considerations in developing FireSmart neighbourhoods. Risk reduction can be achieved through replacement, retrofitting, or minor modifications and be implemented voluntarily or enforced through regulatory mechanisms.

[43] Graphic adapted from Calkin et. al., by A. Westhaver.

Recommended FireSmart guidelines for management of vegetation fuels within the HIZ address characteristic of fuels of both residual native and landscaped vegetation based upon vertical layers (i.e. surface, canopy, and ladder fuels), the density or horizontal continuity, and the relative flammability or fire resistance of different types of vegetation.

Still other FireSmart guidelines recommend measures to reduce the abundance or consequences of miscellaneous combustibles and sites that accumulate fine debris and embers on residential properties.

It is recommended that homeowners take a building envelope – out approach, that is, starting with the home and working their way out. Addressing little projects first can allow for quick, easy, and cost-effective risk reduction efforts to be completed sooner, while larger, more costly projects can be completed as resources and planning allow. Maintaining fire resistant status is also essential. For example, prior to the fire season, clearing roofs and gutters of combustible materials (leaves and needles), clean out any combustible accumulations or stored materials from under decks, moving large potential heat sources such as firewood, spare building materials or vehicles as far from the structure as possible, maintaining a mowed and watered lawn, removing dead vegetation, and pruning trees are actionable, low-cost steps that residents can start working on immediately.[44]

The actions of property owners to mitigate wildfire hazards and reduce the vulnerability of homes to ignition greatly reinforce, and are mutually supportive, of community wildfire protection actions proposed elsewhere in this 2017 CWPP update. Most importantly, they benefit the effectiveness and safety of firefighters.

More details on FireSmart and FireSmart Guidelines can be found in Appendix K.

6.1.1 FIRESMART COMPLIANCE WITHIN THE STUDY AREA

As could be expected, there is a wide range of FireSmart compliance on private properties in Fernie, which may be indicative of property owners' level of awareness regarding actions or guidelines to mitigate the risk of wildfire loss. There are large differences in the degree to which FireSmart best practices are visible within individual HIZs, and in neighbourhoods throughout the City.

Aside from differing levels of awareness, understanding and acceptance of recommended FireSmart guidelines by residential and commercial property owners, there are a number of other factors that add variability to the level of FireSmart compliance within the Fernie study area. Ultimately, these also impact the vulnerability of structures in Fernie and the amount of effort required to achieve a FireSmart rating for individual homes, neighbourhoods or the community as a whole. These factors include, but are not limited to: the age of homes or subdivision; prevailing design features and favored building materials of the era; proximity to forested area; density, lot size and lay-out of the subdivision; positioning of the home or neighbourhood in relation to slope, aspect and prevailing winds; and the stage and maturity of landscaping.

The strength of a CWPP is that it addresses wildfire risks at all spatial scales, across all multiple disciplines, on private and public land ownership lands and suggests coordinated mix of synergistic risk mitigations towards reducing wildfire losses.

[44] http://www.firewise.org/wildfire-preparedness/be-firewise/home-and-landscape/defensible-space.aspx?sso=0

In 2016, Fernie neighbourhoods were surveyed as a pre-cursor to the FSCCR Program. The following observations were made:

- Wildfire hazard levels range from moderate to extreme across neighbourhoods within the study area.
- The bulk of hazards are associated with conditions of natural and landscaped vegetation immediately surrounding residential properties.
- In newer neighbourhoods, where landscaping is not yet completed, educational approaches may aid in promoting fire resistant landscaping options.
- Hazards are magnified in some neighbourhoods due to the steep terrain and effect of slope on potential fire behaviour.
- All the neighbourhoods have good opportunities to mitigate the risk through individual and collective action.
- Implementing the FSCCR Program would benefit Fernie; recruiting FireSmart Community Champions in each neighbourhood would be a desirable early goal for the City.[45]

6.2 FIRESMART FUEL TREATMENTS

FireSmart fuel treatments are an effective method of reducing the ease with which fire can move to and from a home. Treatments are completed by altering the natural vegetation around the home; the type of alteration required is determined by the distance from the home, or value at risk, as defined by the priority zones within the HIZ. The principles and practices of FireSmart fuel treatments are discussed in depth in Appendix J. Recommended practices and principles are described in the FireSmart manual. [46]

It also must be noted that the forested landscapes and vegetation within and surrounding the City of Fernie provide many important and cherished societal values. These include a sense of place and aesthetics; amenities related to lifestyle, recreation and economic and tourism benefits; and environmental values linked to watershed, wildlife habitat and travel corridors, and biodiversity. Fuel modification prescriptions must be sensitive to these values. Fortunately, it is possible to manage for multiple, overlapping values without compromising primary treatment objectives. All fuel treatments and fuel modification prescriptions should be completed by a qualified professional (Registered Professional Forester) working within their field of competence.

During community consultation, it was communicated that disposal of woody material is a challenge for some landowners. Inappropriate disposal often results in piled accumulations on private property or adjacent Crown or municipal land (green space), increasing wildfire hazard. This is a common problem for many municipalities and

[45] Survey completed and takeaways provided via personal communication, A. Westhaver, May 2, 2017

[46] Partners in Protection. (2003). FireSmart: Protecting your community from wildfire. Second edition. Capital Color Press Ltd. Edmonton, Alberta.

should be addressed within by the City. There are a number of potential initiatives which would help to reduce inappropriate disposal and may also reduce private landowner frustration.

7.0 CLIMATE CHANGE

Climate change is a serious and complex aspect to consider in wildfire management planning. Warming of the climate system is unequivocal, and since the 1950s, each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere.[47] Climate change has had, and will continue to have, complex implications for wildfire management planning and risk mitigation.

Numerous studies outline the nature of these impacts on wildland fire in the Rocky Mountains, across Canada, and globally. Although there are uncertainties regarding the extent of the impacts of climate change on wildfire, it is clear that the frequency, intensity, severity, duration and timing of wildfire and other natural disturbances is expected to be altered significantly with the changing climate.[48]

Despite the uncertainties, trends within the data are visible. As a basic starting point, four separate General Circulation Models (GCMs) [49] were run using the Centre for Forest Conservation Genetics ClimateBC Map tool. [50] The GCMs were run for the years 2025 and 2055 and then compared against the historical norms. The following trends were consistent across the four models and indicate a direct impact on future fire weather and potential fire behaviour:

- The summer months (June, July, and August) in the study area will likely have more high and extreme danger class days and fuels and soils will be drier.
- Maximum spring (March – May) temperatures are expected to rise; precipitation is expected to increase as well.
- Maximum summer (June – August) temperatures are expected to increase; precipitation is expected to remain similar or decrease (1 – 55mm).
- Autumn (September – November) is expected to receive more precipitation; maximum temperatures were variable across the models.

[47] International Panel on Climate Change. (2014) Climate change 2014: Synthesis report, summary for policymakers. 32p.

[48] Dale, V., L. Joyce. S. McNulty, R. Neilson, M. Ayres, M. Flannigan, P. Hanson, L. Irland, A. Lugo. C. Peterson, D. Simberloff, F. Swanson, B. Stocks, B. Wotton. *Climate Change and Forest Disturbances*. BioScience 2001 51 (9), 723-734.

[49] GCMs are recognized as the most advanced tools available for simulating global climate system's response to increasing greenhouse gas concentrations. More information can be found at the website for the Intergovernmental Panel on Climate Change: https://www.ipcc.ch/ and http://www.ipcc-data.org/guidelines/pages/gcm_guide.html.

[50] Centre for Forest Conservation Genetics. ClimateBC_Map. http://www.climatewna.com/climateBC_Map.aspx. Accessed May 22, 2017.

- Winter months (December – February) are expected to have higher minimum and maximum temperatures and increased precipitation.

Other research regarding the intricacies of climate change and potential impacts on wildfire threats to Canadian forests has found that:

- Fuel moisture is highly sensitive to temperature change and projected precipitation increases will be insufficient to counteract the impacts of the projected increase in temperature. Results conclude that future conditions will include drier fuels and a higher frequency of extreme fire weather days.[51]

- The future daily fire severity rating (a seasonally cumulative value) is expected to have higher peak levels in Western Canada and head fire intensity is expected to increase significantly in Western Canada. A bi-modal (spring-late summer) pattern of peak values may evolve to replace the historical late summer peak which is the current norm.[52]

- The length of fire seasons is expected to increase and the increase will be most pronounced in the northern hemisphere, specifically at higher latitude northern regions. Fire season severity seems to be sensitive to increasing global temperatures; larger and more intense fires are expected and fire management will become more challenging. [53,54]

In summary, climate scientists expect that the warming global climate will trend towards wildfires that are increasingly larger, more intense and difficult to control. Furthermore, it is likely that these fires will be more threatening to WUI communities due to increased potential fire behaviour, fire season length, and fire severity. This trend is expected to be disproportionately felt in northern latitudes.[55]

The CBT has initiated the Climate Action Program to help communities adapt to the impacts of climate change, such as flood and fire. The City of Fernie may leverage this program to initiate wildfire mitigation or adaptation projects under this initiative. [56]

[51] Flannigan *et al*. 2016.

[52] De Groot *et al*, 2013.

[53] Flanningan *et al.* 2013.

[54] Jandt, R. 2013. Alaska Fire Science Consortium Research Brief 2013-3.

[55] All research noted was completed for Canada or globally, not for the study area. Direct application of trends may not be appropriate, although general expectations for Canada were noted to be consistent across multiple studies.

[56] https://ourtrust.org/funding-support/funding-support-programs/climate-action-program/

8.0 ACTION PLAN

This final section of the CWPP update offers prioritized actions for improving hazardous conditions, mitigating risks or advancing preparedness for WUI fire events. The strength and effectiveness of the CWPP are founded in working across the full range of FireSmart disciplines. The key elements within the CWPP are: Communication and Education; Structure Protection; Emergency Response and Preparedness; Planning and Development; and Vegetation/Fuel Management. Recommendations have been prepared to address each element listed above.

8.1 COMMUNICATION AND EDUCATION

Establishing effective communications and actively engaging key stakeholders in risk reduction activities are keystones to building a FireSmart community. Without the support and involvement of residents, businesses, public officials, industry, and private sector land managers, the efforts of public officials, fire departments, and others to reduce wildfire losses will be hindered. In many communities, there is a general lack of understanding about interface fire, the relationship between ignition potential and loss of homes, and the simple steps that can be taken to minimize risk on private land. In addition, public perceptions regarding responsibility for risk reduction and the ability of firefighters to safely intervene to protect homes during a wildfire are often underdeveloped or inaccurate. As noted in the Section 6.0, the key to breaking the WUI disaster sequence is reducing the ignition potential of individual homes and neighbourhoods. The ignition potential can greatly impact suppression capabilities and success in WUI fire events. Conversely, in communities where the dangers of wildfire are well understood and the importance of homeowner responsibility in risk mitigation are understood, there is increased support and interest in reducing fire risk and tools to reduce fire risk are more likely to be adopted.

Based on the consultation completed during development of this Plan, it is evident that City staff and some residents have a good level of awareness of interface fire risk and a strong level of commitment to continue to grow their awareness and understanding. However, field observations highlighted the need to further educate the community at large on what private land owners can do to build a FireSmart community and take personal responsibility for the ignition potential of their homes, businesses, lands, and neighbourhoods. Often, the risk of wildfire is at the forefront of public awareness during or after major wildfire events, whether close to home or further afield, such as what occurred in Fort McMurray in the spring of 2016 and across BC in 2017. The challenge is to retain this level of awareness outside these times. The Communication and Education objectives for the study area are:

- To improve public understanding of fire risk and personal responsibility by increasing resident and property owner awareness of the wildfire threat in their community, to establish a sense of responsibility for risk mitigation among property owners, and to empower them to act;
- To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding the proactive WUI risk mitigation activities; and,
- To inform private landowners of, and engage them in, programs, initiatives, and opportunities available to them to aid in wildfire risk and fuels reduction on their properties.

Background information regarding communication and education is found in Appendix L.

The City should consider implementing a multi-media education program that maximizes WUI education efforts year round and with emphasis during the wildfire season. The City website has a wildfire prevention page that displays wildfire prevention information prominently and has links to current fire danger and fire/burning bans when they are in effect. Links to any existing or planned wildfire or FireSmart programming (FireSmart or Emergency Preparedness Days, FireSmart seminars, etc.) should be included. The City may find that social media is very effective at reaching a large percentage of their population, as there are multiple, informal, community-minded Facebook pages currently active and well-followed.

The City has been proactive at distributing FireSmart information at community public events. This is helpful and could be expanded upon and/or adapted to further enhance existing fire education programming, and specific wildfire preparedness and education efforts, dependent upon resourcing. The City should encourage local schools to adopt wildfire management and WUI emergency preparedness curriculum modules developed elsewhere in British Columbia or Alberta. As well, a provincially available program 'Master of Disaster' is a good starting point and can include education about other relevant hazards within the study area, such as floods and avalanches.[57] These programs could be delivered at relatively low cost to the City and augmented by visits from Fire Rescue, local forest professionals, Local FireSmart representatives, or BCWS crew members. One way of increasing awareness among secondary school students, which has been implemented by other jurisdictions successfully, is to include a FireSmart site and hazard assessment of the school by the students and to have them develop appropriate FireSmart recommendations. Other literacy-based organizations, such as the Columbia Basin Alliance for Literacy or the Fernie Heritage Library, may be potential partners for developing and delivering environmental literacy programs, which include wildfire and FireSmart as one component of the curriculum.

Existing FireSmart information material is readily available and simple for municipalities to disseminate.[58] It is concise and easy-to-use guidance that allows homeowners to evaluate their homes and take measures to reduce fire risk. However, the information needs to be supported by locally relevant information that not only illustrates the vulnerability of individual houses to wildfire, but also empowers homeowners to take action. Pictures of FireSmart in action can be an effective tool for educating the public (Figure 15).

[57] http://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/preparedbc/master-of-disaster

[58] Information available at www.firesmartcanada.ca or www.firewise.org.

Figure 15. Both photos are from the Beaver Creek Fire in Colorado. Photo credits: Wardner's Type III Incident Management Team. Left: the success was attributed to the combination of efforts of the homeowner with construction and mitigation work and the firefighters with water tanks, pumps, hose, and sprinklers. Right: exterior sprinklers dampen adjacent treated vegetation and combustible home components like decks.

Bringing organizations together to address wildfire issues that overlap physical, jurisdictional or organizational boundaries is a good way to help develop interagency structures and mechanisms to reduce wildfire risk. Engagement of various stakeholders can help with identifying valuable information about the landscape and help provide unique and local solutions to reducing wildfire risk. The City should consider leading the establishment of a local interface steering committee to coordinate wildfire risk reduction efforts.

Table 9. Summary of Communication and Education recommendations.

Item	Priority	Recommendation	Estimated Cost ($ or person hours)
Objective: To improve public understanding of fire risk and personal responsibility by increasing resident and property owner awareness of the wildfire threat in their community, to establish a sense of responsibility for risk mitigation among property owners, and to empower them to act.			
1	High	This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings, workshops and conferences.	1 – 6 hours, depending on method of distribution
2	High	Periodical updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. The frequency of updates is highly dependent upon major changes which would impact the City's wildfire threat assessment or the rate at which wildfire risk reduction efforts are implemented. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.	UBCM/ SWPI funding/ Municipal funding (SWPI funds up to 75% of update cost)

Item	Priority	Recommendation	Estimated Cost ($ or person hours)
3	High	Continue to expand and facilitate the FireSmart Canada Community Recognition Program with the ultimate goal of achieving FireSmart recognition status for 15 neighbourhoods. Specific actions to enhance the FSCCR Program should include: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.	$5,000 / neighbourhood and an additional 40 hours / initiative UBCM / SWPI grant(s) available
4	High	Develop several small (i.e. <1.0 ha.) FireSmart demonstration sites within the community to exemplify and showcase recommended FireSmart guidelines for appropriate vegetation/ fuel management; engage local property owners to assist as volunteers in creating these sites. Advertise and sign these locations to maximize educational and learning value to the community. Invite BCWS crews to assist with FireSmart demonstration sites with falling, pile burning, and other operational skills. Potential locations eligible for UBCM / SWPI funding are identified in Section 8.5.1.	UBCM / SWPI grant(s) available, depending on land ownership Cost for work on private land depends on time donated/ level of participation Project management is ~40 hours per site
5	Moderate	Review current social media effectiveness and create a social media strategy to ensure that the full power of social media is leveraged to communicate fire bans, high Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information. Consider pursuit of social media 'champions', with large, established networks and a high level of community and social media engagement, to amplify the City's messaging regarding wildfire mitigation strategies and to endorse the FireSmart message.	~20 hours to review. ~40 hours to create strategy. ~20 hours to identify partners, initiate relationship, and gain strategy support. Additional daily/weekly hours to implement, depending on strategy.
6	Moderate	Explore potential partnership with literacy programs (such as Columbia Basin Alliance for Literacy (CBAL)) to either include FireSmart and emergency preparedness into currently existing programs or to facilitate development of a FireSmart and emergency preparedness specific program for their clients.	~20 hours to gather information, meet, and discuss programming

Item	Priority	Recommendation	Estimated Cost ($ or person hours)
7	Moderate	Encourage all local schools (private and public) to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/ value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (Cranbrook Zone), as well as local fire officials and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary (and/or secondary) schools.	20 - 40 hours
8	Moderate	Aim to increase wildfire danger (Fire Danger) rating awareness throughout the community during the fire season. Options include: 1) providing updated fire danger rating on City homepage during the fire season. The danger rating could be updated on the right-hand 'Important Messages' section, or 2) engaging BCWS Cranbrook Zone to install a fire danger rating sign in a strategic location in the City (Chamber of Commerce, for example). For both strategies, maintenance by the City is key to the success and effectiveness of the initiative. Signs that are not kept updated may foster apathy or disbelief. (Physical sign maintenance would likely be on the higher side of weekly estimates, whereas website update would be on the lower side.)	2 - 4 hours per year initial set up (engage BCWS; add Fire Danger section to website, for example). ~2 - 4 hours per week (daily check and update, as required) throughout the fire season.
9	Moderate	Supply FireSmart materials to homeowners in the interface. FireSmart informational materials could be mailed out annually with tax assessments or in the quarterly utility bill mail out to ensure they get to homeowners, both full-time residents and second-home owners.	~4 hours. May be eligible for UBCM/ SWPI grant.
Objective: To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding the proactive WUI risk mitigation activities.			
10	Very High	Develop and work with all key stakeholders (adjacent jurisdictions, governments, provincial agencies, utilities, recreational groups, City staff, major land developers, etc.) to establish an Interface Steering Committee. Initial invitees should consider, but not be limited to, the potential partners outlined in Section 2.4. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) The complexity of land ownership within the study area and development of a coordinated approach to fuel management and hazard reduction within and adjacent to the City by member stakeholders. 2) Development of large, landscape level fuelbreaks. 3. Public education and awareness needs. 4) Multi-disciplinary, multi-jurisdictional fuel treatment projects/ hazard abatement projects. 5) Development of a funding strategy. 6) Reduction of human-caused fires, fire prevention and right of way management.	~40 hours to initiate group; an additional ~50 hours/ year to plan, advertise/ communicate, attend, and debrief meetings; additional hours required depending on implementable actions and potential sub-committees developed

8.1.1 COMMUNICATION WITH INDUSTRY

Risk of human-caused ignition within the study area is not limited to private property owners and individual residents. Railways, power lines, and industry activity all pose a risk of ignition, particularly in areas where cured fuels or fuel accumulations exist. Train cars can cause sparks that can ignite cured fuels along the railway tracks and tree failures adjacent to power lines (transmission and distribution) are common occurrences and represent significant risks to ignition within the study area.

Table 10. Summary of recommendations regarding communication with industry.[59]

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To reduce the risk of ignition from industrial sources.			
11	Moderate	Work with industrial operators to ensure that right-of-ways do not contain fine fuel accumulations (easily cured) prior to the fire season and further are maintained in a low hazard state. Work with industrial operators to ensure that high risk activities, such as right of way mowing, do not occur during high or extreme fire danger times to reduce chance of ignitions. Industrial operators include CP Rail, BC Hydro, and private land holders.	2 - 4 hours
12	Moderate	Work with BC Hydro to ensure that hazard trees along distribution lines are assessed regularly. Work with BC Hydro to ensure that transmission line right-of-ways are maintained in a moderate hazard state and dead, fine fuel accumulations do not occur. Generally, ensure the transmission right-of-ways are in moderate or low hazard state and serve as fuelbreaks.	2 - 4 hours

8.2 STRUCTURE PROTECTION AND PLANNING

Protection of critical infrastructure has shown itself to be an essential wildfire preparedness function. Survival and continued functionality of these facilities not only support the community during an emergency but also determine, to a great degree, the extent and cost of wildfire recovery and economic and public disruption during post wildfire reconstruction. Establishing a FireSmart community will reduce losses and impacts related to wildfire. Two classes of structures were considered for this CWPP: critical infrastructure and residential or commercial infrastructure. Critical infrastructure is distinct as it provides important services that may be required during a wildfire event or may require additional considerations or protection. As outlined in Section 6.0, FireSmart principles are important when reducing wildfire risk to both classes of structure and are reflected in the outlined recommendations. The structure protection objectives for the City are to:

- Encourage private homeowners to voluntarily adopt FireSmart principles on their properties and to reduce existing barriers to action; and,
- Enhance protection of critical infrastructure from wildfire.

[59] Communications with industry could be facilitated by, and merged with, the establishment of the interface steering team. The recommendations found in Table 10 should be completed, if possible, in conjunction with the steering team. They remain individual recommendations, in the case that one or more of the stakeholders mentioned does not participate.

The use of fire resistant construction materials, building design and landscaping must be considered for all infrastructure when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines. Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which cuts power for days, or even weeks.

Water is the single most important suppression resource. For suppression within the City, hydrants are available and tested annually. There are some neighbourhoods that have privately owned and maintained hydrants, which should be subject to regular testing like that completed by the City. There are areas outside of the municipal boundary, but within the Fire Service Area, which do not have hydrants. The City can draft from natural water sources, when necessary. Additionally, as per Bylaw 2203, the RDEK provides the City with a water tender for suppression in those areas not serviced by a hydrant. Currently, due to space limitations, the tender resides at a location other than the Fire Hall, which impacts response times. Plans to construct a new Fire Hall are currently under consideration.

The impacts of wildfire extend past the time a fire is extinguished. Depending on fire size and severity, there is the potential for significant hydrological impacts, extending for years post-burn.[60] Some areas may have a lower threshold for precipitation and would be particularly vulnerable to post-wildfire debris flows, landslides, avalanche or flooding. This may impact the community directly, through structure loss and risk to public safety, or indirectly, through loss or damage of critical infrastructure, such as BC Hydro infrastructure, roads, or impacts on the watershed affecting water quality. A goal to increase awareness of, and define, post-wildfire risk levels in the area is recommended. The City recognizes the risks of avalanches and floods and has retained a variety of professionals to assess vulnerability and risk associated with the natural hazards. The City should consider the option of these future assessments exploring the potential hydrologic and geomorphic impacts of wildfire on the watershed and community. Alternatively, there may be an option to complete a stand-alone assessment to help identify and quantify the post-fire risk to the community. Exploration of potential funding opportunities through the province and the National Disaster Mitigation Program may be worthwhile.[61]

[60] Jordan, P., K. Turner, D. Nicol, D. Boyer. 2006. Developing a Risk Analysis Procedure for Post-Wildfire Mass Movement and Flooding in British Columbia. Part of the 1st Specialty Conference on Disaster Mitigation. Calgary, AB May 23 -26, 2006.

[61] https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/dsstr-prvntn-mtgtn/ndmp/index-en.aspx

Table 11. Summary of Structure Protection and Planning recommendations.[62]

Item	Priority	Recommendation	Estimated Cost ($)
Structure Protection and Planning			
Objective: Improve the FireSmart conditions of the City by encouraging home and property owners to voluntarily increase FireSmart compliance and improve suppression abilities for interface areas.			
13	Moderate	Consider working with local distributors on improving education of homeowners and removing some of their barriers to action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include: 1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions / advice for homeowners. These distributors can be educated upon which supplies are FireSmart and in what configuration they can be used (for example, external sprinkler system equipment, aggregates and ground cover, wire mesh for vents, deck skirting). 2) Advocating for a FireSmart branding in the retail outlets (could be stickers on shelf pricing or a FireSmart-specific section) to increase public exposure to projects that can be done at a relatively low cost. 3) Compile a database of local service providers and retailers who can help to install or complete FireSmart home improvements. These providers may be able to further partner to flesh out a list of FireSmart options for various home improvements, based upon a range of variables (for example, price, time to deliver, installation costs, and aesthetics).	~60 hours
14	Moderate	Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood and green waste removed from their property. Programs may include scheduled community chipping opportunities, free wood/ yard waste drop-off in Fernie, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends.	Time dependent upon program. May be eligible for UBCM/ SWPI grant. Additional time for advertisement of program availability will be required.
Objective: Enhance protection of critical municipal infrastructure from wildfire.			
15	High	Complete a vulnerability assessment of all critical infrastructure, including water, in interface areas (secondary power sources, FireSmart compliance) and mitigate/ upgrade as required. FireSmart projects on City-owned structures or assets can be used as public-education/ demonstration projects to display the practices and principles of FireSmart and the City's commitment to wildfire threat reduction. Prioritization of projects can be based upon immediate reduction of fire hazard and vulnerability to fire, cost efficiency, and/or visibility to public.	~60 hours to complete vulnerability assessment and FireSmart upgrading dependent upon project(s) chosen

[62] All activities potentially eligible for UBCM/ SWPI FireSmart funding have been identified in the table, as such. The FireSmart grant of $10,000 is currently offered annually. Activities will need to be further prioritized by the City; it should be recognized that the current UBCM/SWPI funding available will not be sufficient to complete more than one FireSmart activity per funding cycle and that additional person hours may be required by City staff to apply for funding, as well as during implementation.

Item	Priority	Recommendation	Estimated Cost ($)
16	Moderate	Consider identifying areas of poor hydrant placement and/or spacing and development of a prioritized list for improvements and upgrades. Hydrant placement and/ or spacing could be improved and updated, for identified areas, during paving projects, which would improve suppression capabilities within the City gradually over time. Area identification could be based upon the compliance/ non-compliance with the amended Subdivision and Development Servicing Bylaw 1727, 1998 around hydrant spacing and placement (see recommendation #31).	3 hours to create prioritized list of areas. Cost of improvements dependent upon project.
17	Moderate	Work to increase awareness of, and define, post-wildfire risk levels, particularly regarding potential hydrological impacts post-burn. Consider developing response plans for stabilization and rehabilitation of burn areas which may have a lower threshold of precipitation and are vulnerable to post-wildfire debris flows, landslides, avalanche and/ or flooding. Explore the option of avalanche and flood risk assessments considering the potential hydrologic and geomorphic impacts of wildfire on the watershed in future assessments.	Outsource ($5,000 - $15,000)

8.3 EMERGENCY RESPONSE AND PREPAREDNESS

Fire protection within the study area is the responsibility of Fernie Fire Rescue. Fernie Fire Rescue (or Fire Rescue) is a composite department made up of approximately 28 members: 8 career staff and 20 paid-on-call members. The City has a formal agreement with the RDEK to provide fire protection to areas in the RDEK within the Fire Service Area. For the portion of the Fire Service Area under RDEK jurisdiction, the role of the City is limited to one of influence to encourage action (rather than the ability to directly implement programs).

The City has mutual aid agreements with Elkford, Sparwood, and the RDEK. Fire Rescue has a working relationship with the BCWS Cranbrook Zone; in the recent past, communication was irregular, but recently, a more frequent cadence of communication has been established between the City and Zone which has enhanced and solidified the working relationship.

The City responds to an average of 425 calls per year, of which only one per year, on average, is wildfire related. The City also responds to burning complaints.[63] The City works closely with the BCWS: as first responders, they assess the incident and call BCWS when applicable. Some fires remain multi-agency fires (approximately 1 per fire season), while others are transferred to BCWS, depending on fire location, structural involvement, and other variables.

Fire Rescue members undergo significant training, including weekly training throughout the year, and 4 wildland fire training sessions per year. Members undergo internal OFC SPP-WFF 1, wildland fire protection training for structural firefighters by qualified in-house fire service instructors (members with train-the-trainer certification). Currently 100% of members have this certification (SPP-WWF 1), which demonstrates the City's and Fire Rescue's

[63] Information provided by Fernie Fire Rescue.

commitment to wildfire preparedness. Cross-training with BCWS occurs on a semi-annual basis, as schedules allow, and includes clarifying roles and reviewing wildland suppression equipment.

Personnel limitations are a challenge facing the department; paid-on-call members usually have full-time employment elsewhere or are unavailable to respond at a given time for a variety of reasons. There are a variety of web-based applications available to assist in organization of personnel resources during call-outs. These applications allow emergency service departments to know immediately who is responding to dispatches, as well as where they are and when they will be responding. The objective is for faster and more informed decision-making when responding to call-outs, leading to reduced response times. Most of the applications also allow for instant mass-messaging, web-based scheduling, attendance tracking and reporting, and other personnel organization and communication services. [64]

The UBCM owns four complete SPUs, each equipped to protect 30 – 35 structures. The kits are deployed by the MFLNRORD/BCWS incident command structure and are placed strategically across the province during the fire season based on fire weather conditions and fire potential. When the kits are not in use, they may be utilized by fire departments for training exercises. SPUs can be useful tools in the protection of rural/ interface homes in the event of a wildfire. The closest SPU is housed in Jaffray. The City is aware of the availability of the SPUs and the request process.

The Fire Chief noted that house numbers are not always available or visible, particularly in the more rural areas of the Fire Service area, which are within the RDEK. Lack of visible addresses in some cases has slowed emergency response times. It is recommended that the City work with RDEK to increase the number of structures (houses and commercial) which have visible (night and day) addresses.

Table 12. Summary of Emergency Response recommendations.

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To improve structural and wildfire equipment and training available to Fernie Fire Rescue.			
18	High	The City of Fernie to work on continuing and regularizing frequency of annual cross training opportunities with BCWS. Interface training could include completion of a mock wildfire simulation in coordination with BCWS and instruction on early detection and reporting of wildfires, in addition to current meeting agenda of confirming capabilities and roles of the Zone and Fire Rescue on interface fires. Training could be coordinated with other fire departments in the area (RDEK: Baynes Lake, Elko, Hosmer, Jaffray) to enhance regional firefighting capabilities. It is recognized that BCWS crew resources are limited and their availability is highly dependent upon the current fire season and other BCWS priorities.	Within current operating budget

[64] www.iamresponding.com is one example, although there are many similar web-based applications which provide similar services.

Item	Priority	Recommendation	Estimated Cost ($)
19	High	Engage in regular cadence of communication with the BCWS Cranbrook zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities. Twice per year is likely sufficient cadence, unless a cooperative opportunity is recognized, which would require additional hours to implement.	4 hours
20	High	Ensure that the City maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain Fire Rescue member certifications (career and paid-on-call) with Structure Protection Program – Wildland Firefighter Level 1 (SPP-WFF 1) certification, currently offered internally by certified trainers. Consider additional training to improve wildfire preparedness. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural fire fighters on the use of wildfire pumps and hose, and fire service hose and hydrants, in the application of sprinkler protection units (SPU). The OFC is currently developing additional wildfire-specific Officer-level training courses; the City should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources / budget allow.	Within current training budget (SPP-WFF 1 currently implemented; SPP 115 course is 8 hours)
21	High	In light of the 2017 fire season, it is recommended to review the local application of fire bans, motorized vehicle and back country bans (on Crown and private land) and the communications and enforcement of the bans. Identify successes, lessons learned, and potential improvements for future application.	~2 – 6 hours
22	Moderate	Review web-based applications to assist Fire Rescue in personnel / resourcing organization and planning. Consider implementing web-based application supported by dispatch.	10 hours to review applications/ application subscription ~$1,000 annually
23	Moderate	Coordinate with the RDEK to provide or encourage the use of visible house numbers and furthermore to provide instructions about how and where best to affix them to facilitate emergency response (RDEK jurisdiction currently covered by the Fernie Fire Rescue through a Fire Service Agreement). Visible addressing is included in both the RDEK CWPP, as well as the Fire Service Agreement (Bylaw 2203, 2013).	2 – 4 hours
Objective: To improve ability to enforce FireSmart compliance on private lands.			
24	High	Review and amend Bylaw No. 2029, Fire Protection Life and Safety, to explicitly include items prohibiting hazardous accumulations of combustible materials on private property and allow the City the ability to issue an order to reduce any combustible accumulations identified as unsafe. Bylaw 1587 may be an additional, or alternative, vehicle to accomplish the objective.	~20 hours

8.3.1 EVACUATION AND ACCESS

The City of Fernie is situated on Highway 3, which heads east towards Cranbrook and west to the Alberta border. The City is served by the Elk Valley/ South Country Subregion Evacuation Plan (2008). The City is in the process of developing a City of Fernie evacuation plan and core emergency response plan.

Road networks in a community serve several purposes including providing access for emergency vehicles, providing escape/evacuation routes for residents, and creating fuelbreaks. Access and evacuation during a wildfire emergency often must happen simultaneously and road networks should have the capacity to handle both. If wildfire were to block Highway 3 in either direction, evacuation of several communities would be severely limited. Smoke and poor visibility can further complicate evacuations and hinder safe passage.

Within the study area, there are several neighbourhoods with only one access/ egress route, many of which were identified within the 2005 CWPP. Building access routes retroactively may not be feasible for many areas, but there may be opportunities to increase access and egress to neighbourhoods, as development adjacent to those areas occurs. The City should identify areas with inadequate access and assess these areas for feasibility of improving access over the long-term and during development projects.

Table 13. Summary of Evacuation and Access recommendations.

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To improve access and egress and enhance emergency preparedness.			
25	High	The City should identify areas of inadequate emergency response access/ resident egress. Areas identified as lacking secondary access or inadequate access for the purpose of fire suppression and wildfire evacuation should be prioritized and assessed for feasibility for improving access over the long-term. It is recognized that this will not always be possible. However, where secondary routes could potentially be established as development grows or on existing right-of-ways, these opportunities should be further investigated. Gated secondary access for emergency responders may be an option in some areas. FAR and the Lodge Trail Lane area are initial priority areas for review.	~20 hours to create a prioritized list and assess feasibility

8.3.1.1 TRAILS MANAGEMENT AND ACCESS

The City is surrounded by a vast network of multi-use trails, both for motorized and non-motorized recreation. The Direction for City trail management is provided in the Fernie Trails Master Plan (2015). In this plan, a major recommendation is compiling comprehensive trail mapping. It should be recognized that trails can act as effective fuelbreaks for surface fires and, depending on width, clearance, and surfacing, can provide access for equipment and control lines for suppression efforts. Comprehensive mapping of the trail system could include attributes which could also serve for suppression planning purposes, including attributes such as width, surface type, and clearance which could be used to determine accessibility and utility as a surface fire fuel break. Additionally, comprehensive mapping could be useful in the event of trail closures or evacuations in a wildfire event.

To reduce the chance of fire spread upon ignition and to act as a fuelbreak for surface fires, trail side conifers should be pruned to a minimum of 2 m in height and higher on slopes. Thinning activities (removal of flammable understory and intermediate conifer ladder fuels) should be undertaken on 5 m of either side of the trail centreline. Trails used for ATV access should be a minimum width of 1 m; a trail 4.5 m wide can be used for pick-up truck access. Use by motorized vehicles may be limited to emergency access only; it is not recommended to convert non-motorized recreational trails to motorized trails. Furthermore, it is neither feasible, nor desirable to convert all trails into surface fuelbreaks and/ or make them accessible by ATVs or other motorized equipment.

Trails should be reviewed and prioritized for their suitability to act as surface fuelbreaks and points of access based on their location, use, and current accessibility.

The Master Plan was developed with significant stakeholder engagement; the Fernie Trails Alliance Steering Committee served as the collective voice of the various member groups and trail users.[65] There are complexities with private land, land use, and a full array of stakeholder concerns, values, and potential conflicts regarding the trail network and its use. Changes to the area's trail development, planning, and maintenance are not recommended without the support and engagement of the Fernie Trails Alliance.

It is important that trail building and maintenance does not result in residual fuels which increase the fire hazard, especially in very high-use areas where ignition potential is higher. Minor work (pruning or individual tree falling) can usually be mitigated by scattering fuels in a discontinuous manner at a distance more than 5 m from the trail. Larger volumes of biomass resulting from larger thinning, pruning, or trail building operations should be burned or removed off-site. Small amounts of biomass may be chipped and spread, but moderate to large accumulations should be burned or removed due to chipping impacts on fuel loading and potential ecological impacts. Some communities have found success in offering bucked biomass to residents as firewood. Fuels, if left to accumulate from trail work, can significantly increase the chance of ignition and increase the potential fire behaviour should an ignition occur, such as from an errant cigarette butt or other human-caused ignition. It was noted in field work that the trails surrounding Fernie are generally maintained free of fuel accumulations, although there were some trails with surface fuel accumulations within the study area.

FTA volunteers should be knowledgeable of their obligations under the Wildfire Act and Wildfire Regulations, particularly regarding high-risk activities, for example use of spark-producing machinery, such as chainsaws. High risk activities may be limited or restricted during times of high Fire Danger Class ratings; these restrictions apply to activities undertaken by industrial personnel, as well as the general public.

Table 14. Summary of trails management and access recommendations.

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To expand the view of the trail system to include one with a wildfire lens.			
26	Moderate	Work with the Fernie Trails Alliance (FTA) to develop standards for the abatement of residual activity fuels associated with trail building and trail maintenance. Ensure trail crews are aware of mitigation of fuels accumulations that may result from regular maintenance activity. Standards should include fuel disposal or mitigation methods (scattering, chipping, burning, or removal, dependent upon location, amount of material, and access). Fuels from trail maintenance and trail building should not be allowed to accumulate trailside. FTA volunteers should be knowledgeable of their obligations under the Wildfire Act and Wildfire Regulation.	2 - 4 hours of outreach

[65] Langhorst, D. McElhanney Consulting Services Ltd. 2015. Fernie Trails Master Plan.

Item	Priority	Recommendation	Estimated Cost ($)
27	Moderate	Develop a Total Access Plan to map and inventory road and trail network in and around the City for suppression planning, identification of areas with insufficient access, to aid in strategic planning and, if necessary, evacuation and/or area closure efforts in the event of a wildfire in the area. The Fernie Trails Master Plan (TMP) identified the need for consolidation of multiple data sources to create comprehensive trail mapping for the City of Fernie. The Total Access Plan can build upon currently available trails mapping, including back country roads, and specific access attributes, such as width, surfacing, and clearance. Identify and prioritize trails with potential to act as surface fuel breaks and provide access for suppression crews (for example long portions of the Trans Canada Trail are sufficient to currently serve as surface fuel breaks, as well as provide emergency access via ATV or pick-up truck); establish standards for trails to meet those objectives. The plan should be updated periodically, as needed to incorporate additions or changes; data can be supplied by Fernie Trails Alliance as trails are built, upgraded, or decommissioned. Leverage, or build upon, the currently existing database; potential partnership with Fernie Trails Alliance may help to offset costs.	~80 – 100 hours ($5,000 - $10,000)

8.4 PLANNING AND DEVELOPMENT

Municipal policies and bylaws are tools available to mitigate wildfire risk to a community. It is recognized that, to be successful, all levels of government (municipal, provincial, and federal) and individual landowners need to work together to successfully reduce their risk. To that end, local government can use a range of policy tools to help the community to incrementally increase FireSmart compliance over the mid-term (5 – 20 years) and therefore play a role in reducing the chance of structure loss from wildfire.

The 2005 CWPP, as well as the OCP, consider the establishment of a development permit (DP) area to address wildfire risk mitigation. The OCP sets forth a process for other established DPs within the municipality; this process can be used for a wildfire development permit area. It is recommended that the City review the OCP, with consideration towards establishing a wildfire development permit area. Other jurisdictions' wildfire development permit areas can serve as models for various components.[66] The first step should be to establish DP area objectives (for example, minimize risk to property and people from wildland fires; minimize risk to forested area surrounding Fernie; conserve the visual and ecological assets of the forests surrounding Fernie; reduce the risk of post-fire landslides, debris flows, avalanches, and erosion, *etc*.). As part of this analysis, a draft development permit area has been identified (Figure 16). The following components should be considered during the OCP review and DP area development process to help meet the established objectives:

- Use of fire resistant exterior construction materials within the established development permit area, based on recognized standards such as NFPA 1144 or FireSmart.
- Inclusion of minimum setbacks from forested edge and top of slope based on FireSmart principles.

[66] The District of North Vancouver has a robust and well-documented Wildfire Hazard Development Permit process. Other jurisdictions which may be worth reviewing include: District of Elkford, RDEK (Rockyview and Wasa), Williams Lake, Prince George, and Maple Ridge.

- Use of FireSmart landscaping (low flammability plants and appropriate spacing and low flammability aggregates/ ground cover based on FireSmart principles).
- Underground servicing.
- Mitigation of fire hazard through fuel management activities based upon qualified professional recommendations (prescriptions and oversight). This is generally most applicable in the subdivision phase.
- Prompt removal of combustible construction materials, thinning/ fuel management debris, or clearing debris during the fire season.
- Include the ability of the City to require designation of a coordinating professional in areas determined to be particularly complex due to overlapping and possibly conflicting DPs.
- Review and approval process for submitted applications.
- Post-development inspections and sign-offs.
- Outline of responsibilities for staff and applicants.
- Enforcement and regulation (consequences of non-compliance).

It is advised to engage the development community in the DP process to educate, inform, and allow for input. This can be accomplished in a variety of formats, including, but not limited to workshops, informational sessions, or open-houses.

In 2015, the province passed the *Building Act* as the new legislation to guide building and construction in the province (Spring 2015). Section 5 of the *Building Act* allows local governments the authority to set local building bylaws for unrestricted and temporarily unrestricted matters, such as exterior design and finish of buildings in relation to wildfire hazard and within a development permit area. The British Columbia Building Code does not have any wildfire-specific fire resistant design components. Until revisions of the Building Code to include requirements specific to prevention of wildfire spread are completed, local governments can set exterior requirements within an established development permit area for wildfire risk mitigation.[67]

[67] Building and Safety Standards Branch. 2016. Bulletin No. BA 16-01 Building Act Information Bulletin: Update for Local Governments.

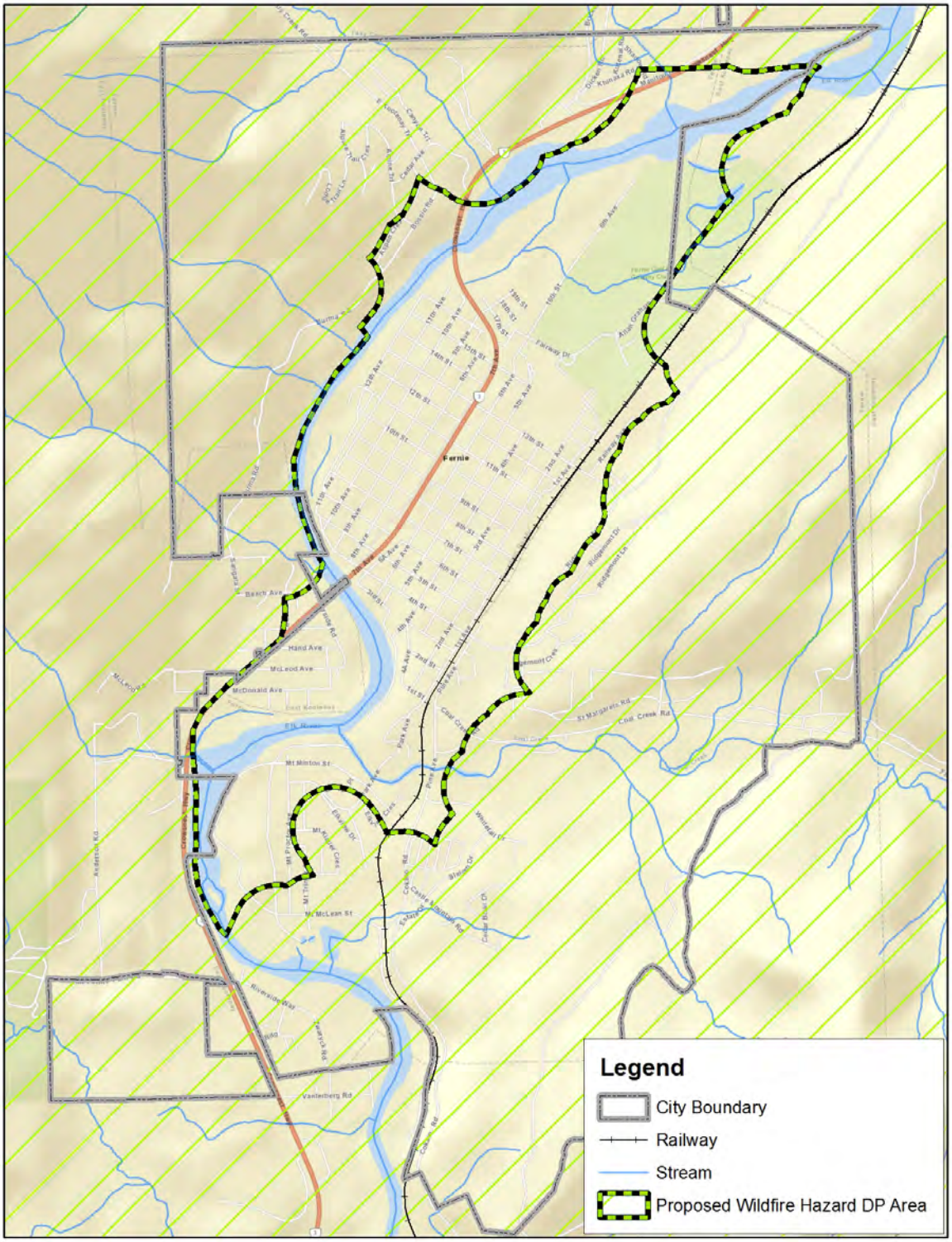


Figure 16. Proposed development permit area for wildfire risk mitigation for the City of Fernie within and surrounding the municipal boundary. Note: areas outside the current municipal boundary were included, in the case of further City expansion.

Fire protection bylaws are another tool available to the City to compel homeowners to mitigate the fire risk on their property. A review and potential amendment of Bylaw 2029 to explicitly prohibit hazardous accumulations of combustible materials on private property (including in gutters, under decks, and in closer proximity of the home) is recommended. Although it is recognized that enforcement will likely be sporadic at best, the inclusion will give the City authority to order action by egregious offenders.

As mentioned in Section 8.2, City hydrants are tested annually. Privately maintained hydrants, if not maintained properly, may present additional challenges to fire suppression. It is recommended that the City consider a bylaw which mandates maintenance and flow testing for private hydrants to ensure that they are maintained to the same standards as those owned by the City.

Table 15. Summary of recommendations for municipal policy and planning.

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To utilize regulatory and administrative tools to reduce wildfire hazard on private land and increase number of homes compliant with FireSmart guidelines (with low ignition potential).			
28	Very High	Review the Official Community Plan (OCP); consider including wildfire as a natural hazard development permit (DP) area. Review similar DPs established in other jurisdictions and use as models for various aspects of the DP process. The first step is to establish DP objectives (e.g. minimize risk to property and people from wildland fires; minimize risk to forested area surrounding Fernie; conserve the visual and ecological assets of the forests surrounding Fernie; reduce the risk of post-fire landslides, debris flows, avalanches, and erosion, etc.). To meet objectives, consider including the following elements: 1) minimum setbacks from forested edge based on FireSmart guidelines, 2) fuel management completed by qualified professionals and based upon FireSmart guidelines, 3) landscaping to an established standard, 4) building materials and design based on NFPA 1144 or FireSmart standards, 5) underground servicing, 6) prompt removal of combustible construction materials or thinning/ fuel management waste, 7) minimum lot size/ housing density, 8) allowing the City to require designation of a coordinating professional for DP applications that are deemed to be particularly complex and which fall into overlapping and possibly partially conflicting DP areas.	~200 hours
29	High	Consider engaging the development/ building community (may include developers, builders, landscapers, and architects) in DP development process. This can be accomplished through a series of workshops/ informational sessions to: 1) increase awareness of wildfire risk in Fernie, 2) demonstrate that there are a variety of actions which can be undertaken to immediately and measurable reduce the risk to the homeowner and community, 3) discuss various strategies and actions which could be implemented to meet DP objectives, 4) educate and inform regarding the DP process and expectations.	~40 hours

Item	Priority	Recommendation	Estimated Cost ($)
30	Moderate	Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, and reduce wildfire hazard. Consider including the landscaping standard as a requirement of Development Permits within the DP area, as well as making it publicly available for residents and homeowners outside of the DP area (can be provided at issue of building permit and made available at City Hall or other strategic locations).	10 - 12 hours or $1,000 - $2,000 to outsource Alternatively, general FireSmart landscaping information is available free of charge, but is not climate/ plant hardiness zone specific

8.4.1.1 SUBDIVISION DESIGN

Subdivision design should include consideration to decrease the overall threat of wildfire. Aspects of subdivision design that influence wildfire risk are access, water pressure and hydrant locations. The number of access points and the width of streets and cul-de-sacs determine the safety and efficiency of evacuation and emergency response. In interface communities, roads are often narrow and densely vegetated to protect the privacy of homes and the character of the neighbourhood. On-street parking can also contribute to the hazard on these roads, which are already unlikely to have a high capacity under heavy smoke conditions.[68] When the time for evacuation is limited, poor access has contributed to deaths associated with entrapments and vehicle collisions during wildfires.[69] Methodologies for access design at the subdivision level can provide tools that help manage the volume of cars that need to egress an area within a given period of time.[70] New subdivisions should be developed with access points that are suitable for evacuation and movement of emergency response equipment.

The spacing and placement of fire hydrants influences how effectively fire fighters can protect structures. Water mains and hydrant spacing can be improved in new subdivisions with a marginal increase in cost; the requirements should be explicitly stated in the bylaw. Currently, the bylaw addresses hydrant spacing, but not placement most conducive to fire response and attack. The cost of changing hydrant placement in existing subdivisions is extremely high and is not generally practical, unless completed during road improvement projects. For this reason, it is recommended that the City identify areas of poor hydrant placement and / or spacing and develop a prioritized list of areas for improvements and upgrades when the opportunities are presented. This would improve suppression capabilities within the City gradually over time.

[68] Cova, T. J. 2005. Public safety in the wildland-urban interface: Should fire-prone communities have a maximum occupancy? Natural Hazards Review. 6:99-109.

[69] De Ronde, C. 2002. Wildland fire-related fatalities in South Africa – A 1994 case study and looking back at the year 2001. Forest Fire Research & Wildland Fire Safety, Viegas (ed.), http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/Wildland.cdr.pdf

[70] Cova, T. J. 2005. Public safety in the wildland-urban interface: Should fire-prone communities have a maximum occupancy? *Natural Hazards Review*. **6**:99-109.

The City guides development through the Subdivision and Development Servicing Bylaw No. 1727, 1998. It is recommended that the City review the bylaw with the following considerations:

- Number of access points and capacity based upon a recognized standard, such as NFPA 1141. Two routes for access / egress are recommended.
- Emergency response access, specifically considering cul-de-sac length and emergency vehicle turn-around.
- Hydrant placement to allow for effective fire suppression.
- Prohibiting combustible materials accumulations, explicitly stating the impact of combustible materials on fire hazard.

Table 16. Summary of recommendations for subdivision design.

Item	Priority	Recommendation	Estimated Cost ($)
Objective: To consider wildfire mitigation in the development of new subdivisions.			
31	High	Review Subdivision and Development Servicing Bylaw No. 1727, 1998, with consideration towards: 1) Sufficient four-season emergency access and egress. New subdivisions should be developed with access points that are suitable for evacuation and the movement of emergency response equipment. The number of access points and their capacity should be determined during subdivision design and be based on threshold densities of houses and vehicles within the subdivision (NFPA 1141 is one recognized standard for subdivision design in wildland, rural and suburban areas which can be used as a reference). Two routes for access / egress are recommended. 2) Emergency response access, specifically working towards minimizing long cul-de-sacs, and allowing emergency vehicle turn around. Options include: requiring a secondary access point, either gravel or paved, to allow for emergency vehicle access and resident egress into and out of longer cul-de-sacs; and, requiring turnarounds with sufficient radius to allow for emergency vehicle turnaround on City and private access cul-de-sacs. 3) Hydrant placement to ensure that the Bylaw includes hydrant placement (and spacing) standards acceptable to the City and to allow for effective fire suppression. 4) Prohibition of accumulation of combustible construction materials during the main construction / fire season (currently the bylaw stipulates clean-up requirements specific to construction materials; consider adding language specific to combustible accumulations and its impact on wildfire hazard).	~30 – 40 hours
32	High	Ensure that privately maintained hydrants are maintained at similar standards as those maintained by the City. Consider a Bylaw which mandates maintenance and flow testing for privately maintained hydrants and that testing records are provided to the City on a regular (annual) basis. Alternatively, consider an option in bylaw requiring City-provided hydrant testing for privately maintained hydrants. Cost recovery can be collected from strata, as determined by the City.	~30 – 60 hours, plus legal fees if required

8.5 FUEL MANAGEMENT

Fuel management (also referred to as vegetation management or fuel treatment) is a key element of the FireSmart approach. For the purpose of this discussion, fuel management generally refers to native vegetation / fuel modifications in forested areas greater than 30 m from homes (Priority Zone 3 and beyond). The 2005 CWPP outlines the principles for fuel management in the Section 13.0 (pages 48 - 52). The principles of fuel management are also outlined in detail in Appendix N.

There has been one major fuel management project of approximately 10 ha completed within the study area since the development of the 2005 CWPP (Figure 17). This fuel treatment was directly adjacent to values at risk (residences in the Ridgemont neighbourhood) and occurred on municipal land. To complement the work completed to-date and to further reduce the wildfire risk in the study area, the objectives for fuel management are to:

- Reduce wildfire threat on private and public lands nearest to values at risk; and,
- Reduce fire intensity, rate of spread, and ember/spot fire activity such that the probability of fire containment increases and the impacts on the forested landscape and the watershed are reduced (more fire resilient landscapes).

Ideally, these objectives will enhance protection to homes and critical infrastructure. Caveats associated with the statement include: 1) wildfire behaviour will only be reduced if the fire burns in the same location as treatments occurred, and 2) protection of homes and critical infrastructure is highly dependent upon the vulnerability to ignition by embers (ignition potential) directly around the value at risk. In summary, fuel treatments alone should not be expected to protect a community from the effects of wildfire, namely structure loss.

As discussed above, fuel treatments are designed to reduce the possibility of uncontrollable crown fire through the reduction of surface fuels, ladder fuels and crown fuels. Fuel management can be undertaken with minimal negative or even positive impact on the aesthetic or ecological quality of the surrounding forest and does not necessarily mean removing most or all the trees. The focus for fuel management in the interface is not necessarily to stop fire but decrease fire behaviour and to ensure that fire intensity is low enough that fire damage is limited. For example, treating fuels near to a home may prevent structure ignition due to direct flame contact; at that point, the ability of the home to survive the fire would come down to whether construction materials and the HIZ can withstand or survive an ember shower without alighting. The degree of fire behaviour reduction achieved by fuel management varies by ecosystem type, current fuel type, fire weather, slope and other variables; it is important to note that it does not stop wildfire.

One of the major complications regarding fuel management in Fernie is private land; funds from public sources, such as UBCM and the Forest Enhancement Society of BC (FESBC), are only eligible to be used on Crown lands and cannot be used to treat private land. The best approach to mitigate fuels on private lands is to urge private landowners to comply with FireSmart guidelines (as described in previous sections) and to conduct appropriate fuel modifications using their own resources. The City should encourage privately managed forest / timber lands to consider community wildfire risk in management decisions. In general, when considering fuel management to reduce fire risk, the following steps should be followed:

- Carefully anticipate the likely wildfire scenarios to properly locate fuel modification areas;
- Acquire an understanding of local ecological, archaeological, and societal values of the site;
- Prescriptions should be developed by a qualified professional forester working within their field of competence;
- Public consultation should be conducted during the process to ensure community support;
- Potential treatment areas and draft prescriptions should be referred to First Nations with sufficient time for meaningful review and input;
- Treatment implementation should weigh the most financially and ecologically beneficial methods of fulfilling the prescriptions goals;
- Pre- and post-treatment plots should be established to monitor treatment effectiveness; and
- A long-term maintenance program should be in place or developed to ensure that the fuel treatment is maintained in a functional state.

Recommended potential treatment areas within the study area are enumerated in Table 17 and displayed in Figure 17.

Another aspect of fuel treatment is displaying the practices and principles of FireSmart activities to the public in the form of demonstration treatments. These small projects are not necessarily completed to reduce fire behaviour or increase stand resiliency in any measurable way, but instead are prioritized more by their visibility to the public and combining the treatment with public education. They demonstrate what can be accomplished on private land. Demonstration treatments may be particularly valuable to Fernie, due to the constrained and complex nature of land ownership surrounding the community, which increases the importance of action on private land to decrease the risk to the community.

8.5.1 LIST OF PRIORITY TREATMENT AREAS

As noted above, funding opportunities are currently limited to Crown Provincial, Regional District, or Municipal land. As such, priority treatment areas were, likewise, limited to land which is eligible for current funding opportunities (Crown land).

The new treatment areas represent high or extreme fire hazard areas which are close to values at risk and on Crown land, moderate fire hazard areas for which treatment would increase efficacy and/or continuity of other treatment areas or would link to low or no fuel areas, or land otherwise identified as eligible for UBCM/SWPI funding. These treatment areas have been prioritized based on the fire hazard, operational feasibility, estimated project cost and expected efficacy of treatment. Demonstration areas are prioritized by size, fire hazard, and public visibility. All polygons will require detailed site-level assessment to stratify treatment areas (and areas of no treatment), identify values and constraints, and identify and engage all appropriate Provincial agencies, First Nations, and stakeholders.

8.5.1.1 RECOMMENDED TREATMENTS

Fuel treatments should be based upon the fuel type, ecosystem, ecological and societal values of the site in order to achieve the primary objectives and avoid or mitigate negative impacts on the other values identified. Generally, prescriptions should target crown closure of 40% or less, remove ladder fuels except for isolated patches, reduce surface fuel loading and continuity, and work to achieve natural variation in density and crown openings across the treatment area, as opposed to uniform spacing patterns. Grass surface fuels should target 40 – 60% cover. Fine (<7 cm diameter) and coarse (>7 cm diameter) woody surface fuels should be scattered: less than 0.5 kg/m^2 and <10% cover, respectively. Larger diameter logs should be favoured for retention to meet biodiversity objectives (wildlife habitat) and function as coarse woody debris (CWD). Prescription details and post-treatment stand targets are highly variable and dependent upon the ecosystem, objectives, and management for other values.

In all cases, fuel management prescriptions should be completed by qualified professional(s) competent both in fire behaviour and local ecology. A thorough site assessment, both desktop and field, should be undertaken to identify existing or potential biodiversity values within any proposed treatment area. And further to that, identified biodiversity values should be included in forest management considerations, including identification of potential impacts and mitigative / avoidance actions or opportunities to enhance the values through ecosystem restoration. This may include, but not be limited to: an emphasis on retaining large diameter trees, prioritization of high value wildlife tree retention during danger tree assessments, enhancing mixed shrub communities, and maintaining intact and functional riparian areas. Specialists in ecology, wildlife, terrain stability, archaeology, or other values may be required to assemble a team competent in achieving wildfire related objectives while protecting biodiversity values.

Site-specific operational challenges exist in almost all treatment areas. Steep ground, limited access or access through private land, and terrain stability issues are among the constraints which must be further investigated during the detailed assessment and prior to prescription development and implementation. Some areas include steep slopes, which may not be accessible by machinery and will limit operations to manual labour. Pile burning is often the most cost-effective method of debris removal however potential treatment areas' proximity to structures and community views on burning / smoke emissions may limit the locations where this debris disposal method can be implemented. The *Environmental Management Act*'s Open Burning Smoke Control Regulations outline minimum burning distances from institutions and residences, as well as timing constraints.

In the future, maintenance burns using prescribed broadcast burning or maintenance thinning are recommended every five to fifteen years, depending on polygon ecosystem and productivity. Maintenance needs should be determined by a professional forester. Walk-throughs to schedule maintenance should occur every 5 – 7 years. The previously treated 10 hectares were assessed as part of this document; both treatment units remain a moderate wildfire behaviour rating. The next assessment should occur 2022 – 2024; maintenance activities should be expected at that time. The mature stand within the treatment area has experienced additional mountain pine beetle mortality since the time of initial treatment, some standing dead and some surface fuels will need to be addressed. Cedar regeneration is not a concern at this time, but should be removed before their size makes it prohibitively expensive to complete maintenance activities. Additional thinning of intermediate cedars (ladder fuels) should be considered during maintenance activity prescription development.

Invasive species can easily spread during, or following, operational fuel treatments and can negatively impact soil productivity, water quality, forest structure, biodiversity, seedling regeneration, range resources, wildlife habitat, species at risk, wildfire fire behaviour, and culturally important plants. [71] Recreation, aesthetics, and human health may also be impacted. The spread of invasive plants can displace native vegetation through competition and aggressive and efficient reproduction (vegetative reproduction, large numbers of seeds, long-lived seeds, etc.). Their spread can be further facilitated by movement of machinery, vehicles, and people which may unknowingly transport seeds and vegetative materials and from soil disturbance creating a bed for regeneration. Prescriptions should include strategies to identify and effectively manage invasive species, including early detection, reporting, and preventative practices to avoid introduction or spread of invasive plants.[72] Within the study area, MFLNRORD identifies more than 25 invasive species in 52 areas, most of which are along roads and major transportation corridors. Additional, not yet identified occurrences should be expected during site level assessments and prescription development.

[71] For more information to important programming and information, please visit: The Invasive Alien Plant Program (IAPP) https://www.for.gov.bc.ca/hra/plants/application.htm; Invasive Species Council of BC http://bcinvasives.ca/; East Kootenay Invasive Species Council http://ekisc.com/.

[72] Invasive Plant Council of BC. TIPS (Targeted Invasive Plant Solutions). http://bcinvasives.ca/documents/For_Oper_TIPS_PRINT.pdf

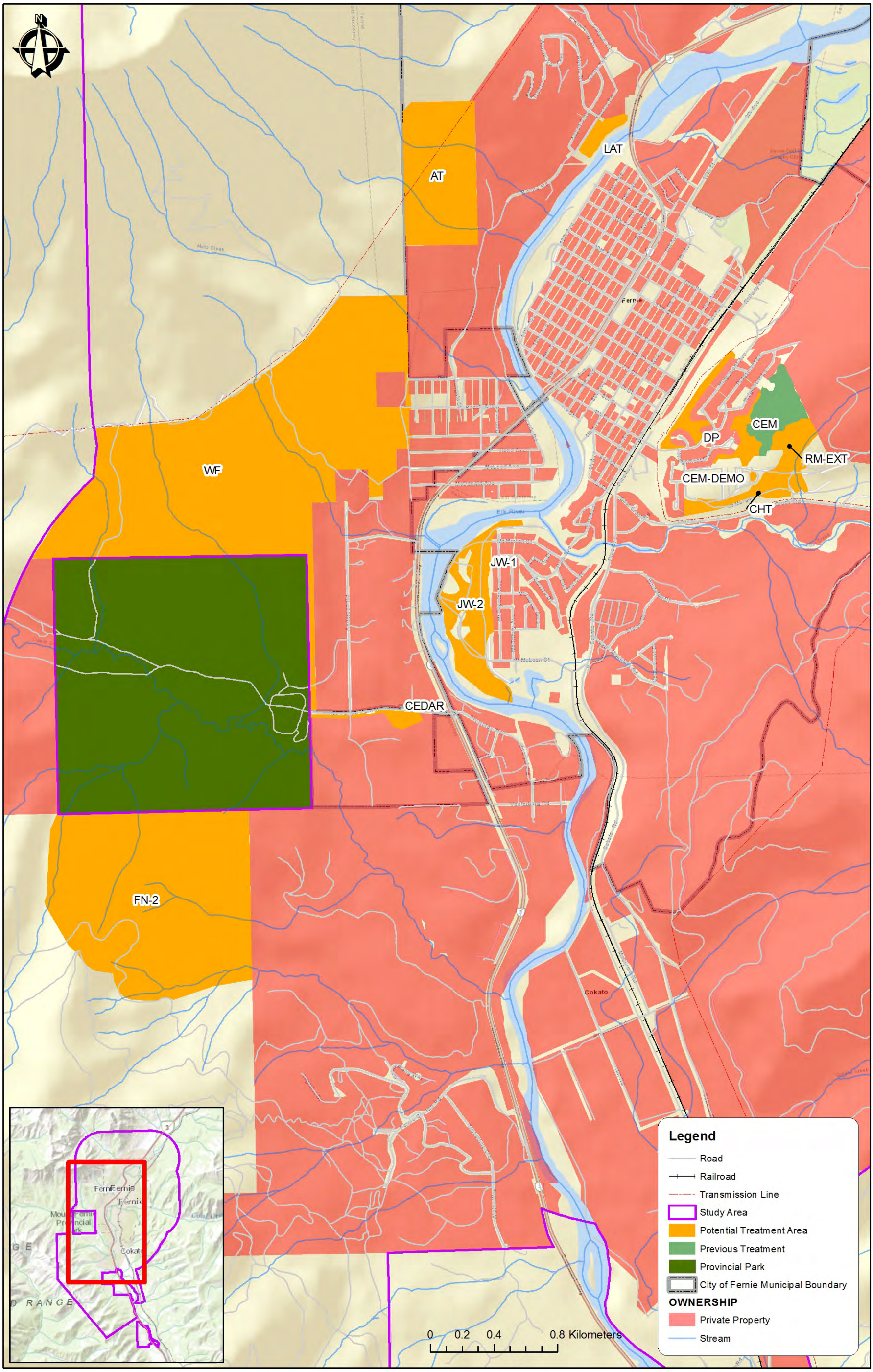


Figure 17. Potential treatment polygons (areas of interest for detailed site-level assessment) in the City of Fernie study area.

Table 17. Proposed fuel treatment projects for the City of Fernie.

Geographic Area	Polygon Mapping Name	WUI Threat Plot No./ Fire Behaviour Rating (Score)	Priority	Approximate Area (ha)	Comments/ Rationale
Cemetery / Ridgemont	CEM	CM-1 / Mod (75) CM-2 / Mod (88)	High	3.9	Directly adjacent to residences (within HIZ). Moderate surface fuels and standing MPB[73] mortality. Continuous with previously treated area. Moderately visible for demonstration purposes: access trails to Ridgemont trail system run throughout. Good opportunity for demonstration treatment while reducing fire hazard to homes and increasing effectiveness of previously treated area.
The Cedars	CEDAR	CE-1 / High (97) CE-2 / Mod (95)	High	2.7	Directly adjacent (downslope) to Cedars residences and future development. Understory cedar regeneration and surface fuels are significant. Good opportunity for demonstration treatment: on Mount Fernie Park Road.
Lower Alpine Trails	LAT	LAT-1 / Moderate (72) LAT-2 / High (107)	High	3.2	FireSmart treatment would considerably lower risk to homes directly upslope in Alpine Trails. Treatment may be extended to area classed as moderate to create an effective and continuous treatment immediately adjacent to values at risk.
James White	JW-1	JW-3 / High (96)	High	3.5	City-owned land with hazardous fuels adjacent to values at risk. Dense coniferous regeneration and suppressed trees creating ladder fuels to crown.
Ridgemont Road	RM-EXT	BPE-1 / High (103)	High	5.8	High hazard stand on City-owned land, which would build on previously treated area. If completed with polygon CEM, all eligible extreme to moderate hazard areas in Ridgemont in close proximity to values at risk would be treated.

[73] MPB is mountain pine beetle.

Geographic Area	Polygon Mapping Name	WUI Threat Plot No./ Fire Behaviour Rating (Score)	Priority	Approximate Area (ha)	Comments/ Rationale
Dog Park	DP	DP-1 / Mod (81)	Moderate	4.8	Directly adjacent (downslope) to Ridgemont residences. Surface fuels are moderate. Good opportunity for highly visible demonstration treatment: visible from town, high use recreational trail (Old Stumpy) and future dog park site.
West Flank	WF	FPP-1 / High (125)	Moderate	213.1	Polygon is Crown Land below the powerline, but overlaps with First Nations Treaty Area Reserve. Wildfire behaviour threat class ranges from low to extreme. Fuel treatment of west flank (FPP and WF) of the valley would considerably reduce the fire threat to the community. Detailed site assessment would be required for stratification of treatment units, due to heterogeneity of fuels and stand structure in polygon. This polygon could be treated in phases (to account for limited resources and funding) and may be eligible for FESBC funding or operational cooperation with Canfor. Potential efficacy is limited by privately-owned forested land between polygon and values at risk.
Alpine Trails	AT	AT-1 / High (121)	Moderate	40.7	Moderate to high hazard stands on the northwest flank of town and above values at risk. Would increase width of fuel break, anchored off currently existing transmission line, to 300 m.
James White	JW-2	JW-2 / Moderate (84)	Low - Moderate	19.0	City-owned land with heterogeneous fuels. Treatment unit stratification required at the detailed site assessment phase.
Coal Heritage	CHT	CH-1 / Moderate (95) CH-2 / Moderate (92)	Low	7.6	City-owned land directly adjacent to values at risk. Fire behaviour class is moderate throughout; fuel management would largely consist of removal of standing mortality and coarse and fine woody surface fuels (from mortality / trail clearing / windthrow). Completion could be effective FireSmart treatment.

Geographic Area	Polygon Mapping Name	WUI Threat Plot No./ Fire Behaviour Rating (Score)	Priority	Approximate Area (ha)	Comments/ Rationale
Cemetery Demonstration	CEM-DEMO	Complete at time of detailed assessment	Low	0.2	City-owned land with potential for demonstration treatment. Stand is isolated patch of coniferous forest within Cemetery; value is in FireSmart demonstration.
Elk Valley Nordic / Alpine Resort	FN-2	Complete at time of detailed assessment	Low	133.5	Crown land within the Fernie Alpine Resort boundary. North/ northeast aspect, mixed fuel types with wildfire threat class ranging from Low to High. Detailed site assessment would be required for stratification of treatment units, due to heterogeneity of fuels and stand structure in polygon. Southwesterly and southern winds are the predominant directions during fire season. High use area.

8.5.2 LANDSCAPE LEVEL FUELBREAKS

Fuelbreaks can be defined as strategically placed strips of low volume fuel where firefighters can make a stand against fire and provide safe access for fire crews in the vicinity of wildfires, commonly for the purpose of lighting backfires. Fuelbreaks act as staging areas where fire suppression crews can anchor their fire suppression efforts; hence increasing the likelihood that fire can be stopped or fire behaviour minimized so the potential for a fire to move easily through the interface into a developed area are substantially reduced. The principles of fuelbreak design are described in detail in Appendix O.

There is little opportunity for City-initiated landscape level fuel breaks within the study area, due to the complex nature of land ownership surrounding the community. The BCWS Cranbrook Zone completed a fire management plan, which identifies potential landscape level fuelbreaks in the zone. There were no opportunities found within, or near to, the study area.

Without the advantages provided by landscape level fuel breaks (on Crown land), the importance of diligence and action from residential and commercial property owners is magnified. The City of Fernie must compensate and place strong emphasis on communicating, educating and engaging the community to increase the sense of responsibility and the diligence in application of recommended FireSmart guidelines.

8.5.3 FUEL TREATMENT RECOMMENDATIONS

Table 18. Summary of Fuel Management recommendations.[74]

Item	Priority	Recommendation	Estimated Cost ($)
Objective: Reduce wildfire threat on public lands through fuel management.			
33	High	Proceed with detailed assessment, prescription development and treatment of hazardous fuel units and FireSmart fuel treatment demonstration treatment areas identified and prioritized in this CWPP.	UBCM SWPI Funding / Municipal Funding (UBCM funds up to 75% of prescription development cost)
Objective: Maintain previously treated areas under an acceptable level of wildfire fire threat (moderate).			
34	High	Complete monitoring and maintenance every 5 – 7 years on previously treated areas. Treated areas should be assessed by a Registered Professional Forester, specific to actions required to maintain treated areas in a moderate or lower hazard. Assessment of treated areas occurred as part of the CWPP Update; the next scheduled monitoring is in 2022 – 2024 and fuel treatment activities to maintain the effectiveness of the treatment should be expected at that time.	UBCM SWPI Funding/ Municipal Funding
Objective: Reduce the wildfire threat to the City of Fernie with a cooperative approach.			
35	Moderate	Explore opportunities to complete larger-scale fuel management projects with Jemi Fibre Corp; start a conversation regarding fire risk and mitigation in land / timber management decisions.	~10 hours

9.0 RESOURCING MITIGATION EFFORTS

One of the key limiting factors to the effective implementation of any plan is the limitation of resources. A range of options for obtaining the support and resources necessary to mitigate existing risks and prevent additional hazards (as per recommendations in the Action Plan, Section 8.0) are listed below:

1. Explore alternative funding options available through the UBCM / SWPI. Although these grants have their own limitations, such as annual funding limits and land ownership restrictions, annual grants are available for fuel prescription development, fuel modification projects, FireSmart demonstration projects, and FireSmart planning.

2. Explore funding from the FESBC. Funding through this program is generally provided for larger and collaborative projects, and funds are applicable to lands not eligible under the UBCM / SWPI program.

[74] Application and administration of FESBC and UBCM SWPI funded projects will take additional City staff time and resources; the amount is dependent upon the role the City plays within the project (FESBC funding) and the amount of area and complexity of area (UBCM SWPI).

3. By promoting and actively facilitating the 8-step FSCCR Program, the City of Fernie is able to harness the community spirit and untold energy of engaged citizens and groups of residents towards community wildfire protection objectives (i.e. public education, communication, actual risk mitigation actions).

4. Through the FSCCR Program, individual neighbourhoods and their FireSmart Boards become eligible to apply for dedicated FireSmart grants provided by FireSmart Canada (and cooperating industry government sponsors) for grants of $500.00 to participate in the annual Wildfire Community Preparedness Day. FireSmart Boards may also petition local industry, businesses, or their own members for donations to support FireSmart events or activities towards achieving objectives of their local FireSmart Community Plans (e.g. donations of funds, equipment or in-kind services).

5. Other alternative funding sources, such as grants available from job creation or youth skills training programs, grants from other Ministries, business continuity planning grants, climate change adaptation grants, and watershed management grants, may become available to help fund a variety of wildfire management programs or initiatives with multiple or overlapping objectives.

6. Remain open and flexible to harnessing community interest and engaged individual's strengths or interests, particularly when implementing public education and communication initiatives. Public education and communication can target a variety of community demographics: business, art, science, new immigrants, youth, etc. Allowing for individual members of the community to be involved utilizes an empowered engaged resource that is the least costly and perhaps most effective.

7. Through regulations and promoting the benefits of pro-active wildfire risk mitigation, the City of Fernie may be able to encourage local landowners, residential developers and builders to make strategic investments towards FireSmart objectives at the earliest stages of development when it is the smallest overall investment (i.e. forest management pre-treatments, building design and materials, and subdivision lay-outs).

8. Stay informed of any new Federal or Provincial funding assistance that may become available as a result of the 2017 wildfire season.

Investments in preventive risk mitigation efforts should be considered as an insurance plan against wildfire losses, reconstruction/recovery and business interruption costs that are generally much more extensive.

10.0 CONCLUSION

Wildfire is a natural, beneficial, and inevitable component of the ecosystem around Fernie. Eliminating fire from the ecosystem, or dependence solely upon fire suppression to protect values at risk, are not feasible strategies for wildfire risk reduction. It is up to the City, province, and individual home and property owners, to take responsibility to complete risk reduction activities.

Recommendations included in this plan are aimed at reducing the wildfire risk to the City through actions pertaining to five key FireSmart disciplines: public communication, education and ultimately engagement, emergency response and preparedness, structure protection and planning, planning and development, and fuel

management. Further prioritization by the City will be required to implement recommendations, as resources allow, in a coordinated and phased approach.

WORKS CONSULTED

Agee, J.K. 1996. The influence of forest structure on fire behavior. pp. 52-68 In Proceedings, 17th Forest Vegetation Management Conference, Redding, CA

Agee, J.K., B. Bahro, M.A. Finney, P.N. Omi, D.B. Sapsis, C.N. Skinner, J.W. van Wagtendonk and C.P. Weatherspoon. 1999. The use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management 48(1): 1-12.

Alexander, M.E. 2003. Understanding Fire Behaviour – The key to effective fuels management. Fuel management workshop. Hinton, AB

Alexander, M.E. 1988. Help with making crown fire hazard assessments. pp. 147-156 In: Fischer, W.C. and S.F. Arno (Compilers) Protecting people and homes from wildfire in the Interior West: Proceedings of the Symposium and Workshop. USDA Forest Service Gen. Tech. Rep. INT-25 1.

Amman, G.D. 1990. Bark beetle associations in the Greater Yellowstone Area. In: Proceedings of the fire and the environment symposium: ecological and cultural perspectives. Knoxville TN, 1990 Mar. 20. USDA For. Ser. Gen. Tech. Rep. SE-69.

Apps, C. D., J. L. Weaver, P. C. Paquet, B. Bateman and B. N. McLellan. 2007. Carnivores in the southern Canadian Rockies: Core areas and connectivity across the Crowsnest Highway. Wildlife Conservation Society Canada Conservation Report No. 3. Toronto, Ontario, Canada.

Association of British Columbia Forest Professionals. 2013. Interim Guidelines – Fire and Fuel Management.

B.C. Conservation Data Centre: CDC iMap [web application]. 2016. Victoria, British Columbia, Canada. Available: http://maps.gov.bc.ca/ess/sv/cdc/ (September 2, 2016).

BC Wildfire Service, 2015. Wildfire of Note Elaho (V30160). [Online] Available at: http://bcwildfire.ca/hprscripts/wildfirenews/OneFire.asp?ID=533 [Accessed 10 September 2016].

Blackwell, B. and A. Needoba. 2006. City of Kelowna Review of Policies Procedures and Bylaws Relating to Wildland Fire.

Buckley, A.J. 1992. Fire behaviour and fuel reduction burning: Bemm River wildfire, October, 1988. Australian Forestry 55: 135-147.

Building and Safety Standards Branch. 2016. Bulletin No. BA 16-01 Building Act Information Bulletin: Update for Local Governments.

Bill 3 – 2015 Building Act passed Third Reading 5 March 2015. Retrieved from https://www.leg.bc.ca/Pages/BCLASS-Legacy.aspx#%2Fcontent%2Fdata%2520-%2520ldp%2Fpages%2F40th4th%2F3rd_read%2Fgov03-3.htm

Byram, G.M. 1959. Combustion of forest fuels. In Brown K.P. (ed.) Forest Fire: Control and Use. McGraw-Hill. New York.

Calkin, D., J. Cohen, M. Finney, M. Thompson. 2014. *How risk management can prevent future wildfire disasters in the wildland-urban interface*. Proc Natl Acad Sci U.S.A. Jan 14; 111(2): 746-751. Accessed online 1 June, 2016 at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896199/.

Cova, T. J. 2005. Public safety in the wildland-urban interface: Should fire-prone communities have a maximum occupancy? Natural Hazards Review. 6:99-109.

Davis, L.S. 1965. The economics of wildfire protection with emphasis on fuel break systems. California Division of Forestry. Sacramento, CA.

de Groot, W. J., M. D. Flannigan, A.S. Cantin. 2013. *Climate change impacts on future boreal fire regimes*. Forest Ecology and Management. 294: 35 -44.

De Ronde, C. 2002. Wildland fire-related fatalities in South Africa – A 1994 case study and looking back at the year 2001. Forest Fire Research & Wildland Fire Safety, Viegas (ed.), http://www.fire.uni-freiburg.de/GlobalNetworks/Africa/Wildland.cdr.pdf

District of North Vancouver. 2014. Wildfire Hazard Report Master Requirement SPE 115.

Edmonds, R., J. Agee, and R. Gara. Forest Health and Protection. Long Grove, IL: Waveland Press Inc, 2000. Print.

Fellin, D.G. 1979. A review of some interactions between harvesting, residue management, fire and forest insect and diseases. USDA For. Ser. Gen. Tech. Rep. INT-90. pp. 335-414

Filmon, G. 2003. Firestorm 2003 Provincial Review. http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/governance/bcws_firestormreport_2003.pdf

Fire Resistant Plants for Home Landscapes: Selecting plants that may reduce your risk from wildfire. 2006. A Pacific Northwest Extension Publication (PNW 590).

Flannigan, M.D., A.S. Cantin, W.J. de Groot, M. Wotton, A. Newbery, L.M. Gowman. 2013. *Global wildland fire season severity in the 21st century*. Forest Ecology and Management (2013) 294: 54 - 61.

Flannigan, M.D., B.M. Wotton, G.A. Marshall, W.J. deGroot, J. Johnston, N. Jurko, A.S. Cantin. 2016. *Fuel moisture sensitivity to temperature and precipitation: climate change implications*. Climatic Change (2016) 134: 59 - 71. Accessed online at https://link.springer.com/content/pdf/10.1007%2Fs10584-015-1521-0.pdf.

Forestry Canada Fire Danger Group. 1992. Development and Structure of the Canadian Forest Fire Behavior Prediction System: Information Report ST-X-3.

Geiszler, D.R., R.I. Gara, C.H. Driver, V.H. Gallucci and R.E. Martin. 1980. Fire, fungi, and beetle influences on a lodgepole pine ecosystem of south-central Oregon. Oceologia 46:239-243

Graham, Russell; Finney, Mark; McHugh, Chuck; Cohen, Jack; Calkin, Dave; Stratton, Rick; Bradshaw, Larry; Ned Nikolov. 2012. Fourmile Canyon Fire Findings. Gen. Tech. Rep. RMRS-GTR-289. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 110 p.

Green, L.R. 1977. Fuelbreaks and other fuel modification for wildland fire control. USDA Agr. Hdbk. 499.

Henigman, J., T. Ebata, E. Allen, J. Westfall, A. Pollard. 2001. Field Guide to Forest Damage in British Columbia – 2nd ed. Joint Publication Canadian Forest Service and BC Ministry of Forests.

Invasive Plant Council of BC TIPS (Targeted Invasive Plant Solutions). http://bcinvasives.ca/documents/For_Oper_TIPS_PRINT.pdf

Jain, Theresa B.; Battaglia, Mike A.; Han, Han-Sup; Graham, Russell T.; Keyes, Christopher R.; Fried, Jeremy S.; Sandquist, Jonathan E. 2014. A comprehensive guide to fuel management practices for dry mixed conifer forests in the northwestern United States: Mechanical, chemical, and biological fuel treatment methods. Res. Note RMRS-RN-61. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 2 p.

Jandt, R. 2013. Alaska Fire Science Consortium Research Brief 2013-3. Accessed online at https://accap.uaf.edu/sites/default/files/AFSC_RB2013-3v3-corrected.pdf

Johnson, E.A. 1992. Fire and Vegetation Dynamics. Cambridge University Press.

Jordan, P., K. Turner, D. Nicol, and D. Boyer. 2006. *Developing a Risk Analysis Procedure for Post-Wildfire Mass Movement and Flooding in British Columbia*. 1st Specialty Conference on Disaster Mitigation. Accessed https://www.for.gov.bc.ca/hfd/pubs/rsi/fsp/Misc/Misc071.pdf. March 7, 2017.

Koch, P. 1996. Lodgepole pine commercial forests: an essay comparing the natural cycle of insect kill and subsequent wildfire with management for utilization and wildlife. USDA For. Ser. Gen. Tech. Rep. INT-342. 24pp

Martinson, Erik J.; Omi, Philip N. 2013. Fuel treatments and fire severity: A metaanalysis. Res. Pap. RMRS-RP-103WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 38 p.

Merson, J. 2005. Historical Trends, Current Practices, and Options for the Future: Union of BC Municipalities Sprinkler Protection Program.

Ministry of Agriculture and Lands. 2008. Sea-to-Sky Land and Resource Management Plan.

Mitchell, R.G. and R.E. Martin. 1980. Fire and insects in pine culture of the Pacific Northwest. pp.182-190. In: Proceedings of the sixth conference on fire and forest meteorology. Seattle, Washington, 1980 Apr 22. Society of American Foresters, Washington, D.C.

Morrow, B., K. Johnston, and J. Davies. 2013. Wildland Urban Interface Wildfire Threat Assessments in BC.

Partners in Protection. 2003. FireSmart: Protecting your community from wildfire. Edmonton, AB

Partners in Protection. 2002. Home Owners FireSmart Manual, Protect your home from wildfire. BC Edition. http://embc.gov.bc.ca/em/hazard_preparedness/FireSmart-BC4.pdf

Perrakis, D.B. and G. Eade. 2015. British Columbia Wildfire Fuel Typing and Fuel Type Layer Description 2015 Version. BC Wildfire Service, Ministry of Forests Lands and Natural Resource Operations. Victoria. http://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/wildfire-management/fire-fuel-management/bcws_bc_provincial_fuel_type_layer_overview_2015_report.pdf

Pike, R.G., M.C. Feller, J.D. Stednick, K.J. Rieberger, M. Carver. 2009. Chapter 12- Water Quality and Forest Management [Draft]. In Compendium of Forest Hydrology and Geomorphology in British Columbia [In Prep. R.G. Pike et al. (editors). B.C. Ministry of Forests, Mines and Lands Research Branch, Victoria B.C. and FORREX Forest Research Extension Partnership, Kamloops, B.C. Land Management Handbook (TDB). URL: http://www.forrex.org/program/water/PDFs/Compendium/Compendium_Chapter12.pdf

Pike R.G., and J. Ussery. 2005. Key Points to Consider when Pre-planning for Post-wildfire Rehabilitation. Draft Manuscript FORREX. 31 pages.

Price M.F. 1991. An assessment of patterns of use and management of mountain forests in Colorado, USA: implications for future policies. Transformations of mountain environments, 11(1): 57-64

Province of British Columbia, 1995. Biodiversity Guidebook, s.l.: s.n.

Rothermel, R.C. 1991. Predicting behaviour and size of crown fires in the northern Rocky Mountains. USDA For. Ser. Res. Pap. INT-438.

Ryan, K.C. and N.V. Noste. 1985. Evaluating prescribed fires. USDA General Technical Report INT-182. pp.230-238.

Schowalter, T.D., R.N. Coulson and D.A. Crossley. 1981. Role of the southern pine beetle and fire in maintenance of structure and function of the southeastern coniferous forest

Scott, J.H., and E.D. Reinhardt. 2001. Assessing crown fire potential by linking models of surface and crown fire behaviour. USDA For. Ser, Rocky Mountain Research Centre, Fort Collins, Colorado. Research Paper RMRS-RP-29. 59p.

Sessions, J., K.N. Johnson, D. Sapsis, B. Bahro, and J.T. Gabriel. 1996. Methodology for simulating forest growth, fire effects, timber harvest, and watershed disturbance under different management regimes. Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Assessments and scientific basis for management options. University of California, Davis, Centers for Water and Wildland Resources.

Van Wagner, C.E. 1977. Conditions for the start and spread of crown fire. Canadian Journal of Forest Research 7: 23-34.

Van Wagner, C.E. 1993. Prediction of crown fire behaviour in two stands of jack pine. Canadian Journal of Forest Research 23: 442-449.

Van Wagtendonk, J.W. 1996. Use of a deterministic fire growth model to test fuel treatments. pp. 1155-1165 In: Sierra Nevada Ecosystem Project: Final Report to Congress, Vol. II, Assessments and scientific basis for management options. University of California, Davis, Centers for Water and Wildland Resources.

Van Wagtendonk, J.W., W.M. Sydoriak, and J.M. Benedict. 1998. Heat content variation of Sierra Nevada conifers. International Journal of Wildland Fire (in press).

Wang, T. and Hamann, H. Climate BC Map. http://www.climatewna.com/climateBC_Map.aspx/. Centre for Forest Gene Resource Conservation.

Westhaver, A. 2017. *Why some homes survived. Learning from the Fort MacMurray wildland/urban interface fire disaster.* A report published by the Institute for Catastrophic Loss Reduction – ICLR research paper series – number 56. https://www.iclr.org/images/Westhaver_Fort_McMurray_Final_2017.pdf

APPENDIX A: STATUS OF 2005 CWPP RECOMMENDATIONS

Table 19. Status of 2005 CWPP recommendations. Please note: recommendations are quoted from the 2005 CWPP; some agency names may have been updated since the authoring of this document (*e.g.* MoFR is now MFLNRORD, Protection Branch is now BCWS, etc.) and major land ownership changes (potential key partners) have taken place.

Item	Recommendation	Status
Communication and Education		
1	The City should work with local developers to construct a FireSmart show home that can be used as a tool to educate and communicate the principles of FireSmart to the public. The demonstration home would be built to FireSmart standards using recommended materials for interface communities. Additionally, vegetation adjacent to the home would be managed to guidelines outlined in the FireSmart program.	Needs improvement
2	The City should add information to their website that outlines community fire risks and proactive steps individual homeowners can apply to making their homes safer within the community. Other information, such as fire danger and FireSmart principles, could be maintained on the City's website so that fire management issues specific to the City could be easily delivered to the local population.	Complete
3	Similar to the ski condition reporting available to guests in resorts and businesses, the City should work toward communicating the fire danger during periods of high and extreme danger to businesses and resorts within the City. This information could be posted in hotel lobbies and public venues to facilitate communication of fire danger in the City.	Needs improvement
4	The Fernie Fire Rescue Department should work with the local Chamber of Commerce to educate the local business community on FireSmart preparation and planning.	In progress - a component of current FireSmart initiatives
Structure Protection		
5	At a minimum the planning department should integrate the FireSmart standard into the design of all new subdivision developments within the City. Wherever possible this standard should be integrated into changes to existing and new construction within subdivisions and built-up areas of the community.	Needs improvement
6	Many homes and businesses are built immediately adjacent to the forest edge. In these interface neighbourhoods, or where developments occur adjacent to park space, trees and vegetation are often in direct contact with homes. The planning department should create building setbacks with a minimum distance of 10m when buildings border the forest interface.	Needs improvement

Item	Recommendation	Status
7	The City's Planning Department and Fernie Fire Rescue should begin a process to review and revise existing bylaws and building codes to be consistent with the development of a FireSmart Community.	Needs improvement
8	In new subdivisions the City should require roofing materials that are fire retardant with a Class A and Class B rating. While it is recognized that wholesale changes to existing roofing materials within the City of Fernie are not practical, a long-term replacement standard that is phased in over the roof rotation period would significantly reduce the vulnerability of the community.	Needs improvement
9	Given the wildfire risk profile of the community, an emergency sprinkler kit capable of protecting 30 to 50 homes should be purchased and maintained in the community or shared with the regional district. Fernie Fire Rescue personnel, or a designate of the department, should be trained to mobilize and set up the equipment efficiently and effectively during a fire event.	Available through RDEK and UBCM
Access Management		
10	The City must work towards improving access in identified areas of the community that are considered isolated and that have inadequate access for evacuation and fire control.	Needs improvement
11	An evacuation plan should be developed for the community and the outlying road and trail networks that could be cut off or impacted by fire. A large fire may require the evacuation of heavily used trails where vehicle access is restricted.	Complete
Emergency Response		
12	During a large wildfire it is probable that the valley bottom (location of the fire hall and hospital) could be severely impacted by smoke. The City should cooperate with provincial and regional governments to develop contingency plans, including an alternate incident command centre and mobile facility, in the event that smoke causes the evacuation of Fernie.	Plan development in progress
Training		
13	The current level of training and available equipment related to interface fire response is considered adequate, but given the risk of fire to the community, Fernie Fire Rescue should adopt an advanced program that fosters continuous improvement and skill renewal.	Current
Fuel Management		
14	The modelling of projected beetle attack in the Fernie valley indicates that significant changes in fuels and fire risk are expected in 2020 and beyond. Fuel treatment strategies should target removal of beetle susceptible lodgepole pine. The City should work with the province and TEMBEC to monitor and quantify changes in fire risk associated with the Mountain Pine Beetle outbreak.	In progress - CWPP update

Item	Recommendation	Status
15	Both the provincial and federal governments have recently announced programs specifically to address the wildfire hazard associated with Mountain Pine Beetle. The City should work with the province to secure funding through these programs to address the problem of a projected outbreak within the City of Fernie and on adjacent crown land.	Forest health update - CWPP update
16	A number of high hazard areas immediately adjacent to, or embedded in, the community have been identified as part of the wildfire risk assessment. These high hazard areas should be the focus of a progressive thinning program that is implemented over the next five to ten years. Thinning should be focused on the highest priority areas: C2, C3 and C4 fuel types. The goals of thinning are to remove hazardous fuels and to reduce the overall fire behaviour potential adjacent to the community.	Completed one project on municipal land. Majority of hazardous fuels identified are on private land.
17	On lands adjacent to the City limits, ownership complicates the fuel treatment issue. There are areas of crown and private land that have been identified as hazardous. The City should work with the RDEK and the province to secure funding for treatment of crown land adjacent to the City. The City should also work with private land owners (in particular TEMBEC) to address hazardous fuels on private land.	Ongoing
18	The City should work with British Columbia Transmission Corporation (BCTC) and BC Hydro to ensure that transmission infrastructure can be maintained and managed during a wildfire event. Maintaining the transmission corridor to a fuel break standard will provide the community with a more reliable power supply that is less likely to fail during a fire event and will reduce the probability of fire spreading into the community.	Ongoing
19	The City should prioritize the development of a fuel break network that builds on existing breaks such as the highway, deciduous fuel types, and BC Transmission and BC Hydro corridors running through the City.	In progress - CWPP update
20	The City should develop further fuel breaks using existing topographic and water features. Given the visual and resource sensitivity of the City, shaded fuel breaks (retaining overstory trees) should be constructed to a size and standard that will minimize fire behaviour potential and aid suppression resources in containing and controlling wildfire.	In progress - CWPP update
21	Important trail networks should be thinned and understory fuels removed within a 5-metre area on each side of the trail networks. Given the level of pedestrian and bicycle traffic in these areas, thinning will limit the ability of fire to spread and improve fire suppression capability throughout the valley.	Needs improvement
22	A qualified professional, with a sound understanding of fire behaviour and fire suppression, should develop fuel break plans and prescriptions.	Complete

Item	Recommendation	Status
23	A significant area of high hazard fuel types identified in this analysis is the responsibility of the crown. Given the spatial scale of this area (approximately 1700 ha) and the current financial resources available it is unlikely that significant progress on treating this area could be achieved under the current funding formulas available. The City of Fernie's financial resources will be taxed just addressing the areas identified within Municipal boundaries. Therefore, it is recommended that the City work with the RDEK and the Province to secure long-term funding of approximately $1,000,000 to begin to address this problem. Conceivably this funding could be spread over a period of 3 to 5 years with the Province and the RDEK taking the lead on the treatment solutions to the hazardous fuel types identified in this analysis on crown land.	Recommendation details partially out of date - FESBC funding potentially available
Post-fire Rehabilitation		
24	The City should develop a plan for post fire rehabilitation that considers the procurement of seed, seedlings and materials required to regenerate an extensive burn area (1,000-5,000 ha). The opportunity to conduct meaningful rehabilitation post fire will be limited to a short fall season (September to November). The focus of initial rehabilitation efforts should be on slope stabilization and infrastructure protection. These issues should form the foundation of an action plan that lays out the necessary steps to stabilize and rehabilitate the burn area.	Needs improvement

APPENDIX B: FULL-SIZE MAPS

Full-size (large-format, georeferenced) PDF maps are to display features submitted in the spatial datasets and referred to in the final report. The content of each map is directed by Appendix 3 of the 2016 CWPP Program and Application Guide (Updated April 2017). PDF maps are submitted separate to this document. All full-sized maps are projected in NAD 1983 BC Environment Albers, as directed by the SWPI Program.

APPENDIX C: CWPP PLANNING PROCESS

This CWPP document will review the background information related to the study area which envelopes the City boundary and a two kilometer spotting buffer, the Fernie Alpine Resort area, and the Fire Service Area. The CWPP update consists of six general phases:

1. **Background research** - general community characteristics, such as demographic and economic profiles, critical infrastructure, environmental and cultural values, fire weather, fire history, relevant legislation and land jurisdiction.
2. **Field work** - site visits to the area to allow for 1) meetings with City staff; 2) fuel type verification; 3) completing WUI hazard assessment forms, and 4) identification of site specific issues.
3. **Consultation** – meetings and consultation with the City of Fernie, Rocky Mountain District (land manager) and Cranbrook Fire Zone representatives to assist with defining the objectives for wildfire protection, and to develop the mitigation strategy alternatives that would best meet Fernie's needs.
4. **GIS analyses –** initial threat analysis with final fuel type updating and threat rating refinement based upon field ground-truthing and results of hazard assessment forms.
5. **Report and map development** - identification of challenges and successes, identification of measures to mitigate risks, and recommendations for action (the Action Plan).
6. **Report review** - by City staff and representatives from the land manager at the Rocky Mountain Natural Resource District, BCWS, and the Ktunaxa Nation Council.

Reducing the level of wildfire risk to the City is the focus of the CWPP. The Action Plan (Section 7.0 specifically addresses the five elements of a CWPP that contribute to risk reduction. The five elements are: 1) communication and education; 2) structure protection and planning; 3) emergency response and preparedness; 4) planning and development; and 5) fuel management. This document makes specific recommendations (planning tools) on how risk can be reduced by implementing recommendations in these five elements.

To assess the threat of wildfire, the 2015 Provincial Strategic Threat Analysis (PSTA) was used in addition to completion of WUI Wildfire Threat Assessment Worksheets (as required by the UBCM).

APPENDIX D: MOUNTAIN PINE BEETLE'S IMPACTS ON FUELS

The following is an excerpt of the 2006 City of Fernie CWPP.[75] While the mountain pine beetle outbreak in the area has subsided, the content remains applicable to the study area because there remains potential for additional outbreaks in the future.

Similar to many communities in B.C., Fernie is experiencing an outbreak of Mountain Pine Beetle. Lodgepole pine is particularly susceptible to attack by Mountain Pine Beetle, and is one of the major wood species harvested in the region.

From a fire perspective, the current outbreak is a concern because it contributes surface fuels that will accelerate fire spread and fire intensity, allowing fires to move more easily into the tree crowns. The intimate relationship and critical role that bark beetles and fire play in the natural succession of lodgepole pine forests has been well documented. These forests, which occupy millions of hectares in the Pacific Northwest, are generally even aged stands younger than 100 years old. This even-aged forest structure is a result of periodic wildfires which follow high mortality from bark beetle attacks (Fellin 1979; Mitchell and Martin 1980; Koch 1996; Price 1991; Schowalter et al. 1981). The stands have adapted to these natural rotations, which tend to repeat every 100 years. Examples illustrating this cycle include the 1988 wildfires in Yellowstone National Park, the 1961 wildfire in the Bitterroot National Forest in Montana, and fires in Washington and Idaho in 1994.

Mountain pine beetle outbreaks occur mainly in mature forests, which are 80 to 150 years old. The outbreaks subside when most of the large diameter trees are killed. The dead trees then fuel subsequent fires, which regenerate the stand (Amman 1990; Fellin 1979; Geiszler et al. 1980; Price 1991). It has been hypothesized that these two agents of disturbance interact to maintain the structure and function of pine forests. Fire regulates forest regeneration in space and time, which is necessary for the pine beetle, and the pine beetle regulates the turnover of patches of dead trees conducive to burning (Schowalter et al. 1981).

[75] B.A. Blackwell and Associates Ltd. 2006. *City of Fernie Community Wildfire Protection Plan Considerations for Wildland Urban Interface Management.* Np.

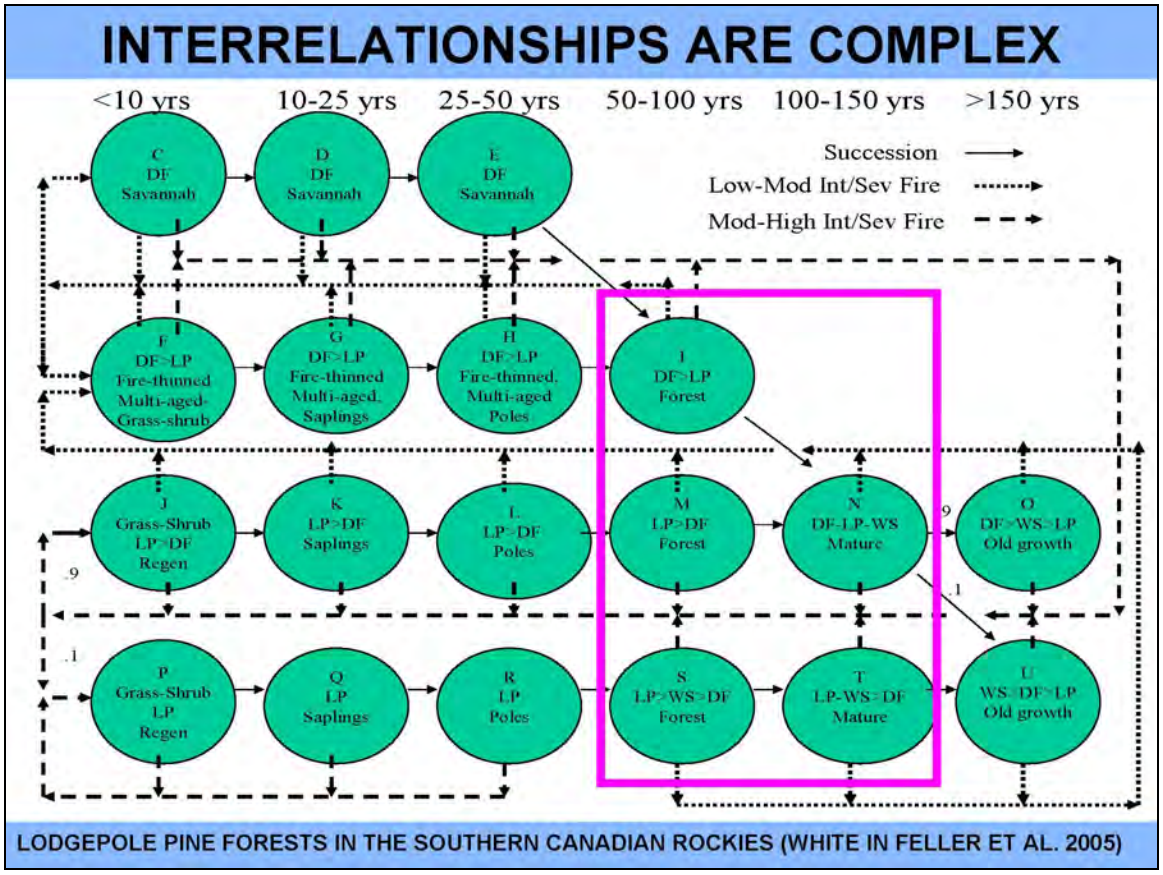


Figure 18. Outline of complex lodgepole pine successional relationships and potential fire severity (From White and Feller et al. 2005)

In the past, agents of disturbance were viewed as a threat to the health of the valuable forest resource. Therefore, standard policy has been to suppress all wildfire and eliminate forest pests. In pine forests, this has resulted in unstable forests that are increasingly susceptible to physical and biological stresses.

Healthy stands typically have a low fire hazard with crown closure ranging from 35 to 45%. This may vary in stands where pine is not the dominant species. Beetle mortality results in a short-term immediate increase in stand level fire hazard during the red attack stage. Fire behaviour observations suggest that rates of spread and head fire intensity are greater when fires burn through red-attacked stands.

The red attack stage of the beetle infestation is followed by foliar inputs to the forest floor, and the creation of standing dead snags (attacked stand). Depending on the site conditions, the loss of overstory tree foliage increases light levels to the forest floor surface and can result in a flush of understory vegetation including new seedlings that regenerate naturally (understory release). This flush depends on a number of factors but is primarily a function of available light, nutrients, moisture and the existing seed bank and plant community. Over time, the seedlings begin to dominate the understory forming a contiguous sapling layer (seedling dominance). At this same time, the dead trees originally killed by beetle attack have become decaying snags, and begin to fall creating high inputs of surface fuel (pine dominated understory). At this point, the stand has reached its highest

fire hazard with the combination of a contiguous fuel load from the surface of the forest floor into the overstory canopy. These characteristics yield a stand that is now highly susceptible to stand replacing crown fire.

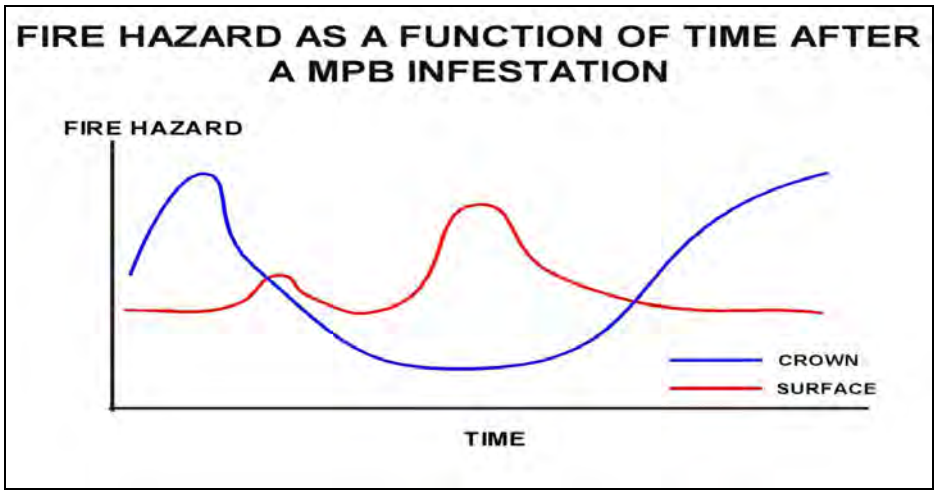


Figure 19. Graphical summary of fire hazard changes associated with an MPB outbreak.

Figure 20, Figure 21 and Figure 22 illustrate the initial stages of fuel loading and an increasing fire hazard.

Figure 20. Blowdown and breakage contributing to fuel loading.

Figure 21. Accumulation of surface fuels (left). Snow damage (right).

Modelling projections of the Mountain Pine Beetle outbreak (Eng 2004) suggest that, over the next 15 years, the forests adjacent to the City will experience significant mortality of lodgepole pine in the absence of any intervention (falling and burning or control through harvest). Based on the discussion above it is expected that surface fuel loads will increase over the next 20 years and landscape level fire hazard in pine dominated forests around the community will peak between 30 and 40 years. Any harvest within close proximity of the City, or tree removal within city limits, should target mature lodgepole pine to reduce the overall landscape level susceptibility. Any prescribed fuel treatments and/or creation of firebreaks should focus on the removal of lodgepole pine. Taking this approach will help to reduce the overall landscape level hazard and potentially limit the size and distribution of the forecasted outbreak.

Recent beetle attack has been limited to the outskirts of the City (to the south and north). The current Mountain Pine Beetle outbreak within the study area is not significantly contributing to fuel loadings and associated fire risk. However, properties along the eastern boundary of the city will be the most heavily impacted by the outbreak based on the projections. The stands surrounding these areas have a low to moderate component of susceptible pine. Left unmanaged, these stands have a high probability of supporting moderate to high fuel loads and will follow the fire hazard succession outlined in Figure 22.

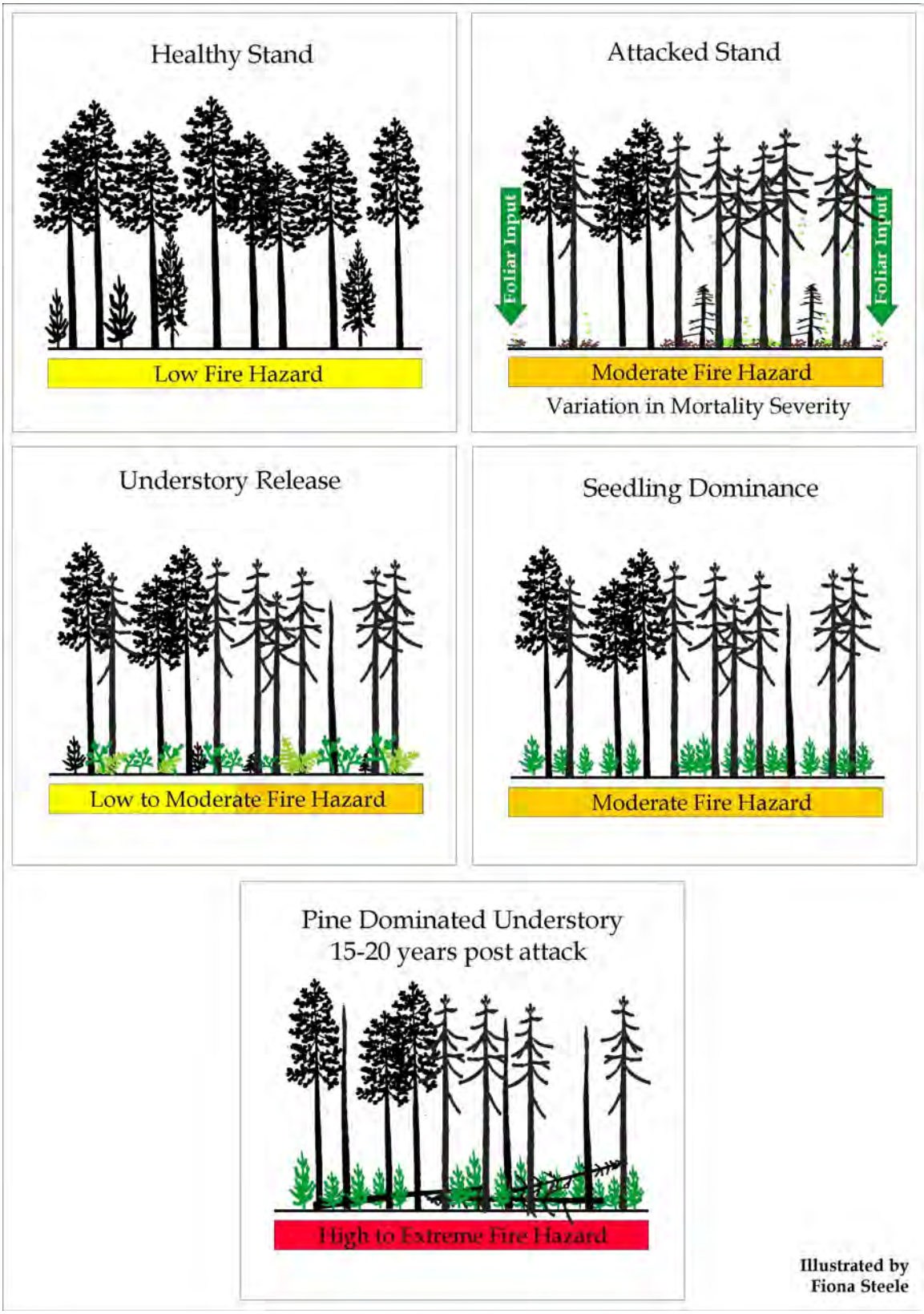


Figure 22. Fire hazard succession following attack.

APPENDIX E: FUEL TYPING METHODOLOGY AND LIMITATIONS

The initial starting point for study area fuel typing for the study area was a combination of the fuel typing provided as part of the *2015 Provincial Strategic Threat Analysis* (PSTA) data package provided by the BCWS and the 2005 CWPP fuel typing, both of which are based on the FBP fuel typing system. PSTA data (polygons and fuel typing) was utilized as the starting point for the western flank of the valley and valley bottom; whereas the 2005 CWPP fuel type data was utilized for the eastern flank of the valley. PSTA data is limited by the accuracy and availability of information within the Vegetation Resource Inventory (VRI) provincial data; confidence in provincial fuel type data is very low on private land. The PSTA fuel typing was more or less non-existent for the eastern flank of the Valley, as it is all privately held land. Fuel types within the study area have been updated using imagery of the study area and spatial data graciously provided by private landholders, with representative fuel type calls confirmed by field fuel type verification.

It should be noted that fuel typing is intended to represent a fire behaviour pattern; a locally observed fuel type may have no exact analog within the FBP system. The FBP system was almost entirely developed for boreal and sub-boreal forest types which do not occur within the study area. Furthermore, Perrakis and Eade (2015) identified six vegetation communities for which there are significant uncertainties and knowledge gaps regarding fuel typing and fire behaviour, one of which is directly applicable to the study area:

- Mixed-conifer stands of the interior wet belt – species such as western larch growing in multi-story canopies, usually associated with Douglas-fir, western redcedar, lodgepole pine, or other conifer species.

They write that the six identified vegetation communities are, “at best, a poor match with any of the FBP types” and that “the greatest uncertainty in fire behaviour is probably associated with these vegetation communities”.[76]

Additionally, provincial fuel typing depends heavily on Vegetation Resource Inventory (VRI) data, which is gathered and maintained in order to inform timber management objectives, not fire behaviour prediction. For this reason, VRI data often does not include important attributes which impact fuel type and hazard, but which are not integral to timber management objectives. Examples include: surface fuels and understory vegetation.

In addition, fuel type polygons may not adequately describe the variation in the fuels present within a given polygon due to errors within the PSTA and VRI data, necessitating adjustments required to the PSTA data. In some areas, aerial imagery is not of sufficiently high resolution to make a fuel type call. Where fuel types could not be updated from imagery with a high level of confidence, the original PSTA fuel type polygon and call were retained.

For information on the provincial fuel typing process used for PSTA data as well as aiding in fuel type updates made in this document, please refer to Perrakis and Eade, 2015.[77]

[76] Perrakis, D. and G. Eade. 2015. BC Wildfire Service. Ministry of Forests, Lands, and Natural Resource Operations. *British Columbia Wildfire Fuel Typing and Fuel Type Layer Description* 2015 Version.

[77] Ibid.

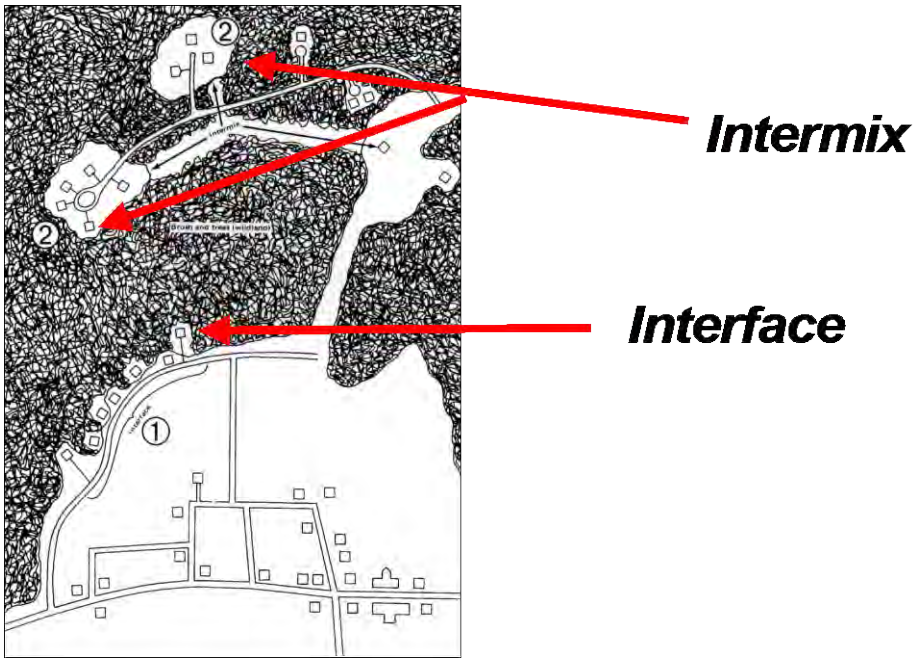
APPENDIX F: WILDLAND URBAN INTERFACE DEFINED

The traditional and most simple definition for the wildland/urban interface (WUI) is "the place where the forest meets the community". However, this definition can be misleading. Incorrectly, it implies that neighbourhoods and structures well within the perimeter of a larger community, like Fernie, are not at risk from wildfire. As well, it fails to recognize that developments adjacent to grassland and bush are also vulnerable.

A more accurate and helpful definition of the WUI is based on a set of conditions, rather than a geographical location: "the presence of structures in locations in which conditions result in the potential for ignition of structures from the flames, radiant heat or embers of a wildland fire." This definition was developed by the National Fire Protection Association and is used by the US Firewise program. It recognizes that all types of wildland fuel/fire can lead to structural ignition (i.e. forest, grassland, brush) and also identifies the three potential sources of structural ignition.

Two situations are differentiated. Locations where there is a clean/abrupt transition from urban development to forest lands are usually specified as the "interface" whereas locations where structures are embedded or mingled within a matrix of dense wildland vegetation are known as the "intermix". An example of interface and intermixed areas is illustrated in Figure 23 .

Figure 23. Illustration of intermix and interface situations.



Within the WUI, fire has the ability to spread from the forest into the community or from the community out into the forest. Although these two scenarios are quite different, they are of equal importance when considering interface fire risk. Regardless of which scenario occurs, there will be consequences for the community and this will have an impact on the way in which the community plans and prepares itself for interface fires.

Fires spreading into the WUI from the forest can impact homes in two distinct ways:

1. From sparks or burning embers carried by the wind, or convection that starts new fires beyond the zone of direct ignition (main advancing fire front), that alight on vulnerable construction materials or adjacent flammable landscaping (roofing, siding, decks, cedar hedges, bark mulch, etc.) (Figure 24).

2. From direct flame contact, convective heating, conductive heating or radiant heating along the edge of a burning fire front (burning forest), or through structure-to-structure contact. Fire can ignite a vulnerable structure when the structure is in close proximity (within 10 meters of the flame) to either the forest edge or a burning house (Figure 25).

Figure 24. Firebrand caused ignitions: burning embers are carried ahead of the fire front and alight on vulnerable building surfaces.

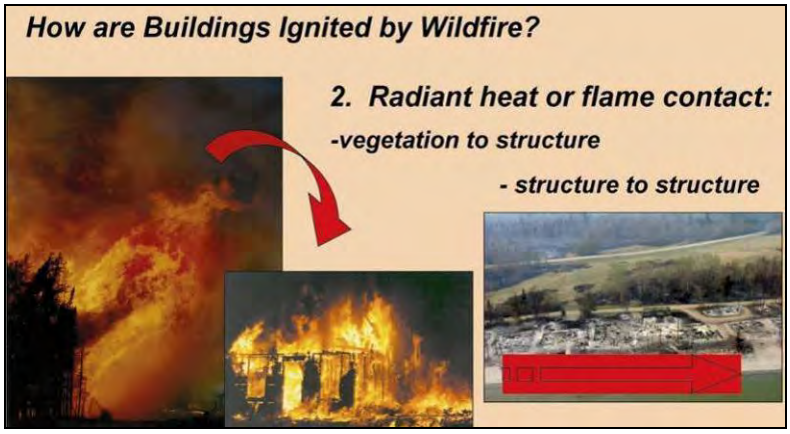


Figure 25. Radiant heat and flame contact allows fire to spread from vegetation to structure or from structure to structure.

Current research confirms that the majority of homes ignited during major WUI events trace back to embers as their cause (e.g. 50% – 80^{+} %). Firebrands can be transported long distances ahead of the wildfire, across any practicable fire guards, and accumulate on horizontal surfaces within the home ignition zone in densities that can reach 600^{+} /m^{2}. Combustible materials found within the home ignition zone combine to provide fire pathways allowing spot fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

Once multiple homes are ignited and fire is well established in an urban area there is increasing potential for fire to spread from structure to structure, independent of the wildland vegetation/fuel. This is known as an urban conflagration. This pattern is commonplace and known as the WUI Disaster Sequence (Figure 26).

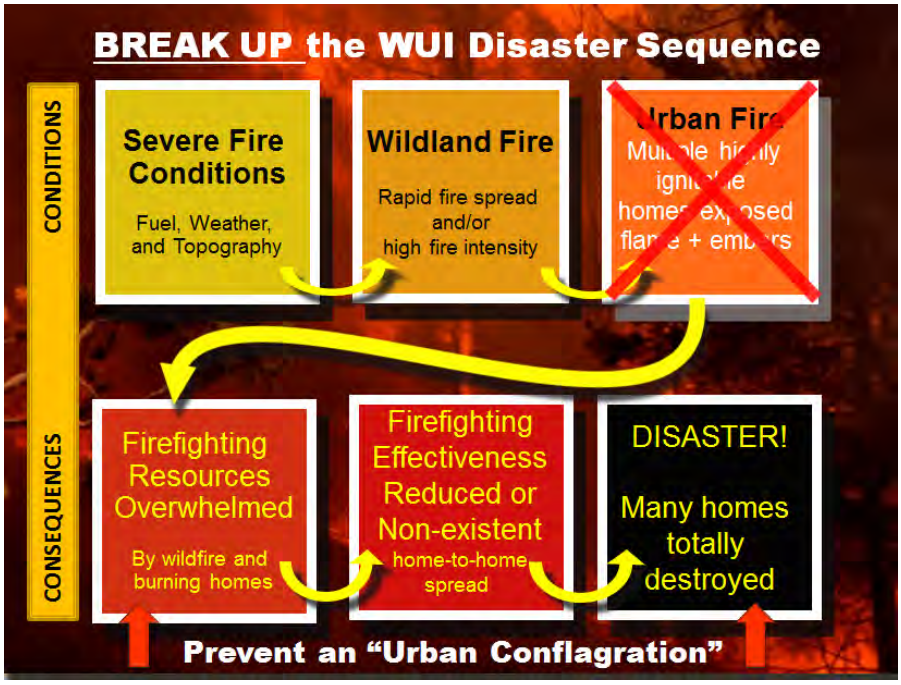


Figure 26. WUI disaster sequence.

APPENDIX G: WUI THREAT PLOT DETAILS

Table 20 displays a summary of all WUI threat plots completed during CWPP field work. The original WUI threat plot forms have been submitted as a separate document. The following ratings are applied to applicable point ranges:

- Wildfire Behaviour Threat Score – Low (0-40); Moderate (41 – 95); High (96 – 149); Extreme (>149); and,
- WUI Threat Score – Low (0 – 13); Moderate (14 – 26); High (27 – 39); Extreme (>39).

Table 20. Summary of WUI Threat Assessment Worksheets.

WUI Plot #	Geographic Location	WUI Threat Worksheet Components				Wildfire Behaviour Threat Class (Score) (/240)	WUI Threat Class (Score) (/55)
		Fuel	Weather	Topography	Structural		
AT-1	Alpine Trails	74	22	25	27	High (121)	High (27)
FAR-2	Fernie Alpine Resort	56	22	17	42	Moderate (95)	N/A (42)
FC-1	Fairy Creek	48	22	18	34	Moderate (85)	N/A (34)
FPP-1	Mt Fernie Park Road	71	22	32	21	High (125)	Moderate (21)
RM-2	Ridgemont Road	33	22	35	25	Moderate (90)	Moderate (25)[78]
CM-2	Cemetery Demo	42	22	24	33	Moderate (88)	N/A (33)
CE-2	Cedar Estates	61	22	12	48	Moderate (95)	N/A (48)
DP-1	Dog Park Demo	31	22	28	43	Moderate (81)	N/A (43)
RM-6	Mature Treated	39	22	32	33	Moderate (93)	High (33)[79]
CE-1	Cedar Estates	58	22	17	48	High (97)	Extreme(48)
CM-1	Cemetery Demo	35	22	35	33	Moderate (75)	N/A (33)

[78] WUI Threat Class given for plot RM-2, despite the Moderate Fire Behaviour Threat Class rating because it is within a previously treated polygon (2010).

[79] WUI Threat Class given for plot RM-6, despite the Moderate Fire Behaviour Threat Class rating because it is within a previously treated polygon (2010).

WUI Plot #	Geographic Location	WUI Threat Worksheet Components				Wildfire Behaviour Threat Class (Score) (/240)	WUI Threat Class (Score) (/55)
		Fuel	Weather	Topography	Structural		
CH-1	Coal Heritage Trail	48	22	25	38	Moderate (95)	N/A (38)
CH-2	Coal Heritage Trail	38	22	32	43	Moderate (92)	N/A (43)
JW-1	Max Turyk	28	N/A	N/A	45	Low (28)[80]	N/A (45)
JW-2	James White Park	45	22	17	40	Moderate (84)	N/A (40)
JW-3	James White Park	57	22	17	33	High (96)	High (33)
LAT-1	Lower Alpine Trails	31	22	22	45	Moderate (75)	N/A (45)
LAT-2	Lower Alpine Trails	68	22	17	45	High (107)	Extreme (45)
BPE-1	Cemetery Bypass Extension	66	22	15	23	High (103)	Moderate (23)

[80] Fuels subtotal must be greater than 29 to proceed with the rest of the assessment.

APPENDIX H: WUI THREAT ASSESSMENT METHODOLOGY

As part of the CWPP process, spatial data submissions are required to meet the defined standards in the Program and Application Guide. As part of the program, proponents completing a CWPP or CWPP update are provided with the Provincial Strategic Threat Analysis (PSTA) dataset. This dataset includes:

- Current Fire Points
- Current Fire Polygons
- Fuel Type
- Historical Fire Points
- Historical Fire Polygons
- Mountain pine beetle polygons
- PSTA Head Fire Intensity
- PSTA Historical Fire Density
- PSTA Spotting Impact
- PSTA Threat Rating
- Structure Density
- Structures (sometimes not included)
- Wildland Urban Interface Buffer Area

The required components for the spatial data submission are detailed in the Program and Application Guide Spatial Appendix – these include:

- AOI
- Fire Threat
- Fuel Type
- Photo Location
- Proposed Treatment
- Structures
- Threat Plot
- Wildland Urban Interface

The provided PSTA data does not necessarily transfer directly into the geodatabase for submission, and several PSTA feature classes require extensive updating or correction. In addition, the Fire Threat determined in the PSTA is fundamentally different than the Fire Threat feature class that must be submitted in the spatial data package. The Fire Threat in the PSTA is based on provincial scale inputs - fire density; spotting impact; and head fire intensity, while the spatial submission Fire Threat is based on the components of the Wildland Urban Interface Threat Assessment Worksheet. For the scope of this project, completion of WUI Threat Assessment plots on the entire AOI is not possible, and therefore an analytical model has been built to assume Fire Threat based on spatially explicit variables that correspond to the WUI Threat Assessment worksheet.

FIELD DATA COLLECTION

The primary goals of field data collection are to confirm or correct the provincial fuel type, complete WUI Threat Assessment Plots, and assess other features of interest to the development of the CWPP. This is accomplished by traversing as much of the study area as possible (within time, budget and access constraints). Threat Assessment plots are completed on the latest version (2013) form, and as per the Wildland Urban Interface Threat Assessment Guide.

For clarity, the final threat ratings for the study area were determined through the completion of the following methodological steps:

1. Update fuel-typing using orthophotography provided by the client and field verification.
2. Update structural data using critical infrastructure information provided by the client, field visits to confirm structure additions or deletions, and orthophotography
3. Complete field work to ground-truth fuel typing and threat ratings (completed 19 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 225+ field stops with qualitative notes, fuel type verification, and/or photographs)
4. Threat assessment analysis using field data collected and rating results of WUI threat plots – see next section.

SPATIAL ANALYSIS

Not all attributes on the WUI Threat Assessment form can be determined using a GIS analysis on a landscape/polygon level. To emulate as closely as possible the threat categorization that would be determined using the Threat Assessment form, the variables in Table 7 were used as the basis for building the analytical model. The features chosen are those that are spatially explicit, available from existing and reliable spatial data or field data, and able to be confidently extrapolated to large polygons.

WUI Threat Sheet Attribute	Used in Analysis?	Comment
FUEL SUBCOMPONENT		
Duff depth and Moisture Regime	No	Many of these attributes assumed by using 'fuel type' as a component of the Fire Threat analysis. Most of these components are not easily extrapolated to a landscape or polygon scale, or the data available to estimate over large areas (VRI) is unreliable.
Surface Fuel continuity	No	
Vegetation Fuel Composition	No	
Fine Woody Debris Continuity	No	
Large Woody Debris Continuity	No	
Live and Dead Coniferous Crown Closure	No	
Live and Dead Conifer Crown Base height	No	
Live and Dead suppressed and Understory Conifers	No	
Forest health	No	

Continuous forest/slash cover within 2 km	No	
WEATHER SUBCOMPONENT		
BEC zone	Yes	
Historical weather fire occurrence	Yes	
TOPOGRAPHY SUBCOMPONENT		
Aspect	Yes	
Slope	Yes	Elevation model was used to determine slope.
Terrain	No	
Landscape/ topographic limitations to wildfire spread	No	
STRUCTURAL SUBCOMPONENT		
Position of structure/ community on slope	No	
Type of development	No	
Position of assessment area relative to values	Yes	Distance to structure is used in analysis; position on slope relative to values at risk is too difficult to analyze spatially.

The field data is used to correct the fuel type polygon attributes provided in the PSTA. The corrected fuel type layer is then used as part of the initial spatial analysis process. The other components are developed using spatial data (BEC zone, fire history zone) or spatial analysis (aspect, slope). A scoring system was developed to categorize resultant polygons as having relatively low, moderate, high or extreme Fire Threat, or Low, Moderate, High or Extreme WUI Threat.

These attributes are combined to produce polygons with a final Fire Behaviour Threat Score. To determine the Wildland Urban Interface Score, only the distance to structures is used. Buffer distances are established as per the WUI Threat Assessment worksheet (<200, 200-500 and >500) for polygons that have a 'high' or 'extreme' Fire Behaviour Threat score. Polygons with structures within 200m are rated as 'extreme', within 500m are rated as 'high', within 2km are 'moderate', and distances over that are rated 'low'.

There are obvious limitations in this method, most notably that not all components of the threat assessment worksheet are scalable to a GIS model, generalizing the Fire Behaviour Threat score. The WUI Threat Score is greatly simplified, as determining the position of structures on a slope, the type of development and the relative

position are difficult in an automated GIS process. This method uses the best available information to produce the initial threat assessment across the study area in a format which is required by the UBCM SWPI program.

Upon completion of the initial spatial threat assessment, individual polygon refinement was completed. In this process, the WUI threat plots completed on the ground were used in the following ways:

- fuel scores were reviewed applied to the fuel type in which the threat plot was completed;
- conservative fuel scores were then applied to the polygons by fuel type to check the initial assessment;
- high and extreme Wildfire Behaviour Threat Class polygons were reviewed in google earth to confirm their position on slope relative to values at risk.

In this way, we were able to consider fuel attributes outside the fuel typing layer, as well as assessment area position on slope relative to structures, which are included in the WUI threat plot worksheet.

Limitations

The threat class ratings are based initially upon (geographic information systems) GIS analysis that best represents the WUI wildfire threat assessment worksheet and are updated with ground-truthing WUI threat plots. WUI threat plots were completed in a variety of fuel types, slopes, and aspects in order to be able to confidently refine the GIS analysis. It should be noted that there are subcomponents in the worksheet which are not able to be analyzed using spatial analysis; these are factors that do not exist in the GIS environment.

The threat assessment is based largely on fuel typing, therefore the limitations with fuel typing accuracy (as detailed in Section 3.1) impacts the threat assessment, as well.

APPENDIX I: FIRE DANGER CLASS DEFINITIONS

Fire Danger Classes are defined as follows:

- **Class 1 (Very Low)**: Fires are likely to be self-extinguishing and new ignitions are unlikely. Any existing fires are limited to smoldering in deep, drier layers.
- **Class 2 (Low)**: Creeping or gentle surface fires. Fires are easily contained by ground crews with pumps and hand tools.
- **Class 3 (Moderate)**: Moderate to vigorous surface fires with intermittent crown involvement. They are challenging for ground crews to handle; heavy equipment (bulldozers, tanker trucks, and aircraft) are often required to contain these fires.
- **Class 4 (High)**: High-intensity fires with partial to full crown involvement. Head fire conditions are beyond the ability of ground crews; air attack with retardant is required to effectively attack the fire's head.
- **Class 5 (Extreme)**: Fires with fast-spreading, high-intensity crown fire. These fires are very difficult to control. Suppression actions are limited to flanks, with only indirect actions possible against the fire's head.

APPENDIX J: FIRESMART FUEL TREATMENTS

The following information regarding fuel treatments is based on the FireSmart Manual (Partners in Protection 2002).

Priority Zone 1 is a 10 m fuel free zone around structures. This ensures that direct flame contact with the building cannot occur and reduces the potential for radiative or conductive heat to ignite the building. While creating this zone is not always possible, landscaping choices should reflect the use of less flammable vegetation such as deciduous shrubs, herbs and other species with low flammability. Coniferous vegetation such as juniper or cedar shrubs and hedges should be avoided, as these are highly flammable. Any vegetation in this zone should be widely spaced and well setback from the house.

Priority Zone 2 extends from 10 to 30 m from the structure. In this zone, trees should be widely spaced 5 to 10 m apart, depending on size and species. Tree crowns should not touch or overlap. Deciduous trees have much lower volatility than coniferous trees, so where possible deciduous trees should be preferred for retention or planting. Trees in this area should be pruned as high as possible (without compromising tree health), especially where long limbs extend towards buildings. This helps to prevent a fire on the ground from moving up into the crown of the tree or spreading to a structure. Any downed wood or other flammable material should also be cleaned up in this zone to reduce fire moving along the ground.

Priority Zone 3 extends from 30 to 100 m from the home. The main threat posed by trees in this zone is spotting, the transmission of fire through embers carried aloft and deposited on the building or adjacent flammable vegetation. To reduce this threat, cleanup of surface fuels as well as pruning and spacing of trees should be completed in this zone (Partners in Protection 2002).

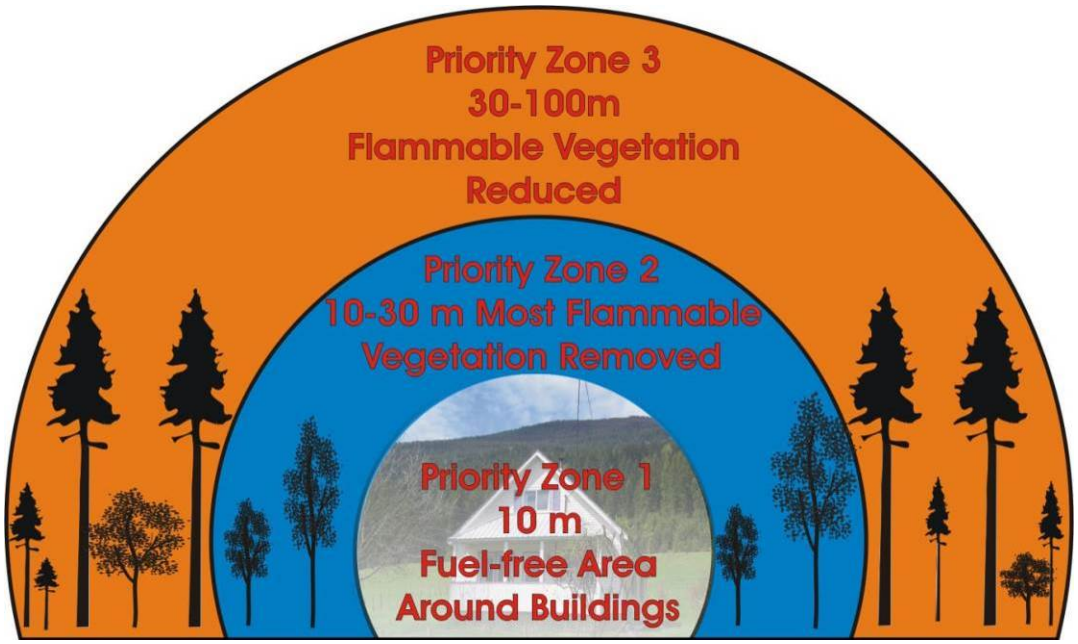


Figure 27. Illustration of FireSmart zones. (Figure adapted from FireSmart)

APPENDIX K: FIRESMART CONSTRUCTION AND LANDSCAPING

Two recent studies by Westhaver (2015, 2017) found that certain "fatal flaws", such as high-flammability landscaping like bulky ornamental junipers and large, easily ignited fuel sources (e.g. motorized vehicles, firewood, construction materials, *etc*.) were sufficiently influential to result in structure ignition of homes otherwise assessed as "Low" hazard by overwhelming the advantages provided by highly fire resistant structures[81].

In the 2017 Fort McMurray investigations (Westhaver) it was found that the most notable observed attributes of the surviving interface homes were: vegetation and fuels within the HIZ which were compliant with FireSmart practices, HIZs with relatively few combustible objects and ignition sites (examples of ignition sites include: combustible accumulations on roofs, gutters, *etc*.) , and Low to Moderate structural hazard ratings.[82,83] This investigation, and other similar investigations, indicate that the FireSmart principles can be effective at reducing structure loss, particularly in the urban perimeter where fire initially spreads from the forest to structures.

The following link accesses an excellent four-minute video demonstrating the importance of FireSmart building practices during a simulated ember shower: https://www.youtube.com/watch?v=IvbNOPSYyss.

FIRESMART CONSTRUCTION

Roofing Material:

Roofing material is one of the most important characteristics influencing a home's vulnerability to fire. Roofing materials that can be ignited by burning embers increases the probability of fire related damage to a home during an interface fire event.

In many communities, there is no fire vulnerability standard for roofing material. Homes are often constructed with unrated materials that are considered a major hazard during a large fire event. In addition to the vulnerability of roofing materials, adjacent vegetation may be in contact with roofs, or roof surfaces may be covered with litter fall from adjacent trees. This increases the hazard by increasing the ignitable surfaces and potentially enabling direct flame contact between vegetation and structures.

Soffits and Eaves

Open soffits or eaves provide locations for embers to accumulate, igniting a structure. Soffits and eaves should be closed. Vents which open into insulated attic space are of particular concern, as they provide a clear path for embers to a highly flammable material inside the structure. Any exhaust or intake vents that open into attic spaces should resist ember intrusion with non-combustible wire mesh no larger than 3 mm.

[81] Westhaver, A. 2017. *Why some homes survived. Learning from the Fort McMurray wildland/urban interface fire disaster*. A report published by the Institute for Catastrophic Loss Reduction – ICLR research paper series – number 56. https://www.iclr.org/images/Westhaver_Fort_McMurray_Final_2017.pdf

[82] Ibid.

[83] Using the FireSmart hazard assessment system.

Building Exterior - Siding Material:

Building exteriors constructed of vinyl or wood are considered the second highest contributor to structural hazard after roofing material. These materials are vulnerable to direct flame or may ignite when sufficiently heated by nearby burning fuels. The smoke column will transport burning embers, which may lodge against siding materials. Brick, stucco, or heavy timber materials offer much better resistance to fire. While wood may not be the best choice for use in the WUI, other values from economic and environmental perspectives must also be considered. It is significantly less expensive than many other materials, supplies a great deal of employment in BC, and is a renewable resource. New treatments and paints are now available for wood that increase its resistance to fire and they should be considered for use.

Balconies and Decking:

Open balconies and decks increase fire vulnerability through their ability to trap rising heat, by permitting the entry of sparks and embers, and by enabling fire access to these areas. Closing these structures off limits ember access to these areas and reduces fire vulnerability. Horizontal surfaces, such as decks, of flammable materials are vulnerable to ignition from embers. Fire resistant decking/ patio materials will reduce the ignitability of the home.

Combustible Materials:

Combustible materials stored within 10 m of residences are also considered a significant issue. Woodpiles, propane tanks, recreational motorized vehicles, and other flammable materials adjacent to the home provide fuel and ignitable surfaces. Locating these fuels away from structures helps to reduce structural fire hazards and makes it easier and safer for suppression crews to implement suppression activities adjacent to a house or multiple houses.

FIRESMART LANDSCAPING

Future landscaping choices should be limited to plant species with low flammability within 10 m of the building. Coniferous vegetation such as Juniper, Cypress, Yew or Cedar hedging or shrubs of any height should not be planted within this 10 m zone as these species are considered highly flammable under extreme fire hazard conditions.

Decorative bark mulch, often used in home landscapes is easily ignitable from wildfire embers or errant cigarettes and can convey fire to the home. Alternatives to bark mulch include gravel, decorative rock, or a combination of wood bark and decorative rock.[84]

LANDSCAPING ALTERNATIVES

The landscaping challenges faced by many homeowners pertain to limited space, privacy and the desire to create visually explicit edge treatments to demarcate property ownership from adjacent lots with evergreen vegetation screens. Ornamental plant characteristics fulfilling these criteria have an upright branching habit, compact form, dense foliage, as well as a moderate growth rate. Dwarf and ornamental conifers such as Arborvitae hedging are popular choices, yet conifers such as these which have needle or scale-like foliage are highly flammable and not

[84] *Fire Resistant Plants for Home Landscapes: Selecting plants that may reduce your risk from wildfire*. 2006. A Pacific Northwest Extension Publication (PNW 590).

compliant with FireSmart principles and should be omitted from the 10 m Fire Priority Zone of the planned home footprint.

There are a number of broadleaved deciduous and evergreen plants with low flammability which can be used for landscaping within FireSmart PZ 1 (within 10 m of structures). Landscaping should be selected for the appropriate Canadian Plant Hardiness Zone (see www.planthardiness.gc.ca for the Hardiness Zone specific to the various study area). The majority of the areas would be within Zone 4b.

Plants that are fire resistant/ have low flammability generally have the following characteristics:

- Foliage with high moisture content (moist and supple),
- Little dead wood and do not tend to accumulate dry and dead foliage or woody materials, and
- Sap that is water-like and without a strong odour.[3]

It is important to note that even fire resistant plants can burn if not maintained. Grass, shrubs, and herbs must be maintained in a state that reduces fire hazard by maintaining foliar moisture content. This can be accomplished by:

- Choosing plant species that are well-adapted to the site (microclimate and soil conditions of the parcel);
- Incorporating a landscape design where shrubs, herbs, and grasses are planted in discrete units manageable by hand watering;
- Removal of dead and dying foliage; and/or,
- Installing irrigation.

Depending solely on irrigation to maintain landscaping in a low flammability state can be limiting, and may actually increase the fire hazard on the parcel, particularly in times of drought and watering restrictions. Lack of irrigation in times of watering restrictions may create a landscape which is unhealthy, unsightly, as well as dead, dry, and highly flammable.

There are a number of resources available to aid in development of FireSmart compliant landscaping curriculum or educational material; links can be found below.

The Canadian and U.S. systems for determining Plant Hardiness Zones differ.

- The USDA bases hardiness zones on minimum winter temperatures only: http://planthardiness.ars.usda.gov/PHZMWeb/Default.aspx,
- The Canadian system bases them on seven climatic factors including frost free days, and minimum and maximum temperature: http://www.planthardiness.gc.ca/

APPENDIX L: COMMUNICATION AND EDUCATION BACKGROUND

Communicating effectively is the key aspect of education. Communication materials must be audience specific, and delivered in a format and through a medium that will reach the target audience. Audiences should include home and landowners and occupiers, school students, local businesses, City council and staff, community members, and other community groups. Education and communication messages should be engaging, empowering, simple yet comprehensive. A basic level of background information is required to enable a solid understanding of fire risk issues and the level of complexity and detail of the message should be specific to the target audience.

Websites and social media are some of the most cost-effective methods of communication available. Pew Research Center recently found that approximately 60% of Americans get their news from social media; 44% get their news from Facebook.[85] Twitter, LinkedIn, and Instagram are other social media platforms which can be used to provide real-time information to a large audience and are used, albeit to a lesser extent, by users as their primary news source.[86]

The challenge of all social media is to ensure that your message reaches the intended audience, accomplished by having users 'like' the page, engage with the posts, or re-share information to an even larger audience. There are communication experts who specialize in social media who can evaluate an organization's goals and offer tips to increase engagement and create compelling content to communicate the message. Likewise, it is important to be aware of the demographic of the community; a younger, more digitally connected community, such as Fernie, is more likely to use social media to get updates on 'newsworthy items'.[87]

[85] Pew Research Center Journalism and Media. Social media news use: Facebook leads the pack. May 25, 2016. Accessed November 17, 2016 from http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016/pj_2016-05-26_social-media-and-news_0-03/.

[86] Although the research cited in this document is of American social media users, it can be cautiously assumed that, while data and numbers are not likely exact to the Canadian demographic, similar trends in Canada likely occur.

[87] The Pew Research Center finds that 69% of Facebook users are 49 and younger. Only 8% of Facebook users are older than 65.

APPENDIX M: WUI SITE AND STRUCTURE HAZARD ASSESSMENT PROGRAMS

There are a number of mechanisms that can be employed to motivate homeowners to reduce the threat to their home, and in turn, to the neighborhood/community. One mechanism is to instigate change through bylaws or covenants. Another way to motivate change is through education and increased awareness of fire hazard on private property. In other jurisdictions (notably Colorado Springs, CO and Whistler, BC), programs to increase awareness of fire hazard and spur homeowner action have been implemented successfully. In these jurisdictions, fire hazard assessments were completed for homes in the Wildland Urban Interface. The results of the assessments were shared with the homeowner/ property owner at the time of assessment. The assessors also were able to use this opportunity to provide advice on easily actionable items which could decrease the fire hazard to the property. The results of the hazard assessments were compiled into a geo-spatial database and made available to the public. Each home and property owner could look up to see the hazard of their property, as well as their neighbours' and how both may contribute to, or lessen, the overall fire hazard and risk of their neighborhood (Figure 28). A similar database may be useful for the Fernie Fire Rescue as triage assessments and to aid in suppression planning.

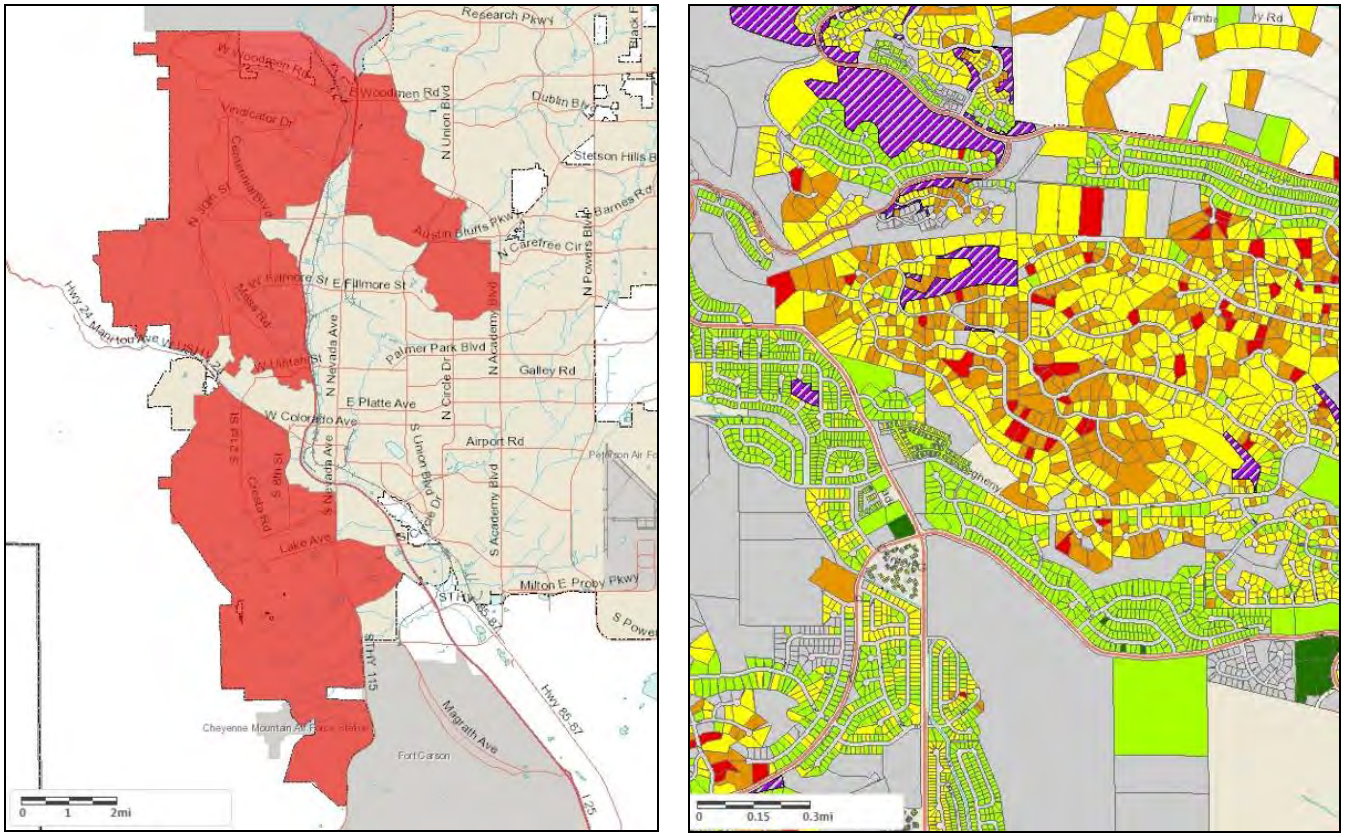


Figure 28. Screen captures of Colorado Springs, Colorado public internet mapping service. The left figure displays the WUI area in red in which fire hazard assessments were completed. The right figure displays a

neighbourhood within the WUI area and the fire hazard for each individual property (red is extreme, orange is very high, yellow is high, bright green is moderate and dark green is low).[88]

It is recognized that a large-scale individual home assessment program may not be feasible for the City, due to resource limitations and prioritization of recommendations. Consultation with another community that has implemented a similar, but smaller scale program was completed. In this community, individual home assessments were completed upon homeowner request. By completing home assessments for those that showed initial interest in FireSmart activities the following results were found:

- Recommended mitigation activities were more likely to be implemented by homeowners;
- Assessments were not 'wasted', but instead targeted, and benefitted, those who were already engaged in the FireSmart program and had proved that engagement by taking the first step in requesting the assessment, making the program more cost-effective; and,
- Assessments were useful in recruiting Community Champions into programs similar to the FireSmart Canada Community Recognition Program.[89,90]

Individual home assessments could be combined with education on other initiatives, such as a chipping program, free unlimited yard waste drop-off days, scheduled garden debris burning weekend, or upcoming FireSmart events. The program will be most effective if it evaluates hazard, as well as provides property owners the information they need to effectively reduce the hazard and methods to dispose of materials removed.

The recently launched SWPI FireSmart Grant Program provides funding of up to $10,000 to undertake FireSmart planning activities for private lands.

[88] http://gis.coloradosprings.gov/Html5Viewer/?viewer=wildfiremitigation. Colorado Springs, CO.

[89] Firewise Communities USA Recognition Program is the US equivalent to the FCCRP.

[90] Personal communication, Hillary Lundgren, Executive Director, Chumstick Wildfire Stewardship Coalition, May 8, 2017.

APPENDIX N: PRINCIPLES OF FUEL MANAGEMENT

Fuel or vegetation management is a key element of the FireSmart approach. Given public concerns, fuel management is often difficult to implement and must be carefully rationalized in an open and transparent process. Vegetation management should be strategically focused on minimizing impact while maximizing value to the community. The decision whether or not to implement vegetation management must be evaluated against other elements of wildfire risk reduction to determine the best avenue for risk reduction. The effectiveness of fuel treatments is dependent on the extent to which hazardous fuels are modified or removed and the treatment area size and location (strategic placement considers the proximity to values at risk, topographic features, existing fuel types, etc.) in addition to other site specific considerations. The longevity of fuels treatments varies by the methods used and site productivity.

What is fuel management?

Fuel management is the planned manipulation and/or reduction of living and dead forest fuels for land management objectives (*e.g.*, hazard reduction). Fuels can be effectively manipulated to reduce fire hazard by mechanical means, such as tree removal or modification, or abiotic means, such as prescribed fire. The goal of fuel management is to lessen potential fire behavior proactively, thereby increasing the probability of successful containment and minimizing adverse impacts to values at risk. More specifically, the goal is to decrease the rate of fire spread, and in turn reduce fire size and intensity, as well as crowning and spotting potential (Alexander, 2003).

Fire Triangle:

Fire is a chemical reaction that requires fuel (carbon), oxygen and heat. These three components make up the fire triangle and if one is not present, a fire will not burn. Fuel is generally available in adequate quantities in the forest. Fuel comes from living or dead plant materials (organic matter). Trees and branches lying on the ground are a major source of fuel in a forest. Such fuel can accumulate gradually as trees in the stand die. Fuel can also build up in large amounts after catastrophic events such as insect infestations. Oxygen is present in the air. As oxygen is used up by fire it is replenished quickly by wind. Heat is needed to start and maintain a fire. Heat can be supplied by nature through lightning or people can be a source through misuse of matches, campfires, trash fires and cigarettes. Once a fire has started, it provides its own heat source as it spreads through a fuel bed capable of supporting it.

Forest Fuels:

The amount of fuel available to burn on any site is a function of biomass production and decomposition. Many of the forest ecosystems within BC have the potential to produce large amounts of vegetation biomass. Variation in the amount of biomass produced is typically a function of site productivity and climate. The disposition or removal of vegetation biomass is a function of decomposition. Decomposition is regulated by temperature and moisture. In wet maritime coastal climates, the rates of decomposition are relatively high when compared with drier cooler

continental climates of the interior. Rates of decomposition can be accelerated naturally by fire and/or anthropogenic means.

A hazardous fuel type can be defined by high surface fuel loadings, high proportions of fine fuels (<1 cm) relative to larger size classes, high fuel continuity between the ground surface and overstory tree canopies, and high stand densities. A fuel complex is defined by any combination of these attributes at the stand level and may include groupings of stands.

Surface Fuels:

Surface fuels consist of forest floor, understory vegetation (grasses, herbs and shrubs, and small trees), and coarse woody debris that are in contact with the forest floor. Forest fuel loading is a function of natural disturbance, tree mortality and/or human related disturbance. Surface fuels typically include all combustible material lying on or immediately above the ground. Often roots and organic soils have the potential to be consumed by fire and are included in the surface fuel category.

Surface fuels that are less than 7 cm in diameter contribute to surface fire spread; these fuels often dry quickly and are ignited more easily than larger diameter fuels. Therefore, this category of fuel is the most important when considering a fuel reduction treatment. Larger surface fuels greater than 7 cm are important in the contribution to sustained burning conditions, but, when compared with smaller size classes, are often not as contiguous and are less flammable because of delayed drying and high moisture content. In some cases, where these larger size classes form a contiguous surface layer, such as following a windthrow event or wildfire, they can contribute an enormous amount of fuel, which will increase fire severity and the potential for fire damage.

Aerial Fuels:

Aerial fuels include all dead and living material that is not in direct contact with the forest floor surface. The fire potential of these fuels is dependent on type, size, moisture content, and overall vertical continuity. Dead branches and bark on trees and snags (dead standing trees) are important aerial fuels. Concentrations of dead branches and foliage increase the aerial fuel bulk density and enable fire to move from tree to tree. The exception is for deciduous trees where the live leaves will not normally carry fire. Numerous species of moss, lichens, and plants hanging on trees are light and easily ignited aerial fuels. All of the fuels above the ground surface and below the upper forest canopy are described as ladder fuels.

Two measures that describe crown fire potential of aerial fuels are the height to live crown and crown closure (Figure 29 and Figure 30). The height to live crown describes fuel continuity between the ground surface and the lower limit of the upper tree canopy. Crown closure describes the inter-tree crown continuity and reflects how easily fire can be propagated from tree to tree. In addition to crown closure, tree density is an important measure of the distribution of aerial fuels and has significant influence on the overall crown and surface fire conditions (Figure 31). Higher stand density is associated with lower inter tree spacing, which increases overall crown continuity. While high density stands may increase the potential for fire spread in the upper canopy, a combination of high crown closure and high stand density usually results in a reduction in light levels associated with these stand types. Reduced light levels accelerate self-tree pruning, inhibit the growth of lower branches, and decrease the cover and biomass of understory vegetation.

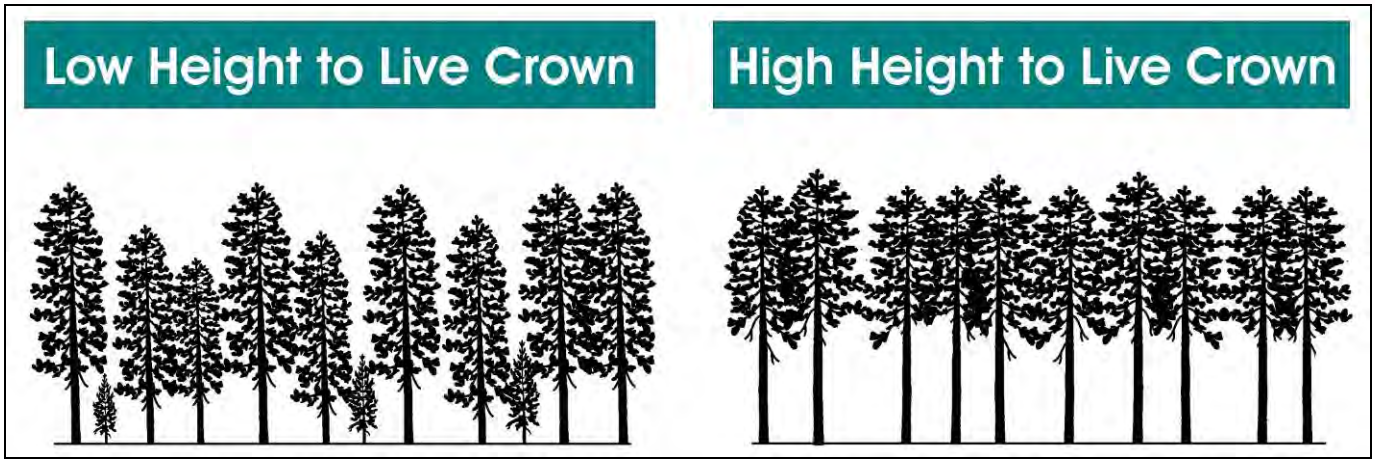


Figure 29. Comparison of stand level differences in height-to-live crown in an interior forest, where low height to live crown is more hazardous than high height to live crown.

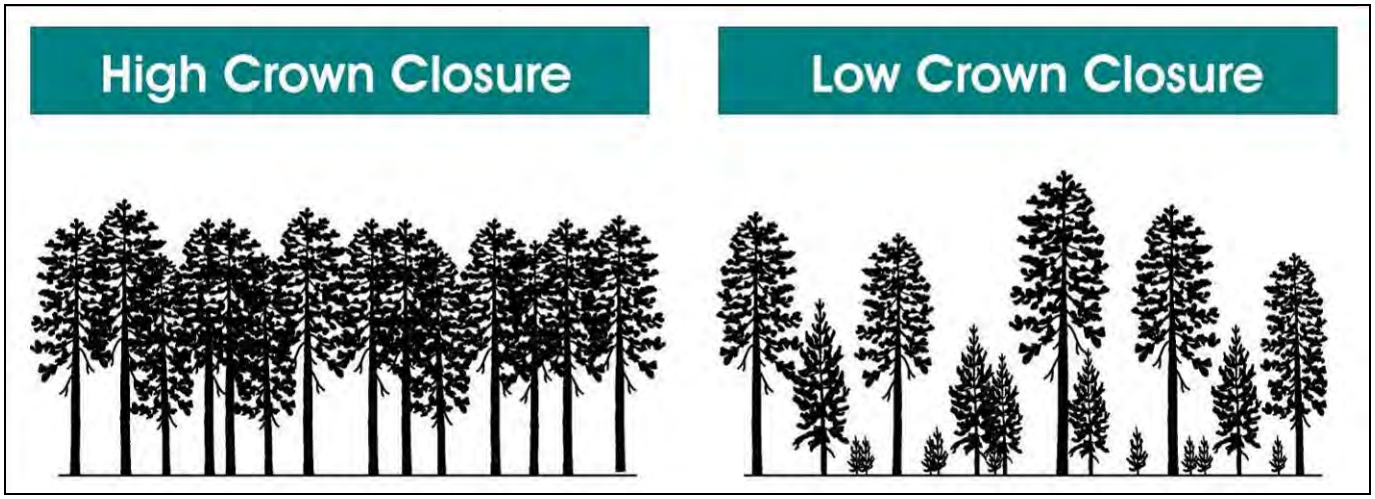


Figure 30. Comparison of stand level differences in crown closure, where high crown closure/continuity contributes to crown fire spread, while low crown closure reduces crown fire potential.

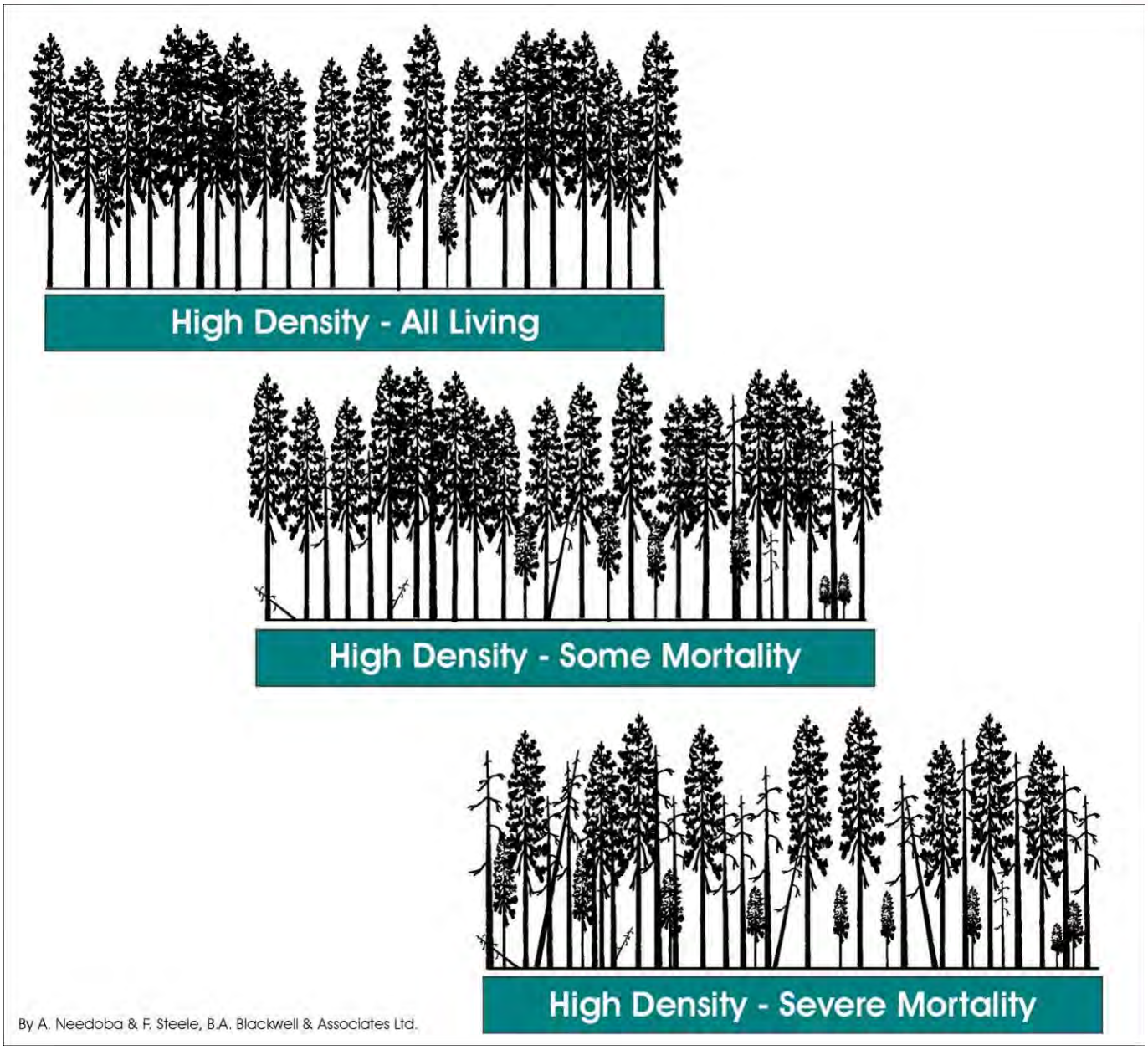


Figure 31. Comparison of stand level differences in density and mortality, and the distribution of live and dead fuels in these types of stands.

Thinning is a preferred approach to fuel treatment (Figure 33.) and offers several advantages compared to other methods:

- Thinning provides the most control over stand level attributes such as species composition, vertical structure, tree density, and spatial pattern, as well as the retention of snags and coarse woody debris for maintenance of wildlife habitat and biodiversity.
- Unlike prescribed fire treatments, thinning is comparatively low risk, and is less constrained by fire weather windows.

- Thinning may provide marketable materials that can be utilized by the local economy.
- Thinning can be carried out using sensitive methods that limit soil disturbance, minimize damage to leave trees, and provide benefits to other values such as wildlife.

The main wildfire objective of thinning is to shift stands from having a high crown fire potential to having a low surface fire potential. In general, the goals of thinning are to:

- Reduce stem density below a critical threshold to minimize the potential for crown fire spread;
- Prune to increase the height to live crown to reduce the potential of surface fire spreading into tree crowns; and
- Remove slash created by spacing and pruning to minimize surface fuel loadings while still maintaining adequate woody debris to maintain ecosystem function.

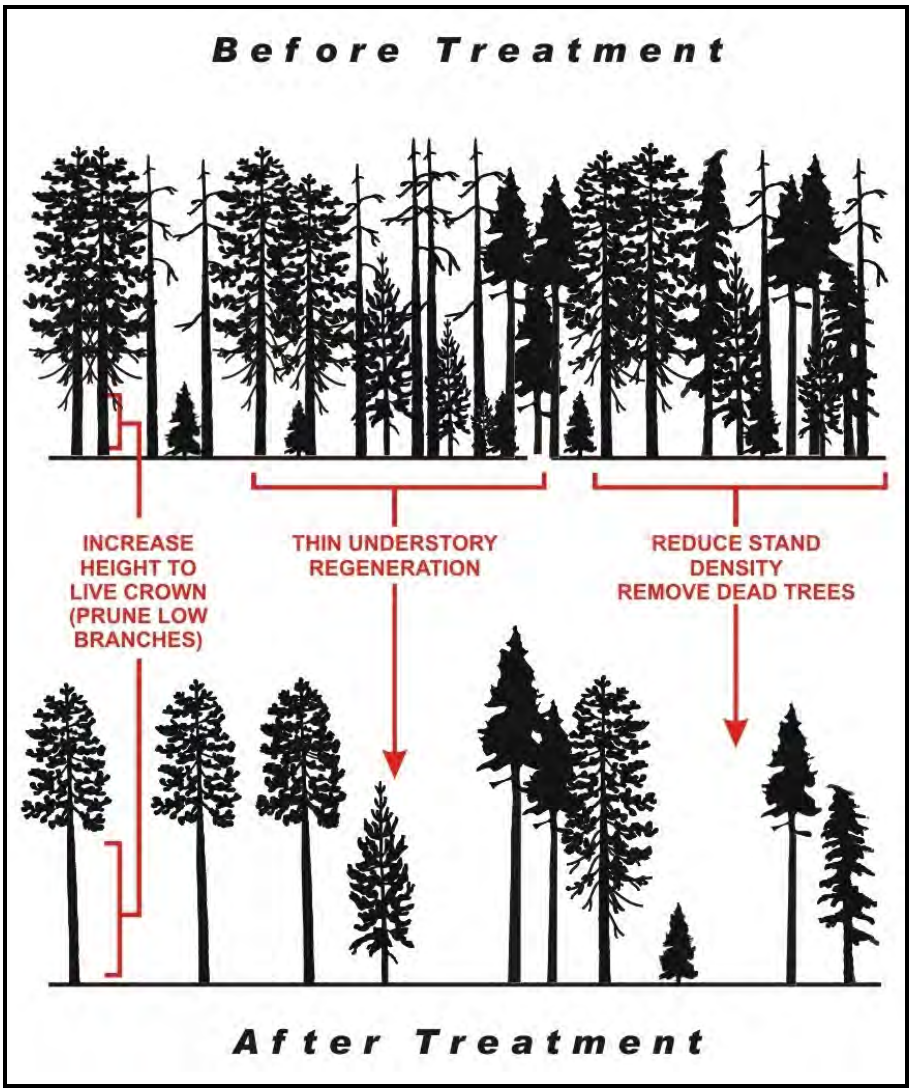


Figure 32. Illustration of the principles of thinning to reduce the stand level wildfire hazard.

Fuel type, weather and topography are all primary factors that influence the spread of fires. The three most important components of weather include wind, temperature and humidity. Fuel type and slope are primary concerns related to fire spread along the forested areas on the slopes surrounding the City. The steepness of a slope can affect the rate and direction a fire spreads and generally fires move faster uphill than downhill, and fire will move faster on steeper slopes. This is attributed to (MFLNRO, 2014):

- *On the uphill side, the flames are closer to the fuel;*
- *The fuels become drier and ignite more quickly than if on level ground;*
- *Wind currents are normally uphill and this tends to push heat flames into new fuels;*
- *Convected heat rises along the slope causing a draft which further increases the rate of spread; and*
- *Burning embers and chunks of fuel may roll downhill into unburned fuels, increasing spread and starting new fires.*

APPENDIX O: LANDSCAPE LEVEL FUELBREAK MANAGEMENT

The information contained within this section has been inserted from "The Use of Fuelbreaks in Landscape Fire Management" by James K. Agee, Benii Bahro, Mark A. Finney, Philip N. Omi, David B. Sapsis, Carl N. Skinner, Jan W. van Wagtendonk, and C. Phill Weatherspoon. This article succinctly describes the principles and use of fuelbreaks in landscape fire management.

The principal objective behind the use of fuelbreaks, as well as any other fuel treatment, is to alter fire behaviour over the area of treatment. As discussed above, fuelbreaks provide points of anchor for suppression activities.

Surface Fire Behaviour:

Surface fuel management can limit fireline intensity (Byram 1959) and lower potential fire severity (Ryan and Noste 1985). The management of surface fuels so that potential fireline intensity remains below some critical level can be accomplished through several strategies and techniques. Among the common strategies are fuel removal by prescribed fire, adjusting fuel arrangement to produce a less flammable fuelbed (e.g., crushing), or "introducing" live understory vegetation to raise average moisture content of surface fuels (Agee 1996). Wildland fire behaviour has been observed to decrease with fuel treatment (Buckley 1992), and simulations conducted by van Wagtendonk (1996) found both pile burning and prescribed fire, which reduced fuel loads, to decrease subsequent fire behaviour. These treatments usually result in efficient fire line construction rates, so that control potential (reducing "resistance to control") can increase dramatically after fuel treatment.

The various surface fuel categories interact with one another to influence fireline intensity. Although more litter and fine branch fuel on the forest floor usually results in higher intensities; however, that is not always the case. If additional fuels are packed tightly (low fuelbed porosity), they may result in lower intensities. Although larger fuels (>3 inches) - are not included in fire spread models, as they do not usually affect the spread of the fire (unless decomposed [Rothennel 1991]), they may result in higher energy releases over longer periods of time when a fire occurs, having significant effects on fire severity, and they reduce rates of fireline construction.

The effect of herb and shrub fuels on fireline intensity is not simply predicted. First of all, more herb and shrub fuels usually imply more open conditions. These should be associated with lower relative humidity and higher surface windspeeds. Dead fuels may be drier - and the rate of spread may be higher - because of the altered microclimate compared to more closed canopy forest with less understory. Live fuels, with higher foliar moisture while green, will have a dampening effect on fire behaviour. However, if the grasses and forbs cure, the fine dead fuel can increase fireline intensity and localized spotting.

Conditions That Initiate Crown Fire:

A fire moving through a stand of trees may move as a surface fire, an independent crown fire, or as a combination of intermediate types of fire (Van Wagner 1977). The initiation of crown fire behaviour is a function of surface fireline intensity and of the forest canopy: its height above ground and moisture content (Van Wagner 1977). The critical surface fire intensity needed to initiate crown fire behaviour can be calculated for a range of crown base heights and foliar moisture contents, and represents the minimum level of fireline intensity necessary to initiate crown fire (Table 1); Alexander 1988, Agee 1996). Fireline intensity or flame length below this critical level may result in fires that do not crown but may still be of stand replacement severity. For the limited range of crown

base heights and foliar moistures shown in Table 11, the critical levels of flame length appear more sensitive to height to crown base than to foliar moisture (Alexander 1988).

Table 21. Flame lengths associated with critical levels of fireline intensity that are associated with initiating crown fire, using Byram's (1959) equation.

Foliar Moisture Content (%)	Height of Crown Base Separation			
	2 meters	6 meters	12 meters	20 meters
	6 feet	20 feet	40 feet	66 feet
	M (ft)	M (ft)	M (ft)	M (ft)
70	1.1 (4)	2.3 (8)	3.7 (12)	5.3 (17)
80	1.1 (4)	2.5 (8)	4.0 (13)	5.7 (19)
90	1.3 (4)	2.7 (9)	4.3 (14)	6.1 (20)
100	1.3 (4)	2.8 (9)	4.6 (15)	6.5 (21)
120	1.5 (5)	3.2 (10)	5.1 (17)	7.3 (24)

If the structural dimensions of a stand and information about foliar moisture are known, then critical levels of fireline intensity that will be associated with crown fire for that stand can be calculated. Fireline intensity can be predicted for a range of stand fuel conditions, topographic situations such as slope and aspect, and anticipated weather conditions, making it possible to link on-the-ground conditions with the initiating potential for crown fires. In order to avoid crown fire initiation, fireline intensity must be kept below the critical level. Managing surface fuels can accomplish this, such that fireline intensity is kept well below the critical level; raising crown base heights such that the critical fireline intensity is difficult to reach is another option. In the field, the variability in fuels, topography and microclimate will result in varying levels of potential fireline intensity, critical fireline intensity, and therefore, varying crown fire potential.

Conditions That Allow Crown Fire to Spread:

The crown of a forest is similar to any other porous fuel medium in its ability to burn and the conditions under which crown fire will or will not spread. The heat from a spreading crown fire into unburned crown ahead is a function of the crown rate of spread, the crown bulk density, and the crown foliage ignition energy. The crown fire rate of spread is not the same as the surface fire rate of spread, and often includes effects of short-range spotting. The crown bulk density is the mass of crown fuel, including needles, fine twigs, lichens, etc., per unit of crown volume (analogous to soil bulk density). Crown foliage ignition energy is the net energy content of the fuel and varies primarily by foliar moisture content, although species differences in energy content are apparent (van Wagtendonk et al. 1998). Crown fires will stop spreading, but not necessarily stop torching, if either the crown fire rate of spread or crown bulk density falls below some minimum value.

If surface fireline intensity rises above the critical surface intensity needed to initiate crown fire behaviour, the crown will likely become involved in combustion. Three phases of crown fire behaviour can be described by critical levels of surface fireline intensity and crown fire rates of spread (Van Wagner 1977, 1993): 1) a passive crown fire, where the crown fire rate of spread is equal to the surface fire rate of spread, and crown fire activity is limited to individual tree torching; 2) an active crown fire, where the crown fire rate of spread is above some

minimum spread rate; and 3) an independent crown fire, where crown fire rate of spread is largely independent of heat from the surface fire intensity. Scott and Reinhardt (in prep.) have defined an additional class, 4) conditional surface fire, where the active crowning spread rate exceeds a critical level, but the critical level for surface fire intensity is not met. A crown fire will not initiate from a surface fire in this stand, but an active crown fire may spread through the stand if it initiates in an adjacent stand.

Critical conditions can be defined as the level below which active or independent crown fire spread is unlikely. To derive these conditions, visualize a crown fire as a mass of fuel being carried on a "conveyor belt" through a stationary flaming front. The amount of fine fuel passing through the front per unit time (the mass flow rate) depends on the speed of the conveyor belt (crown fire rate of spread) and the density of the forest crown fuel (crown bulk density). If the mass flow rate falls below some minimum level (Van Wagner 1977) crown fires will not spread. Individual crown torching, and/or crown scorch of varying degrees, may still occur.

Defining a set of critical conditions that may be influenced by management activities is difficult. At least two alternative methods can define conditions such that crown fire spread would be unlikely (that is, mass flow rate is too low). One is to calculate critical windspeeds for given levels of crown bulk density (Scott and Reinhardt, in prep.), and the other is to define empirically derived thresholds of crown fire rate of spread so that critical levels of crown bulk density can be defined (Agee 1996). Crown bulk densities of 0.2 kg m^{-3} are common in boreal forests that burn with crown fire (Johnson 1992), and in mixed conifer forests, Agee (1996) estimated that at levels below 0.10 kg m^{-3} crown fire spread was unlikely, but no definitive single "threshold" is likely to exist.

Therefore, reducing surface fuels, increasing the height to the live crown base, and opening canopies should result in a) lower fire intensity, b) less probability of torching, and c) lower probability of independent crown fire. There are two caveats to these conclusions. The first is that a grassy cover is often preferred as the fuelbreak ground cover, and while fireline intensity may decrease in the fuelbreak, rate of spread may increase. Van Wagtendonk (1996) simulated fire behaviour in untreated mixed conifer forests and fuelbreaks with a grassy understory, and found fireline intensity decreased in the fuelbreak (flame length decline from 0.83 to 0.63 m [2.7 to 2.1 ft]) but rate of spread in the grassy cover increased by a factor of 4 (0.81 to 3.35 m/min [2.7-11.05 ft/min]). This flashy fuel is an advantage for backfiring large areas in the fuelbreak as a wildland fire is approaching (Green 1977), as well as for other purposes described later, but if a fireline is not established in the fuelbreak, the fine fuels will allow the fire to pass through the fuelbreak quickly. The second caveat is that more open canopies will result in an altered microclimate near the ground surface, with somewhat lower fuel moisture and higher windspeeds in the open understory (van Wagtendonk 1996).

Fuelbreak Effectiveness:

The effectiveness of fuelbreaks continues to be questioned because they have been constructed to varying standards, "tested" under a wide variety of wildland fire conditions, and measured by different standards of effectiveness. Green (1977) describes a number of situations where traditional fuelbreaks were successful in stopping wildland fires, and some where fuelbreaks were not effective due to excessive spotting of wildland fires approaching the fuelbreaks.

Fuelbreak construction standards, the behaviour of the approaching wildland fire, and the level of suppression each contribute to the effectiveness of a fuelbreak. Wider fuelbreaks appear more effective than narrow ones. Fuel treatment outside the fuelbreak may also contribute to their effectiveness (van Wagtendonk 1996). Area treatment such as prescribed fire beyond the fuelbreak may be used to lower fireline intensity and reduce spotting as a wildland fire approaches a fuelbreak, thereby increasing its effectiveness. Suppression forces must be willing and able to apply appropriate suppression tactics in the fuelbreak. They must also know that the fuelbreaks exist, a common problem in the past. The effectiveness of suppression forces depends on the level of funding for people, equipment, and aerial application of retardant, which can more easily reach surface fuels in a fuelbreak. Effectiveness is also dependent on the psychology of firefighters regarding their safety. Narrow or unmaintained fuelbreaks are less likely to be entered than wider, well-maintained ones.

No absolute standards for width or fuel manipulation are available. Fuelbreak widths have always been quite variable, in both recommendations and construction. A minimum of 90 m (300 ft) was typically specified for primary fuelbreaks (Green 1977). As early as the 1960's, fuelbreaks as wide as 300 m (1000 ft) were included in gaming simulations of fuelbreak effectiveness (Davis 1965), and the recent proposal for northern California national forests by the Quincy Library Group (see web site http://www.qlg.org for details) includes fuelbreaks 390 m (0.25 mi) wide. Fuelbreak simulations for the Sierra Nevada Ecosystem Project (SNEP) adopted similar wide fuelbreaks (van Wagtendonk 1996, Sessions et al. 1996).

Fuel manipulations can be achieved using a variety of techniques (Green 1977) with the intent of removing surface fuels, increasing the height to the live crown of residual trees, and spacing the crowns to prevent independent crown fire activity. In the Sierra Nevada simulations, pruning of residual trees to 3 m (10 ft) height was assumed, with canopy cover at 1-20% (van Wagtendonk 1996). Canopy cover less than 40% has been proposed for the Lassen National Forest in northern California. Clearly, prescriptions for creation of fuelbreaks must not only specify what is to be removed, but must describe the residual structure in terms of standard or custom fuel models so that potential fire behaviour can be analyzed.