# District of Mackenzie Community Wildfire Protection Plan 2017 Update


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# EXECUTIVE SUMMARY/ SUMMARY OF CWPP RECOMMENDATIONS

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 Strategic Wildfire Prevention Working Group, CWPPs aim to develop strategic recommendations to assist in improving safety and to reduce the risk of damage to property from wildfires.

This document intends to update the 2005 District of Mackenzie CWPP document, and to 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 CWPP will provide the District of Mackenzie with a framework that can be used to review and assess areas of identified high fire risk. Additionally, the information contained in this report should help to guide the development of emergency plans, emergency response, communication and education programs, bylaw development in areas of fire risk, and the management of forest lands adjacent to the community.

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 aimed at reducing wildfire losses.

Since the development of the last CWPP in 2005, the District of Mackenzie has made progress at implementing recommendations from the CWPP. The most notable actions include implementation of the following[2]:

- Enacting specific sections of the Wildfire Act and Wildfire Regulation by introducing and adopting a Fire Protection Services Bylaw, in March, 2010 (High Priority Recommendation #1)
- Fuel treatment on approximately 325 ha of land surrounding the community and development in Gantahaz (High Priority Recommendation #2)
- Provision of specialized training to local fire department staff for Interface Fire Response (Medium Priority #2)
- Coordination with the McLeod Lake Mackenzie Community Forest (MLMCF) for urban wildland interface management and inclusion of fire abatement objectives as part of the MLMCF Forest Management Plan (Medium Priority #3)
- Establishment of fuel treatment specific prescription stocking standards as part of the MLMCF Forest Stewardship Plan (2016-2021), that promote the retention and acceptance of broadleaf

[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 from the 2005 CWPP can be found in Appendix D – Summary of 2005 CWPP Recommendations.

species to reduce fuel loading and wildfire risk within identified forest development units (Low Priority #7).

Wildfire management requires a multi-faceted approach for greatest efficacy and risk reduction outcomes. A total 37 strategic recommendations in various categories are outlined as part of this CWPP update. Because the study area extends outside the District boundary onto private land and therefore outside District jurisdiction, the District's role may be limited to the role of an 'influencer' in some instances, while other recommendations can be directly implemented by Mackenzie. The recommendations are displayed in totality in Table 1. Ultimately, the recommendations within this strategy should be considered a 'toolbox' 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 District of Mackenzie will have to further prioritize based on resources, strengths, constraints, and availability of funding and regularly update the prioritization and course of action as variables change through time.

**Table 1. Summary of CWPP Recommendations by Document Section**

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| **Section 5: Risk Management and Mitigation Factors** | | | |
| **Objective:** Reduce wildfire threat on public lands through fuel management. | | | |
| 1 | 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.[3] | UBCM SWPI Funding[4] / Municipal Funding (UBCM funds up to 75% of prescription development cost) or other funding sources (biomass energy technologies) |

[3] Note: Due to identified local variability in prevailing wind conditions, it is recommended that additional weather monitoring stations be established in the industrial area of the District of Mackenzie and the satellite development of Gantahaz in order to better inform and guide future proposed treatments and local fire threat reduction recommendations.

[4] Note: The SWPI funding stream may evolve into a new program and/or be assimilated into an existing government program, as per recommendations from the 2017 BC Flood and Wildfire Review Report by Abbott and Chapman (https://bcfloodfirereview.ca/wp-content/uploads/2018/05/BC-Flood-and-Wildfire-Review-Addressing-the-New-Normal-21st-Century-Disaster-Management-in-BC-Web.pdf). Changes incurred to the SWPI funding stream are anticipated to be revealed by October 31, 2018 by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (https://news.gov.bc.ca/releases/2018FLNR0114-000880). For the purpose of clarity, SWPI funding within this Plan refers both to the current and future funding streams, to accommodate potential future program development and/or changes.

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 2 | High | Consider developing a rationale for reduced stocking standards applicable to the District of Mackenzie AOI, by employing a qualified wildfire management professional, and in consultation with the Fuel Management Specialist (Prince George Fire Centre) and MFLNRORD. Engage partners such as the MLMCF, CONIFEX, BC Timber Sales and all other licensees to apply the MFLNRORD approved reduced fire management stocking standards in the AOI to reduce interface wildfire threat. | $3,000 |
| **Objective:** Maintain previously treated areas under an acceptable level of wildfire fire threat (moderate). | | | |
| 3 | High | Apply for funding for maintenance activities prioritized and scheduled in this CWPP. | UBCM SWPI Funding/ Municipal Funding |
| 4 | Moderate | Monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise. | UBCM SWPI Funding/ Municipal Funding |
| **Objective:** Improve emergency access / egress and public safety in the event of an evacuation through reduction of hazardous fuels / landscape level fuel treatment. | | | |
| 5 | High | The District should work with the Ministry of Transportation and Infrastructure (MOTI), MFLNRORD, and the Regional District of Fraser Fort George (RDFFG) to assess the entirety of Hwy 39 and reduce hazardous fuels within 100 m of either side of the road, where possible. This is to increase public safety / improve emergency access in the event of an evacuation or wildfire event. | FESBC funding; person hours are dependent upon District role within the project |
| **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). | | | |
| 6 | High | Review the Official Community Plan (OCP); consider including wildfire as a natural hazard development permit area. A recommended development permit (DP) area for the District of Mackenzie would include all areas within the District Boundary that are located within 50 m of high and extreme wildfire behaviour threat class areas. Review similar DPs established in other jurisdictions and use as models for various aspects of the DP process. Detailed information about related DP objectives and requirements are provided in Section 5.2.2, Table 18. | ~40-80 hours |
| 7 | High | Ensure that DP permit applications are provided to Mackenzie Fire Department for opportunity for input prior to approval. As more wildfire DP applications are received, the importance of communication and integration between Mackenzie Fire Department (MFD) and the Planning Department will increase. | Dependent on the number of DP applications |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 8 | 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 Permit within the applicable 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 Municipal Office 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 |
| 9 | Moderate | Consider engaging the development/ building community (may include developers, builders, landscapers, and architects) in DP development process. Additional detail on recommended engagement approaches is provided in Section 5.2.2, Table 18. | ~40 hours |
| 10 | Moderate | Review Subdivision Bylaw No. 780, 1993, with consideration towards:<br>1) Sufficient emergency access and egress.<br>2) Emergency response access, specifically working towards minimizing long cul-de-sacs, and allowing emergency vehicle turn around.<br>3) Hydrant placement to ensure that the Bylaw includes hydrant placement (and spacing) standards acceptable to the District and to allow for effective fire suppression. | ~30-40 hours per development |
| 11 | Moderate | Review water availability for new developments in rural settings. All new developments within the Fire Service Area should meet the minimum requirements for water availability, as set out in NFPA 1142. | ~5 - 10 hours per development |
| **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. | | | |
| 12 | High | This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings. | 1 – 6 hours, depending on method of distribution |
| 13 | High | Periodic 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 Mackenzie'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 / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 14 | High | Review current social media effectiveness and develop a social media strategy to ensure that its full power 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, evacuations, and other real-time information in an accurate and timely manner. | ~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. |
| 15 | High | Continue to 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. | ~4 hours. May be eligible for UBCM/ SWPI grant. |
| 16 | High | Work towards recognition as a FireSmart community and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications. | FireSmart Grant (when funding is available). |
| 17 | Moderate | Facilitate the FSCCRP uptake within the District and enhance its applications by including the following: 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 |
| 18 | Moderate | Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk.[5] | ~1.5 hours / assessment |

[5] FireSmart Home Partners Program. https://www.livefiresmart.ca/firesmart-home-partners-program/

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 19 | Moderate | Encourage schools 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) (Mackenzie Fire Zone), as well as MFD 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 (field trips, guest speakers, *etc*.). | ~20 - 40 hours |
| **Objective:** To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding proactive WUI risk mitigation activities. | | | |
| 20 | Very High | Develop and work with all key stakeholders (Industrial operators, Community Forest Representatives, MFLNRORD, BCWS, recreational groups / representatives, District staff) to formalize an Interface Steering Committee. 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) Development of large, landscape level fuel breaks; 2) Public education and awareness needs; 3) Multi-disciplinary, multi-jurisdictional fuel treatment projects / hazard abatement projects; 4) Development of a funding strategy; and, 5) 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 |
| **Objective:** To reduce the risk of ignition from industrial sources. | | | |
| 21 | High | Work with industrial operators to ensure that industrial sawdust piles are properly disposed of or utilized, so as to reduce fire hazard within the industrial area. Work with industrial operators to ensure that high risk activities, such as grubbing/brushing work are restricted during high fire danger times to reduce chance of ignitions. Industrial operators include CN Rail, BC Hydro, Fortis BC, CANFOR and CONIFEX and other private land holders. | 2 - 4 hours |
| 22 | 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 CN Rail, BC Hydro, and private land holders. | 2 - 4 hours |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 23 | 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 low to moderate hazard state and dead, fine fuel accumulations do not occur. Generally, ensure the transmission right-of-ways are in low or moderate hazard state and serve as fuel breaks. | 2 - 4 hours |
| **Section 6: Wildfire Response** | | | |
| **Objective:** To improve access and egress and enhance emergency preparedness. | | | |
| 24 | High | Complete / participate in regular testing of, and updates to, the evacuation plan. | ~ 30 - 40 hours to plan and stage; 8 hours to complete testing |
| 25 | High | Consider developing a community wildfire pre-planning brochure that addresses the following: 1) locations of staging areas 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of the area of interest. | ~ $10,000 - $15,000 budget to complete (contractor estimate) |
| **Objective:** To expand the view of the trail system to include one with a wildfire lens. | | | |
| 26 | High | Develop a Total Access Plan for the District to create, map and inventory trail and road network in natural areas for suppression planning, identification of areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and / or changes. | ~ Budget of $8,000-10,000 to build plan, map, populate attributes, and update (contractor estimate). |
| 27 | High | Include a qualified professional with experience in operational wildland / interface fire suppression in the planning and strategic siting of future trails and parks. | 10 – 20 hours to review current trails / map, provide recommendations |
| **Objective**: To improve structural and wildfire equipment and training available to Mackenzie Fire Department. | | | |
| 28 | High | The District should work on continuing annual cross training opportunities with BCWS. Interface training could include completion of a mock wildfire simulation in coordination with BCWS. Training could be coordinated with other fire departments in the area to enhance regional firefighting capabilities. It is recognized that BCWS crew resources are limited and their availability and is highly dependent upon the current fire season and other BCWS priorities. | Cost and time dependent upon training exercise (scope, number of participating members, etc.). |
| 29 | High | Continue to engage in regular cadence of communication with the BCWS Mackenzie Fire Zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities. | ~4 hours / year |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| 30 | High | Ensure that the District maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs). The OFC is currently developing additional wildfire-specific Officer-level training courses; the District 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 (NFPA 1051, equivalent to SPP-WFF 1 currently implemented, and inhouse training for SPP-115). |
| 31 | High | Review the 2017 fire season local/regional application of fire bans, motorized vehicle and/or back country bans (on Crown and private land) and the potential for implementing an evacuation alert/order. Identify potential improvements for future application and develop a sound protocol for execution. | ~2 – 6 hours |
| **Objective:** Improve the FireSmart conditions of Mackenzie by encouraging home and property owners to voluntarily increase FireSmart compliance and improve suppression abilities for interface areas. | | | |
| 32 | High | Consider working with Mackenzie local distributors (i.e., hardware stores, garden centres, and aggregate providers) and homeowners within the Gantahaz/Gagnon areas. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Initiatives may include:<br>1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions / advice for homeowners.<br>2) Advocating for a FireSmart branding in the retail stores to increase public exposure to projects that can be done at a relatively low cost.<br>3) Compile a database of local service providers and retailers which can help to install or complete FireSmart home improvements. | ~60 hours |
| 33 | High | Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. Programs may include scheduled community chipping opportunities, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends. Programs should be available during times of greatest resident activity (likely spring and fall). | Time dependent upon program. May be eligible for UBCM/ SWPI grant. Additional time for advertisement of program availability will be required. |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($) or Person hours |
|---|---|---|---|
| **Objective:** Enhance protection of critical municipal infrastructure from wildfire. | | | |
| 34 | High | Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized. | ~20 hours to complete vulnerability assessment and upgrading dependent upon project(s) chosen |
| 35 | High | Consider completing a fire flow / water vulnerability assessment for each water system to identify and map all viable alternative water sources (reservoirs, streams, lakes, etc.). Identify areas where water availability may be improved and provide recommendations to reduce District's vulnerability. | $10,000 |
| 36 | High | Consider updating the District of Mackenzie Hazard Risk and Vulnerability Assessment (2005) by conducting detailed hazard assessments and proactively (in advance of wildfire) developing response plans for stabilization and rehabilitation of burn areas in watersheds that are vulnerable to post-wildfire debris flows and floods. | $25,000 |
| **Objective:** Enhance protection of critical municipal infrastructure from wildfire. | | | |
| 37 | High | Complete the acquisition of the Type 2 SPU for the District of Mackenzie. | $100,000-$150,000 depending on configuration. |

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# COMMONLY USED ACRONYMS

| | |
|---|---|
| AOI | Area of Interest |
| BCWS | British Columbia Wildfire Service |
| BEC | Biogeoclimatic Ecosystem Classification |
| CFFDRS | Canadian Forest Fire Danger Rating System |
| CWPP | Community Wildfire Protection Plan |
| DP | Development Permit |
| FBP | Fire Behaviour Prediction System |
| FESBC | Forest Enhancement Society of British Columbia |
| FMP | Fire Management Plan |
| FSCCRP | FireSmart Canada Community Recognition Program |
| HIZ | Home Ignition Zone |
| MFD | Mackenzie Fire Department |
| MFLNRORD | Ministry of Forests, Lands, Natural Resource Operations, and Rural Development |
| MLIB | McLeod Lake Indian Band |
| MLMCF | McLeod Lake Mackenzie Community Forest |
| MOTI | Ministry of Transportation and Infrastructure |
| NFPA | National Fire Protection Agency |
| OFC | Office of the Fire Commissioner |
| PSTA | Provincial Strategic Threat Analysis |
| RDFFG | Regional District of Fraser Fort George |
| SWPI | Strategic Wildfire Prevention Initiative |
| TSA | Timber Supply Area |
| UBCM | Union of British Columbian Municipalities |
| WUI | Wildland Urban Interface |

# SECTION 1: INTRODUCTION

In 2017, B.A. Blackwell and Associates Ltd. was retained to assist the District of Mackenzie (the District) to develop an update to the Community Wildfire Protection Plan (CWPP). The previous CWPP was developed in 2005 and was titled *District of Mackenzie Community Wildfire Protection Plan 2005* (hereinafter referred to as the 2005 CWPP). The District staff recognized that there have been significant changes since 2005, which have a direct impact on wildfire mitigation activities and programs. These changes include: the creation of the McLeod Lake Mackenzie Community Forest (MLMCF) in 2009; implementation of new bylaws regarding development and planning; fuel treatments completed; new development; and changes in fuels and forest health surrounding the community.

The data and methodology used to assess wildfire threat have also been updated since the initial 2005 CWPP was developed. Specifically, the Provincial Strategic Threat Analysis (PSTA) data has been updated by the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (MFLNRORD). The wildfire threat analysis methodology has also been updated and improved since the original CWPP was produced.

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 which was included in the 2005 document, and which remains integral to the comprehension of this CWPP update, is provided in Appendix D.

Although forest fires are both inevitable and essential to the health of forested ecosystems, the 2003, 2004, 2009, 2010, 2015, and 2017 wildfire seasons resulted in significant economic, social and environmental losses in BC. The 2017 BC wildfire season was the most extensive, in terms of area burned, and although final suppression costs for the 2017 season have not yet been made public, it is expected to be the most expensive season on record for suppression costs, with the most recent estimate indicating a cost of approximately $550 million[6]. This is before counting additional costs (i.e., to support evacuees, small businesses, and insurance claims for losses), rehabilitation costs and indirect long-term costs. Recent wildfire disasters like those experienced in Slave Lake, Alberta (2011), Washington State (2014 and 2015), Fort McMurray, Alberta (2016) and BC and California (2017) all display 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

[6] Total Fire Cost: the Rationale and Value of Increased Investment in Prevention.
http://www.emaofbc.com/wp-content/uploads/2017/11/Total-Fire-Cost_rwg.pdf

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[7] (WUI).

## 1.1 PURPOSE

The purpose of this CWPP is to identify and update the wildfire risks within and surrounding the District of Mackenzie, to describe the potential consequences if a wildfire was to impact the community, and to examine options and strategies to reduce the wildfire risks. 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 District of Mackenzie a current and accurate understanding of the threats faced by their community to human life, property and critical infrastructure from wildfires. The goal of this CWPP, in addition to defining the threats, is to identify measures necessary to mitigate these threats, and outline a plan of action for implementing these measures.

Specifically, the CWPP update is intended to serve as a framework to inform the implementation of specific actions and strategies that will serve to:

1) Provide the District with an updated threat assessment considering new development, changes in forest health and fuels, and mitigative actions taken by the District;
2) Refresh and prioritize mitigative action recommendations to address communication and education, structure protection, emergency response, planning and development, and fuel management;
3) Provide a maintenance plan for those areas within which fuel management has occurred;
4) Identify and prioritize potential treatment areas to help protect values at risk and reduce the chance of structure/ infrastructure loss or damage in the event of an interface fire;
5) Assist the District of Mackenzie and its residents to become better adapted to wildfires that may occur, and be more resilient (i.e., able to bounce back more quickly) when they do.

## 1.2 CWPP PLANNING PROCESS

This CWPP document will review the background information related to the study area which envelopes the District Boundary and a two-kilometer spotting buffer. The planning process and approach that was used in developing this CWPP consists of four general phases:

1) **Consultation involving key local government representatives, structural and wildfire specialists, stakeholders**. Information sharing with First Nations at various stages of the Plan development and ensuring linkages with relevant existing land use plans, legislation, and policy currently in place.

[7] 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).

2) **Identification of the values at risk and assessment of the local wildfire threat**. Wildfire threat assessment takes into consideration Natural Fire Regime and Ecology, Provincial Strategic Threat Analysis (2015), and field work, fuel type verification, completion of WUI Threat Forms and GIS wildfire threat analyses.
3) **Developing a risk mitigation strategy**. A guide for the District to implement mitigation and risk reduction activities. The risk mitigation strategy accounts for prioritization of fuel treatments, FireSmart Activities, and wildfire response recommendations that will reduce wildfire threat locally. and
4) **Building a community engagement and education strategy**. This phase includes presentation of the CWPP update to the Board or Council, and engagement of District staff and representatives from the Mackenzie Natural Resource District, McLeod Lake Mackenzie Community Forest, BC Wildfire Service (BCWS), and the McLeod Lake Indian Band. Other key stakeholders, such as the Land and Resource Specialist, Stewardship Forester, and Tenures Officer, were contacted and provided input into the plan. Additionally, this phase provides recommendations for informing and engaging the public and community members regarding wildfire hazard and provides steps that can be taken to reduce threat on private properties.

These four phases of the planning process are detailed below.

### 1.2.1 Consultation

Broad engagement with local government, Provincial government landowner representatives, stakeholders and First Nations played a key role in developing this CWPP.

The first step in the consultation process was to assemble the key players in a 'Wildfire Working Group'; the District hosted the initial meeting. Key internal District staff (representatives from the planning and bylaw departments), local fire officials (fire chief, deputy fire chief,) and key stakeholders, such as the McLeod Lake Mackenzie Community Forest and BCWS staff (fuels management specialist and Mackenzie Zone representatives) participated in the steering committee. The objective was to obtain information on wildfire risk mitigation initiatives currently in place or completed, existing plans and policies, current resources, identify areas of concern, identify District vulnerabilities, and to determine priorities and potential mitigation strategies. Members of the Working Group were consulted on an ongoing basis throughout plan development and were integral in providing Plan review and approval.

BCWS representatives from Mackenzie Fire Zone and Fire Centre (Fuel Management Specialist) were consulted as follows: 1) at the onset of the project planning phase through involvement in the Wildfire Working Group meeting attended by Key Stakeholders; 2) throughout the CWPP update development process, both via the submission of Fuel Type Change Rationales and questionnaire regarding concerns and priorities of BCWS with respect to wildfire and emergency planning in the District of Mackenzie; and 3) revision of draft document upon plan completion.

Information sharing took place with the McLeod Lake Indian Band as identified through the Consultative Areas Database and in consultation with MFLNRORD, regarding the CWPP and locations or potential for

possible cultural values at risk requiring protection consideration. Information sharing consisted of an initial phone call, and subsequent distribution of a referral letter and information package (maps, explanation of CWPP, and CWPP draft). The McLeod Lake Indian Band provided Plan review and feedback, which helped to inform Section 3.3 and other sections of the document.

Additional stakeholders were consulted to identify synergies, opportunities for collaboration, and ensure linkages with adjacent and overlapping planning. These stakeholders included a technical review committee made up of Mackenzie Natural Resource District Staff and MFLNRORD Omineca Region staff such as the Land Manager, Land and Resource Specialist, Stewardship Forester, Resource Manager, Tenure Officer and Ecosystem Biologist.

Combined, these various consultation and engagement opportunities have generated a shared understanding of the CWPP objectives and expected outcomes among local government, stakeholders, residents and land managers.

### 1.2.2 Identification of Values at Risk and Local Wildfire Threat Assessment

The risks associated with wildfire must be clearly identified and understood before a CWPP can define strategies or actions to mitigate risks. The identified values at risk are described in Section 3. The wildfire threat in the District of Mackenzie was assessed through a combination of the following approaches:

- Natural fire regime and ecology (Section 4.1);
- Provincial Strategic Threat Analysis (section 4.2); and
- Local wildfire threat analysis (Section 4.3).

The relationship between wildfire hazard, threat and risk is defined as follows:

$$Wildfire\ risk\ =\ Probability\ x\ Consequence$$

Where:

- Wildfire risk is defined as the potential losses incurred to human life, property and critical infrastructure within a community in the event of a wildfire;
- Probability is the likelihood of fire occurring in an area and is related to the susceptibility of an area to fire (fuel type, climate, probability of ignition etc.); and
- Consequences refer to the repercussions associated with fire occurrence in a given area (higher consequences are associated with densely populated areas, or areas of high biodiversity etc.).

### 1.2.3 Development of a Risk Management Strategy

An effective risk management strategy was developed considering a full range of activities relating to the following:

- Fuel management;
- FireSmart planning and activities;

- Community communication and education;
- Other prevention measures;
- Structure protection and planning (i.e., FireSmart activities);
- Emergency response and preparedness;
- Evacuation and access; and
- Planning and development.

### 1.2.4 Building Community Engagement and Education Strategy

Engaging the community from local government staff and officials, to key stakeholders and residents in wildfire protection planning activities is crucial to ensuring successful implementation. A community engagement and education strategy is described in Section 5.3.

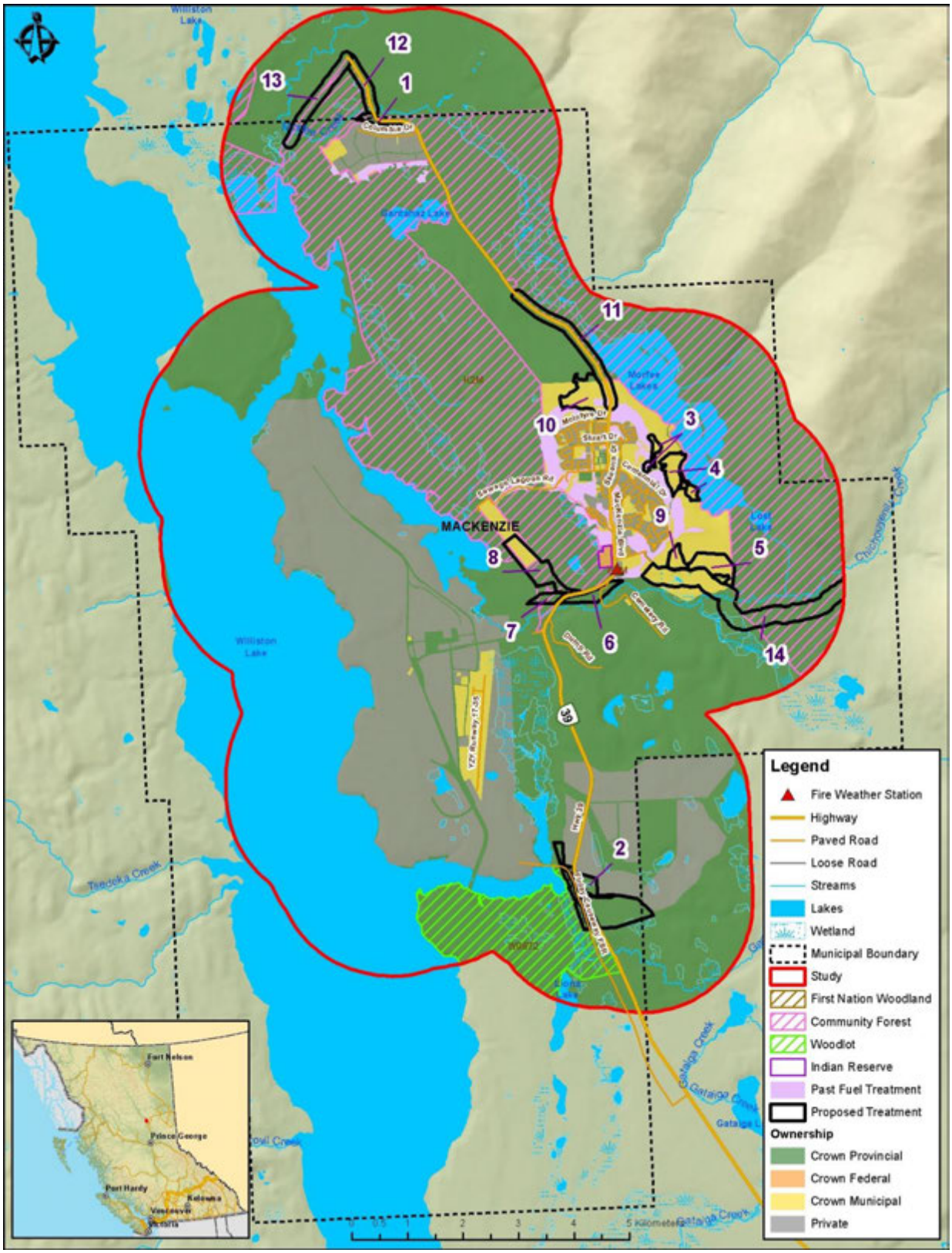
A future presentation to Council will aim to ensure high level approval and support for this CWPP.

# SECTION 2: LOCAL AREA DESCRIPTION

This section defines the Area of Interest (AOI) and describes the community of Mackenzie within the AOI. It also summarizes the current community engagement in wildfire prevention and mitigation and identifies linkages to other plans and policies with relevance to wildfire planning.

## 2.1 CWPP AREA OF INTEREST

The Area of Interest for the CWPP is illustrated below in Map 1. The study area includes the majority of the District of Mackenzie municipal boundary, which overlaps the 2-kilometer (km) buffer representing the WUI and an additional 520 ha outside of the WUI, located in the northern area of the AOI, included as requested by the Wildfire Working Group. The AOI was expanded to include the aforementioned non-WUI area, as this area is part of the access and egress route to the Gantahaz subdivision, a newer development in the northern portion of the AOI. The AOI encompasses approximately 15,510 ha in total. A breakdown of land ownership is provided in Table 2.




**Map 1. Area of Interest (AOI).**

**Table 2. Summary of AOI by land ownership.**

| Land Ownership | Hectares |
|---|---|
| Private | 2,588 |
| Local Government | 758 |
| Provincial Crown | 12,152 |
| Federal Crown | 10 |
| **Total** | **15,509** |

## 2.2 COMMUNITY DESCRIPTION

The District of Mackenzie is a member municipality of the Regional District of Fraser Fort George (RDFFG). The municipality was incorporated on May 19, 1966, following the construction of the first pulp and saw mills, and the establishment of the forestry sector as primary driver of the local economy.[8] The District is located in the Rocky Mountain Trench and is bordered to the west by the Omineca Mountains and to the east by the Rocky Mountains. The District straddles the southeastern-most portion of the 360-kilometer Williston Lake, and covers an area of 212 $km^2$.

The District of Mackenzie is located approximately 193 km north of Prince George, and can be reached via Highway 39, by following Highway 97 North. Highway 39 south to Highway 97 is the only reliable, paved access to and from the community; there is no reliable access from the north. However, given the role of the forestry sector within the District of Mackenzie, there are multiple important, unpaved and high-use Forest Service Roads (FSR) such as the Parsnip West FSR, Parsnip East FSR and the Finlay Causeway providing secondary access/egress routes to various parts of the AOI. In an emergency wildfire scenario, evacuation routes consist of Highway 39 (primary option) or the Parsnip West FSR (secondary option).

Fire protection within the study area is the responsibility of Mackenzie Fire Department (MFD). The Fire Service Area includes the majority of the District of Mackenzie: more than 21,000 hectares. The AOI encompasses an Indian Reserve (Number 19), pertaining to the McLeod Lake Indian Band and two satellite developments: Gantahaz and Gagnon, located north and south, respectively, of town centre. Additionally, many industrial sites (mills) are located within the AOI, such as the CONIFEX Sawmill (Site 2), CONIFEX Power Plant, CANFOR Mackenzie, and the Mackenzie Pulp Mill, Duz Cho Forest Products, and Parallel 55 East Fraser Fiber Chip Plant and Finger Joint Mill.

## 2.3 PAST WILDFIRES, EVACUATIONS AND IMPACTS

Through consultation with the local BCWS Wildfire Officer it was determined that the District of Mackenzie has not had a major issue with human caused fires. The Mackenzie Forest District has a 10-year average of 5.4 human caused fires, most of which fall in the following categories: 1) escaped open

[8] District of Mackenzie Official Community Plan (2014). https://www.district.mackenzie.bc.ca/Portals/0/documents/Townhall/Schedule%20A%202014%20Mackenzie%20OCP%20Approved.pdf

burns; 2) abandoned campfires; and, 3) mechanical or logging related fires. The most volatile fuel types in the region within and adjacent to the AOI are those associated with slash and/or grey attack lodgepole pine stands (S-1, S-2 and C-3 fuel types, respectively). In general, forest industry compliance with fuel hazard abatement requirements and dead pine removal within the AOI has been good. The BCWS has identified the area outside and/or adjacent to the AOI as posing a higher risk of ignition potential due to accumulations of surface and aerial fuels resulting from the pine beetle epidemic.

## 2.4 CURRENT COMMUNITY ENGAGEMENT

There is widespread recognition and awareness, both among District staff and the community members in general, of the threat posed to the community by wildfire, and general support for hazard mitigation activities. The 2005 CWPP provided key recommendations for fuel management and wildfire response for the District and the Mackenzie Fire Department. Since the 2005 CWPP, fuel treatments have occurred in various areas surrounding the town centre, Mackenzie and Fraser Boulevards, the Hospital, Hydro Station area, on Pioneer Street, and near the Tree Crusher Site. Additional fuel treatments were also implemented directly south and upwind of the northern development of Gantahaz. Fuel management in the aforementioned areas consisted of a combination of thinning, surface fuel reduction and removal of accumulated standing dead resulting from the Mountain Pine Beetle disturbance.

There has been variable community engagement in FireSmart initiatives to this point, with the newer Gantahaz development having moderate acceptance rate of FireSmart principles. However, the District is taking an active role in engaging the community through student education, pamphlet distribution, posters, and radio broadcasts to provide the community with information regarding FireSmart planning. The Mackenzie Fire Department regularly hosts FireSmart training for personnel. Recently, the District has established an Emergency Network via the use of social media to inform the public on wildfire risks and prevention initiatives. There may be potential to build upon heightened awareness of wildfire risk after the 2017 fire season.

The District has a working relationship with the McLeod Lake Mackenzie Community Forest (MLMCF) and the McLeod Lake Indian Band and a shared interest in fuel management for community protection purposes. The MLMCF has assumed a mandate to conduct fuel hazard reduction and abatement within their assigned wildland urban interface management unit.[9] Accordingly, within this forest development unit, fuel management is attained through the implementation of fuel management stocking standards.

The District of Mackenzie Official Community Plan (OCP)[10] states that current land use and development policies within the Municipality are dictated and controlled by the Zoning Bylaw (No. 1114, 2006). Currently, development permit applications are a requirement within the District, in order to ensure

[9] McLeod Lake Mackenzie Community Forest – Forest Stewardship Plan #2 (2016-2021). http://mlmcf.ca/wp-content/uploads/K2M_MLMCF_FSP2_13JUNE2016_Signed.pdf

[10] District of Mackenzie Official Community Plan (2014). https://www.district.mackenzie.bc.ca/Portals/0/documents/Townhall/Schedule%20A%202014%20Mackenzie%20OCP%20Approved.pdf

public compliance with the British Columbia (B.C.) Building Code and the B.C. Plumbing Code. There is no established wildfire development permit area, which can set standards based upon FireSmart principles for building material use, landscaping and appropriate setbacks.

The District Staff recognizes the District's wildfire risk and is actively looking for implementable risk reduction efforts. This CWPP is another step in the process of gaining more widespread participation and support.

## 2.5 LINKAGES TO OTHER PLANS AND POLICIES

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

### 2.5.1 Local Authority Emergency Plan

Emergency preparedness and response is managed locally by the District and the Mackenzie Fire Department (MFD), as well as regionally through cooperation with the RDFFG. The RDFFG is responsible for emergency preparedness service for seven electoral areas, outside the boundaries of its four-member Municipalities – Mackenzie, Prince George, McBride, and Valemount. The RDFFG Emergency Preparedness Service Bylaw No. 2162 guides the provision of emergency services for the seven electoral areas contained within the RDFFG (Areas A, C, D, E, F, G, and H). Additionally, at the regional level, Emergency Management provided by the RDFFG is legislated through Bylaw No. 2960 and provides guidance for mitigation, planning, preparedness, response and recovery in the case of a regional emergency, outside of the boundaries of the aforementioned four-member Municipalities.[11]

The District of Mackenzie has an official Emergency Response and Recovery Plan, which was developed in 2006 and updated in 2011, 2014, 2015 and 2016. The aforementioned Emergency Response and Recovery Plan provides a framework to ensure preparedness and efficient response action at the local level, in the event of an emergency or natural disaster. The District has established an Emergency Management Committee that is tasked with coordinating meetings and exercises and organizing emergency plans by bringing together industry, the RCMP, Fire Department, Search and Rescue, District Staff and Emergency Social Services.[12] Additionally, the District's Emergency Committee has developed a municipal Emergency Response Guide pamphlet, outlining options for preferred access and egress routes in case of an evacuation emergency.[13,14] Coordination with the RDFFG and other member

[11] Regional District of Fraser-Fort George. http://www.rdffg.bc.ca/services/public-safety/emergency-management-program/overview-23

[12] District of Mackenzie – 2014 Committee Agenda https://mackenzie.civicweb.net/document/15802

[13] District of Mackenzie. November 2017 Committee Agenda https://mackenzie.civicweb.net/document/31734/Committee%20of%20the%20Whole%20-%2010%20Apr%202017.pdf?handle=9CB7C0633EF04382859D844E02A93C09

[14] District of Mackenzie. Emergency Evacuation Procedures https://www.district.mackenzie.bc.ca/Portals/0/documents/Emergency.pdf

Municipalities for joint development of a region-wide Emergency Response and Recovery Program is currently in progress.

### 2.5.2 Affiliated CWPPs

The McLeod Lake Indian Band (MLIB) 2016 CWPP document (currently under review) covers an area that is adjacent to the AOI and has been reviewed for synergistic project opportunities, as well as to confirm that there are no conflicting recommendations. Duplicated effort for strategies is not anticipated as there is no direct area overlap. However, there may be future opportunities for landscape level fuel break development between the two areas, which will require cooperation with the MLIB. The District may wish to initiate or cooperate on projects recommended within this CWPP, as projects may benefit both the District and the McLeod Lake Indian Band community, as well as the region. Should this be the case, the appropriate CWPP and government should be consulted for implementation recommendations and funding opportunities.

### 2.5.3 Local Government and First Nation Plans and Policies

The following municipal bylaws and policies are relevant to wildfire planning in the District.

#### *Bylaw No. 1304, 2014: Official Community Plan*[15]

The Official Community Plan (OCP) provides guidance for land use and development within the District of Mackenzie and establishes a long-term vision for the community's future.

**Section 2.1** provides details regarding development permit areas and policies that take into account existing infrastructure and the costs and limitations associated with development in non-urban areas of the District. The following Policies speak to public safety, health and cost considerations:

- Policy 4 states that the District will consider offering incentives for infill development that will promote setbacks, amongst other things.
- Policies 6 and 7 emphasize the need to consider where current infrastructure exists within the District prior to approving new residential development. This policy is particularly pertinent to fire protection, as the costs associated with building and servicing fire protection infrastructure in undeveloped areas can be high.
- Policies 14 and 15 are directly related to opportunities for development of rural waterfront properties. More specifically, these two policies speak to the water supply limitations associated with firefighting and fire suppression within underdeveloped areas.

**Section 2.4** speaks directly to the maintenance, improvement and accessibility to the District parks and recreational areas. Policies 1 and 7 speak to the need to maintain a Parks, Recreation & Cultural Master

[15] District of Mackenzie. Official Community Plan Bylaw No. 1304, 2014. https://mackenzie.civicweb.net/document/18737

Plan, while ensuring the public has access to parks and greenspaces. Regular maintenance of these access routes may improve fire suppression efforts in the event of a wildfire emergency.

**Section 2.5** identifies the importance of safeguarding the network that provides public utilities to the District of Mackenzie and is directly linked to fire protection requirements and emergency preparedness. The following policies work to reduce fire risk to utilities and public services:

- In Policy 5 the District acknowledges the existing road and trail system in proximity to lakeside areas and limits new access/road development in these areas with the exception of fire suppression needs.
- Policies 6 and 7 recognize the District's potential limitations associated with the water distribution system in case of water shortages or heavy public demands, and the provision of water services to new developments. These Policies call for an evaluation of the District's ability to provide immediate response in emergency situations or its ability to supply services prior to approving new development.

**Section 2.7** recognizes the environmental, recreational, and economic value provided by the forest land resources. Policy 13 is directly relevant to strategic wildfire planning:

- The District will continue to foster a working relationship with the Ministry of Forests, Lands and Natural Resource Operations and the Ministry of Environment to jointly take action and reduce the risk of wildfire in the community.

### *Bylaw No. 1249, 2010: Fire Protection Services*[16]

The following sections work to minimize unwanted ignitions:

**Section 10(c)** grants authority to the Fire Chief to require property owners to remove items that can directly impact fire hazard on the property or result in increased fire risk.

**Section 25** outlines burning restrictions for open air fires; a Burning Permit is required for all open-air fires. Furthermore, the bylaw grants the authority to 1) impose terms and conditions for permit issuance regarding safety; 2) deny permit issuance if safety hazard is posed to the public; and 3) cancel the permit, if deemed unsafe to the public or the property.

### *Bylaw No. 1368, 2017: Zoning Bylaw*[17]

Bylaw 1368 sets forth regulations and requirements of works and services with respect to the subdivision and development of land. The following points are applicable to wildfire management planning:

[16] District of Mackenzie. Fire Protection Services Bylaw No. 1249, 2010. https://mackenzie.civicweb.net/document/2322

[17] District of Mackenzie. Zoning Bylaw No. 1368, 2017. https://mackenzie.civicweb.net/document/34428

**Section 4.13-6 - Landscaping and Screening** sets a requirement for vegetative buffers in all commercial and industrial zones, as well as institutional zones if adjacent to the residential zones. An exemption could be provided to prospective developments if a fire lane access setback is deemed necessary.

### *Bylaw No. 780, 1993: Subdivision Development Bylaw*[18]

Bylaw 780 regulates the subdivision of land within the District of Mackenzie and has direct impact on fire protection and risk reduction. The following sections refer specifically to burning compliance and regulations:

**Section 2 - Workmanship (Schedule D)** speaks directly to burning requirements for land undergoing clearing. More specifically, this section places the onus on the developer to safely conduct burning of cleared materials according to federal, provincial and municipal Acts, Regulations and Bylaws, and ensure that adequate protection is provided to reduce the risk of fire spreading to adjacent timber or property.

**Section 9 - Clean-up (Schedule D)** places the onus on the developer to maintain the construction site to a cleanliness standard that does not increase the fire hazard risk for the property.

### *Bylaw No. 1204, 2008: Fireworks Control*[19] *and Bylaw No. 1204, 2008 Fireworks Control Amendment*

Bylaw 1204 regulates the possession and discharging of fireworks in the District of Mackenzie. The Fireworks Control Bylaw speaks directly to wildfire protection planning in the following sections:

**Section 13** delineates the conditions in which high hazard firework permits are issued by the Fire Chief and requires that a Fire Safety Plan be submitted to the Fire Chief ahead of fireworks discharging.

**Section 14** requires that any permit issued for High Hazard Fireworks specify the day and time of day in which the Fireworks may be discharged or used.

**Section 18** establishes that a permit holder that fails to control or secure a site during Fireworks deployment is considered to have committed an unlawful offence.

### *Bylaw No. 714, 1990: Unsightly Premises*[20]

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: discarded materials,

[18] District of Mackenzie. Subdivision development Bylaw No. 780, 1993.
https://mackenzie.civicweb.net/document/144
[19] District of Mackenzie. Fireworks Control Bylaw No. 1204, 2008.
https://mackenzie.civicweb.net/document/1688
[20] District of Mackenzie. Unsightly Premises Bylaw No. 714, 1990.
https://mackenzie.civicweb.net/document/147

building materials, rubbish, and brush. Additionally, it prohibits the accumulation and uncontrolled growth of vegetation including weeds, brush and trees. It allows the District to require the property owner to address the accumulations, and gives the District authority to enforce any order, as well as collect on expenses incurred.

#### *Bylaw No. 1102, 2002: Emergency Measures*[21]

Bylaw 1102 establishes a District-specific Emergency Executive Committee comprised of the Mayor, Councillors, Chief Administrative Officer, Emergency Program Coordinator, and representative from the Fire, Leisure Services and Public Works Departments. Additionally, the bylaw also appoints an Emergency Program Coordinator (Fire Chief) tasked with facilitation of emergency preparedness, response and recovery measures in the District of Mackenzie. An important clause in the Emergency Measures bylaw encourages agreements with regional districts or other municipalities to jointly tackle emergency assistance measures, or coordination of emergency preparedness, response and recovery measures.

### 2.5.4 Higher Level Plans and Relevant Legislation

#### *Mackenzie Land Resource Management Plan (MLRMP)*[22]*:*

The MLRMP is the higher-level planning document for the Mackenzie Natural Resource District (MNRD) located within the Omineca Region; it establishes Resource Management Zones and objectives for each zone. The plan provides general resource management direction, as well as defined objectives for the following areas: 1) Biodiversity Emphasis; 2) Air, Soils and Water Quality; 3) Fish and Wildlife Habitat; 4) Grizzly Bear Management; 5) Ungulate Winter Range; 6) Grazing; 7) Visual Quality; 8) Heritage and Culture; 9) Trapping and Guide Outfitting; 10) First Nations; and 11) Social and Economic Security. According to the MLRMP, the AOI land base is classified as follows, in order of most to least common: 1) Settlement/Agricultural Management Zone; 2) Enhanced Management Zone; and 3) General Management Zone. The MLRMP requires that a Fire Management Plan (FMP) be developed prior to allowing wildfires to burn on the land base. Similarly, there is a requirement for an FMP and site-specific research prior to carrying out prescribed burns. The MLRMP also designates Enhanced Management Zones, in which the operable timber supply land base is actively managed via aggressive reforestation or wildfire suppression in order to maintain a sustainable future timber harvest.

There are a few specific, spatially explicit ministerial orders pertaining to Old-Growth Management Areas (OGMA) and visual quality objectives (VQO) in the study area which may impact potential fuel

[21] District of Mackenzie. Emergency Measures Bylaw No. 1102, 2002. https://mackenzie.civicweb.net/document/119/Emergency%20Measures%20Bylaw%20_1102.pdf?handle=B1D553149468437A9B555B7AE8ED5F12

[22] Mackenzie Land and Resource Management Plan (LRMP). 2000. https://www.for.gov.bc.ca/tasb/slrp/lrmp/princegeorge/mackenzie/plan/files/lrmp/Mackenzie_LRMP_Feb2001.pdf

treatment 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 (Mackenzie 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.

#### *Mackenzie Sustainable Resource Management Plan (MSRMP)[23]: Ministerial Order Establishing Agriculture Development Areas and Settlement Reserve Areas*

The MSRMP dictates the establishment of a legal Order for Agricultural Development Areas and Settlement Reserve Areas which overlaps the southern portion of the AOI. This spatially explicit ministerial order guides forest management within the designated areas, and permits timber harvesting for environmental or safety reasons, such as interface fire preparedness. Timber harvesting within the MSRMP designated areas may only occur under the direction of an operational plan and consultation and approval from the MFLNRORD and the Ministry of Agriculture and Lands.

### 2.5.5 Ministry or Industry Plans

Reviewing and incorporating other important forest management planning initiatives into the CWPP planning process is a critical step in ensuring a proactive and effective wildfire mitigation approach in the AOI. The Fire Management Plan[24] that encompasses the District of Mackenzie was reviewed to identify future landscape level fire management planning at the Natural Resource District level. More specifically, directions provided in FMPs have direct implications for activities undertaken by the District and adjacent jurisdictions.

The Mackenzie Natural Resource District has completed a Fire Management Plan (FMP) in 2017 to identify values at risk and prioritize broad categories of values as 'themes' for categorizing response through the Resource Strategic Wildfire Allocation Protocol (RSWAP). According to the MNRD FMP, fuel reduction at the landscape level should mimic approaches used in the urban interface reduction, but at a large scale. Examples of treatment recommendations for these landscape level fuel breaks includes the following: 1) stand conversion to deciduous, wherever possible; 2) tree spacing and or thinning to improve timber quality and reduce fire behaviour potential; 3) pruning retained trees to reduce crown fire potential; and 4) woody debris removal and or fuel hazard abatement. Through consultation with the land manager and the stewardship officer (MFLNRORD Mackenzie Natural Resource District), it was determined that currently, there are no landscape level fuel breaks recommended within, or near to, the study area. However, the MNRD is in the process of identifying potential landscape level fuel breaks in cooperation with the BC Wildfire Service. Future opportunities are expected to be located along major

[23] Mackenzie Sustainable Resource Management Plan (LRMP). 2000. https://www.for.gov.bc.ca/tasb/slrp/lrmp/princegeorge/mackenzie/plan/files/lrmp/Mackenzie_LRMP_Feb2001.pdf

[24] Mackenzie Natural Resource District Fire Management Plan. 2017.

roads and in consideration of values at risk and natural features, in order to reduce fire threat. The process of designating locations for future fuel breaks will include consultation with Licensees, First Nations and other key stakeholders. Landscape level fuel break opportunities have been identified as part of this CWPP, in order to bolster access and egress routes in the District of Mackenzie as well as to serve as strategic anchors for fire suppression and to reduce extreme crown fire behaviour.

However, because the District of Mackenzie has limited access and egress options, improving access and increasing public safety in the event of an emergency evacuation should be a priority. There may be funding opportunities for fuel breaks on Crown land along Highway 39 through the Forest Enhancement Society of British Columbia (FESBC). Communication with the Natural Resource District and Ministry of Transportation and Infrastructure should be initiated to explore potential fuel treatments.

The 2015 Integrated Silviculture Strategy – Situation Analysis for the MNRD[25] is a document that speaks to government objectives targeting mitigation of impacts on mid-term timber supply and delivery of predefined stewardship outcomes. The aforementioned document acknowledges the impact of Mountain Pine Beetle disturbance on the landscape, the resulting increased fuel loads and potential for aggressive fire behaviour. The document broadly covers fuel management objectives within the MNRD; it speaks to the development of a coordinated Harvest Strategy aimed to provide scheduling direction for applications such as landscape level fuel breaks employed to target forest health issues.

The MLMCF, overlaps a significant portion of the AOI and has a current Forest Stewardship Plan (FSP) (2016-2021) in which a Forest Development Unit (FDU) has been designated with the primary objective for fuel hazard reduction and abatement in the WUI. Within this FDU, Fuel Treatment Prescriptions must be included in the Site Plan for a proposed opening, created for the purpose of fuel reduction of fire hazard mitigation. Additionally, any opening within this FDU must apply Fuel Treatment Prescription stocking standards specified in the FSP. Other licensees with tenure in the AOI are CONIFEX, BCTS and OBO Forest Management in order of highest to lowest area coverage.

Forest health management and associated initiatives within the Mackenzie Natural Resource District are guided by the following documents: 1) Omineca Region Forest Health Strategy[26]; 2) Provincial Spruce

[25] BC Ministry of Forests, Lands and Natural Resource Operations. Integrated Silviculture Strategy for the Mackenzie Natural Resource District – Situation Analysis. 2015. https://www.for.gov.bc.ca/hfp/silstrat/Mackenzie/DMK_Situation_Analysis_V1%202.pdf

[26] BC Ministry of Forests, Lands and Natural Resource Operations. Omineca Region Forest Health Strategy 2017-2018. https://www.for.gov.bc.ca/ftp/hfp/external/!publish/Forest_Health/TSA_FH_Strategies/2016%20Omineca%20Region%20Forest%20Health%20Strategy_signed.pdf

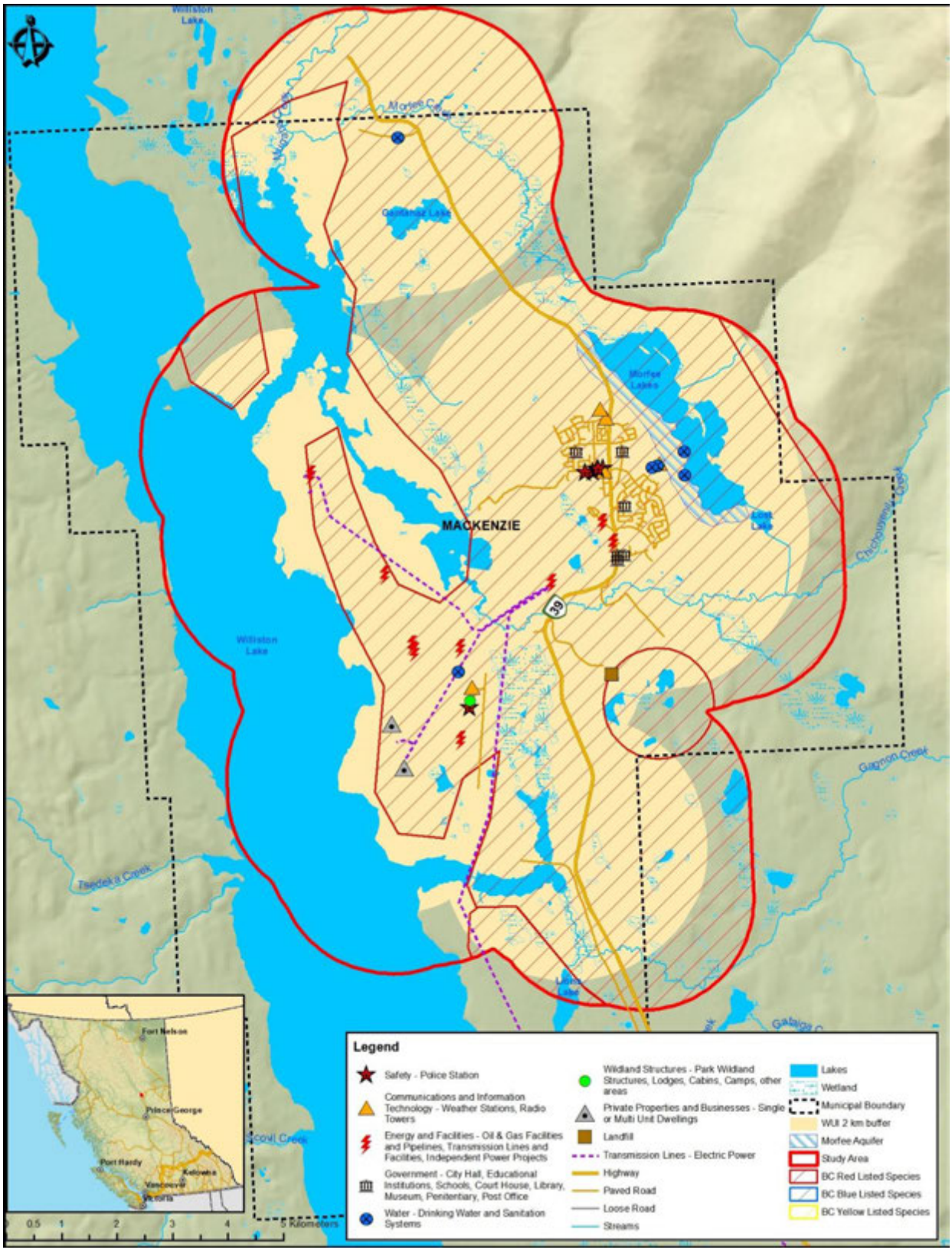
Beetle Mitigation Strategy[27]; and 3) Rust Management Strategy Omineca Region[28]. These plans must be reviewed, considered, and addressed during the site-level planning phase. Fuel management and prescriptions aimed at reducing wildfire hazard within the AOI should aim to incorporate the guiding principles and best management practices (BMPs) presented within the aforementioned plans.

# SECTION 3: VALUES AT RISK

Following is a description of the extent to which wildfire has the potential to impact the values at risk (VAR) within the District of Mackenzie. VAR or the human and natural resources that may be impacted by wildfire include human life and property, critical infrastructure, high environmental and cultural values, and other resource values. VAR also include hazardous values that pose a safety hazard. Key identified VAR are illustrated below in Map 2.

[27] Ministry of Forests, Lands and Natural Resource Operations. Working Together: British Columbia's Spruce Beetle Mitigation Strategy. 2016. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/bark-beetles/4805dc_ominecasprucebeetlestrategy_web.pdf

[28] Ministry of Forests, Lands and Natural Resource Operations. Rust Management Strategy Omineca Region. 2013. https://www.for.gov.bc.ca/ftp/TPG/external/!publish/Forest_Stewardship_Plans/PG-FSP/Approved%20FSP/Support%20Documents/7.2.15/1_ORMS_Version_1_May%2029_2013_MRWG%20(3).pdf




**Map 2. Values at Risk.**

## 3.1 HUMAN LIFE AND SAFETY

One of the primary goals of the BCWS is to support emergency response and provide efficient wildfire management on behalf of the BC government. BCWS aims to protect life and values at risk, while ensuring the maintenance and enhancing the sustainability, health and resilience of BC ecosystems.[29]

Human life and safety is the first priority in the event of a wildfire. A key consideration is the evacuation of at risk areas and safe egress. Evacuation can be complicated by the unpredictable and dynamic nature of wildfire, which can move quickly. Evacuation takes time and safe egress routes can be compromised by wildfire, limited visibility, or by traffic congestion and/or accidents.

The population distribution (both people and structures) within the AOI is important in determining the wildfire risk and identifying mitigation activities. Since 2005, the population has generally seen a downward turn, with the latest statistics (2016) measured at 3,262 persons.[30] According to the 2016 Census, there are 1,630 private dwellings in the District, of which, approximately 220 residences are occupied on a part-time basis. The majority of private residences and people are concentrated in and around the town centre, with a smaller development existing north of the town centre - Gantahaz, and a sprawling, less dense development occurring in the southern Gagnon area of the AOI. Most residences in the Gagnon development area are on private road systems and fenced, which poses a substantial barrier to provision of protection services in the event of a wildfire emergency.

Having knowledge and access to updated structure locations within an area is a critical step in efficient and successful emergency response planning and the development of mitigation strategies and recommendations. Field visits to the District of Mackenzie AOI and access to recent orthophotography has enabled the development of an updated WUI boundary that accounts for the most recent development inclusive of the southern, sprawling and less dense Gagnon development.

## 3.2 CRITICAL INFRASTRUCTURE

Protection of critical infrastructure assets (CI) during a wildfire event is an important consideration for emergency response effectiveness, ensuring that coordinated evacuation can occur if necessary, and that essential services in the study area can be maintained and/or restored quickly in the case of an emergency. Critical infrastructure includes emergency and medical services, electrical and gas services, transportation, water, social services, and communications infrastructure. The District of Mackenzie retains spatial data of critical infrastructure. The 2005 CWPP did not identify infrastructure which the District deems to be critical to community function. Table 3 (Section 3.2.2) details an inventory of critical infrastructure identified by the District and via field visits.

[29] BC Provincial Coordination Plan for Wildland Urban Interface Fires. 2016. https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/provincial-emergency-planning/bc-provincial-coord-plan-for-wuifire_revised_july_2016.pdf

[30] Statistics Canada. 2016 Census.

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/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 5.2.1, FireSmart principles are important when reducing wildfire risk to both classes of structure and are reflected in the outlined recommendations.

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. During field visits, it was observed that generally the District's critical infrastructure is compliant with FireSmart principles. Potential treatment areas were identified around some structures for additional protection.

### 3.2.1 Electrical Power

Electrical service for most of the District is received through a network of wood pole transmission and underground distribution infrastructure supplied by BC Hydro's Central Region. Neighbourhoods with small, street-side wooden poles to connect homes are particularly vulnerable to fire. It is recommended that utility right-of-way BMPs such as, regular brushing and clearing of woody debris and shrubs be employed to help reduce fire risk, utility pole damage and subsequent outages. There are 5 BC Hydro substations in and around the District of Mackenzie and power is supplied via a radial transmission line of (138kV), which is connected to the 500kV transmission line that follows Highway 97. Within the AOI there is a recent (2015) biomass power plant operated by CONIFEX Power, which is set to produce 230 gigawatt hours of net energy per year to power over 20,000 homes in BC, over a 20-year agreement period. Potential vulnerabilities associated with the biomass power plant are as follows: 1) during an emergency (i.e., wildfire event) the power supply to the consumers may be impacted, and 2) following a wildfire event, there is potential for severe impacts to biomass supply to the plant, which would threaten the power supply.

Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which cuts power for days, or even weeks. Secondary power is available for critical infrastructure such as municipal buildings (Fire Hall, Emergency Operation Centre etc.,) and water pumping stations via mobile diesel generators. Vulnerabilities for secondary power sources include mechanical failure, potentially insufficient power sources should a wide-scale outage occur, and fuel shortage in the event of very long outages.

### 3.2.2 Communications, Pipelines and Municipal Buildings

The District of Mackenzie is serviced by one hospital, an airport, three municipal buildings, and four communication towers or communication structures. There is a main gas line that starts at the Fortis BC Gas Pressure Station at the intersection between Highway 39 and Mackenzie Boulevard and runs west, south-west and south, respectively between the Sewage Lagoons and the BC Hydro Sub-station. A full inventory of critical infrastructure for communications, pipelines and municipal buildings with updated locations is presented in Table 3 below.

**Table 3. Critical Infrastructure Identified in 2017 CWPP field visits.**

| Critical Infrastructure Type | 2017 Status |
|---|---|
| Cell Tower A | 22 Laurier Drive |
| Cell Tower B | North of McIntyre Drive, west entrance off Highway 39. |
| City Hall | 1 Mackenzie Boulevard |
| Electrical service | Service from regionally integrated transmission network. Distribution is combination of wood poles and underground servicing. |
| Emergency Operations Centre (EOC) | 1 Mackenzie Boulevard |
| Emergency Social Services (ESS) | Fire Hall – 60 Centennial Drive |
| Mackenzie Airport | Airport Road |
| Mackenzie Ambulance Station | 49 Centennial Drive |
| Mackenzie Fire Hall 1 Search and Rescue | 60 Centennial Drive |
| Mackenzie Fire Hall 2 | 700 Airport Road |
| Mackenzie Hospital | 45 Centennial Drive |
| Mackenzie Public Works | 10 Cicada Road |
| Mackenzie RCMP Detachment | 62 Centennial Drive |
| Mackenzie Power grid | BC Hydro Morfee sub-station and Fortis BC Gas pressure station on Highway 39. |
| Telus Phone and Internet Hub | 65 Centennial Drive |
| VEP Communications | 1000 Airport Road |

### 3.2.3 Water and Sewage

The District did not identify any immediate concerns with regards to water availability for firefighting purposes or the susceptibility of water sources to drought conditions within the town center or Gantahaz subdivision. However, a few issues regarding limited water availability were identified within the rural subdivision of Gagnon. A detailed account of water availability for wildfire suppression is provided in Section 6.1.2. Critical water supply and sewage system infrastructure was not identified in the 2005

CWPP. Updated locations for water and sewage infrastructure within the District of Mackenzie are detailed below in Table 4.

**Table 4. Critical Infrastructure Identified in 2017 CWPP field visits.**

| Critical Infrastructure Type | 2017 Status |
|---|---|
| Water supply | Primary infiltrative source of domestic water for the District is taken from wells near Morfee Lakes (southern basin of lakes where motorboat access is prohibited). Small residential wells supply the rural residential development of Gantahaz. Additional infrastructure includes: Main Water Booster Station (31 Laurier Drive), Morfee Lake Pump Station 1 and 2, Dom Public Works (10 Cicada Road), Industrial Well Site (5050 Coquiwaldie Road), Gantahaz Pumphouse (23 Columbia Drive), and the Main Water Reservoir (33 Laurier Drive). |
| Sanitary sewer system | Central community sewage collection and disposal system. Gantahaz subdivision relies on septic tanks, while industrial areas are self-sufficient. |
| Sewage lagoons | On Parsnip West FSR, north of BH Hydro Morfee Sub-station. |

## 3.3 HIGH ENVIRONMENTAL AND CULTURAL VALUES

The following section identifies high environmental and cultural values and where they are located. Environmental, cultural and recreational values are high throughout the study area. The diversity in vegetative communities found in the study were briefly discussed in the 2005 CWPP and still apply. A more detailed account of environmental and biodiversity aspects of this region is presented in Section 3.3.3.

### 3.3.1 Drinking Water Supply Area and Community Watersheds

According to the OCP, the District of Mackenzie draws its domestic water from wells near Morfee Lake. Protection from contamination for this valuable water source is provided through the following avenues: 1) limited access to undeveloped areas in proximity to water source – access permitted is limited to hiking, horseback riding, mountain biking, or cross country skiing; 2) area is off limits from development opportunities, with road access only permitted for fire suppression purposes; 3) water wells are located at the southern end of the lake basin, where a restriction exists for motor boats access.

The 2005 CWPP provided additional detail on watershed and watercourse vulnerability for the District of Mackenzie, which remains accurate and will not be reiterated herein (Appendix E). 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.[31] Some areas may have a lower threshold for precipitation triggered events and would be particularly vulnerable to post-wildfire debris flows, mass wasting, landslides, 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 District should consider the option of conducting future assessments to explore 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.[32]

### 3.3.2 Cultural Values

The District of Mackenzie is within the McLeod Lake Indian Band's traditional territory. Historically the Tse'khene people seasonally migrated throughout their traditional territory to obtain food, medicine, and materials for clothing and shelter from the land.[33]

Archaeological sites in BC that pre-date 1846 are protected from disturbance, intentional and inadvertent, by the *Heritage Conservation Act* (HCA), which applies on both private and public lands. Sites that are of an unknown age that have a likely probability of dating prior to 1846 (e.g., lithic scatters) as well as Aboriginal pictographs, petroglyphs, and burials (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 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 District of Mackenzie should ensure that they have direct access to Remote Access to Archaeological Data (RAAD), which allows the District of Mackenzie to look up or track any archeological sites in the area.[34]

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

[31] 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.

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

[33] http://www.mlib.ca/about/History

[34] Ministry of Forests, Lands and Natural Resources Operations. Remote Access to Archaeological Data Application (RAAD)
https://www.for.gov.bc.ca/archaeology/accessing_archaeological_data/obtaining_access.htm

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 McLeod Lake 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.

### 3.3.3 High Environmental Values

The AOI overlaps with a legal OGMA (PRG_MP_21) in the northern area of the AOI, located northwest of the rural subdivision of Gantahaz. Any proposed fuel treatment that may overlap this area requires MNFLRORD oversight at the prescription development phase, and works can only occur following MNFLRORD approval (OGMA amendment policy replacement application and / or detailed rationale must be provided to the District Manager for review).

Within the MNRD there are two legal orders that guide forest management with regards to retention and long-term management of old-growth forest features:

1. **Ministry of Agriculture and Land Ministerial Order, Non-Spatial Landscape Biodiversity Objectives in the Mackenzie Forest District[35] -** Legal order of importance within the MNRD (enacted in 2009, and amended in 2010), provides non-spatial landscape biodiversity objectives for old growth retention levels for all landscape units within the MNRD and defines old forest according to stand age, composition and BEC.
2. **Ministry of Agriculture and Lands Ministerial Order, Spatial Land Use Objectives for part of the Mackenzie Forest District Area[36]** – Legal order (enacted in 2010) that establishes legal spatial OGMAs in seven landscape units in the MNRD.

The MNRD has established legal objectives and orders for Ungulate Winter Ranges (UWRs) for the following species: northern caribou, mountain goat and Stone's sheep. The grizzly bear, bull trout, fisher, moose, and Arctic Grayling are additional regionally important wildlife species that the MNRD is actively managing and has best management guidelines for.

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 kept by the CDC: non-sensitive occurrences for which all information

[35] Ministry of Agriculture and Lands Ministerial Order – Non-spatial Landscape Biodiversity Objectives in the Mackenzie Forest District (2008).
https://www.for.gov.bc.ca/tasb/slrp/srmp/north/mackenzie/approved_Mack_nonspatial_Apr9_08.pdf

[36] Ministry of Agriculture and Lands Ministerial Order – Spatial Land Use Objectives for part of the Mackenzie Forest District Area (2010).
https://www.for.gov.bc.ca/tasb/slrp/pdf/srmp/signed_mackenzie_OGMA_order_20100923.pdf

is available (species or ecosystems at risk and location); and masked, or sensitive, occurrences where only generalized location information is available.

There are 2 occurrences of Red-listed species within the study area (Table 5). There are no overlaps with masked occurrences. Through consultation with the CDC and a biologist or qualified professional, all 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.

Further information can be found at the CDC website[37].

**Table 5. Publicly available occurrences of Red and Blue-listed species recorded within the AOI.**

| Common Name | Scientific Name | Category | BC List | Global Rank[38] | Habitat Type |
|---|---|---|---|---|---|
| Caribou (Central Mountain Population) Scott Herd and Kennedy Siding Herd | *Rangifer tarandus pop. 18* | Vertebrate animal | Red | G5T2Q | Winter: Old-growth forests Preferred: Peatlands |
| Small White Waterlily | *Nymphaea leibergii* | Vascular plant | Red | G5 | Montane: Palustrine (Bog/Fern) |

## 3.4 OTHER RESOURCE VALUES

The study area is within the Mackenzie Timber Supply Area (TSA), which covers approximately 6.41 million hectares of Northwestern BC and is administered by the Mackenzie Natural Resource District. The current Allowable Annual Cut (AAC) is 4.5 million cubic meters per year (the AAC is not applicable to private or community managed forest land). The last Timber Supply Review (TSR) was completed in

[37] Conservation Data Centre.
http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre

[38] Global rankings are a ranking of the global conservation status, reflecting an assessment of the condition of the species or community across its entire range. Where more than one rank occurs, this is used to indicate the range of uncertainty regarding the status. GX- presumed extinct, GH – possibly extinct, G1 – critically imperiled, G2 – imperiled, G3 – vulnerable, G4 – apparently secure, G5 – secure. Subspecies or varieties are indicated by a T ranking, which follows the same principles as for the G ranking. Q denotes questionable taxonomy.

2012. The TSR determined that the timber harvesting land base (THLB) is 1.36 million hectares or 41% of the Crown forest managed land base (CFMLB).[39]

Fuel reduction treatments are not anticipated to have a measurable effect on the timber harvesting land base. Typically, forest stands identified for fuels treatments are highly constrained for conventional logging and are often in undesirable or uneconomic stand types. The opportunity exists to work with local licensees and the MLMCF on commercial thinning projects that meet fuels management objectives. This has been explored with the McLeod Lake Mackenzie Community Forest, which operates on approximately 4,387 ha of the AOI. Additionally, the AOI overlaps Woodlot W0672, over an approximate area of 455 ha. This Woodlot is part of the Mackenzie Forestry Education Program and is known as the Secondary School Woodlot.

## 3.5 HAZARDOUS VALUES

The District has identified four critical and hazardous infrastructures, located primarily in the industrial zone of the AOI immediately to the east of Williston Lake (Table 6). Additionally, the District Landfill is located on the eastern side of Highway 39 between town centre and the subdivision of Gagnon. The management and treatment of fuels in proximity to hazardous infrastructure is critical in order to reduce the risks associated with both structural fire and wildfire. Specifically, best management practices recommended for management of hazardous values include: 1) incorporating FireSmart planning and setback requirements for all infrastructure in this category; 2) maintain emergency fuel/propane emergency shut off procedures to be enacted immediately and efficiently in the event of an approaching wildfire or ember shower; and 3) in relation to landfills, during periods of high or extreme fire danger, ensure that landfill contents are covered with soil or disposed of appropriately to avoid increased risk of a fire occurring due to incoming ember showers. It is recommended that the MFD review or establish a mock emergency shut-down procedure for hazardous values within the AOI, as well as conduct a thorough FireSmart assessment of these values at risk.

**Table 6. Hazardous Infrastructure Identified in 2017 CWPP field visits.**

| Critical/Hazardous Infrastructure Name | 2017 Status/Location |
|---|---|
| Esso Card Lock | 4550 Coquiwaldie Road |
| Jepson Fuel | 5325 Ritchie Road |
| Superior Propane | 5355 Ritchie Road |
| COOP CardLock | 1151 Mill Road |
| Mackenzie Landfill | Located east of Highway 39 halfway between town centre and the rural subdivision of Gagnon. |

[39] Ministry of Forests, Lands, and Natural Resource Operations Forest Analysis and Inventory Branch. 2013. *Mackenzie Timber Supply Area Timber Supply Analysis Public Discussion Paper*.

# SECTION 4: WILDFIRE THREAT

This section summarizes the factors that contribute to and were assessed in the determination of wildfire threat around the community. These factors include the natural fire regime and ecology, the Provincial Strategic Threat Analysis, and the local threat assessment completed for the AOI.

## 4.1 FIRE REGIME, FIRE DANGER DAYS AND CLIMATE CHANGE

The ecological context of wildfire and the role of fire in the local ecosystem under historical conditions is an important basis for understanding the current conditions and the potential implications of future conditions on wildfire threat to the community. Historical conditions may be altered by the interruption of the natural fire cycle (i.e., due to fire exclusion, forest health issues, human development) and/or climate change.

### 4.1.1 Fire Regime

***Ecological Context***

The Biogeoclimatic Ecosystem Classification (BEC) system describes zones by vegetation, soils, and climate. Regional subzones are derived from relative precipitation and temperature. Subzones may be further divided into variants based upon climatic variation and the resulting changes in the vegetative communities; variants are generally slightly drier, wetter, snowier, warmer, or colder than the climate of the regional subzone.[40] The following section is synthesized from information found on MFLRNORD's Research Branch BECWeb.[41]

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.[42]

The study area is characterized by the following BEC subzones in order of highest to lowest occurrence within the AOI:

**1. Moist Cool Sub-Boreal Spruce (SBSmk2) (Williston variant) – NDT 3**

Over half of the study area is within the Sub-Boreal Spruce Moist Cool (SBSmk2) BEC subzone; the entire northern development of Gantahaz and the westernmost part of Mackenzie is within the SBSmk2

[40] https://www.for.gov.bc.ca/hre/becweb/system/how/index.html#basic_concepts

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

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

subzone. The SBSmk2 occurs along Williston Lake at lower elevations, and along major drainage systems leading to Williston Lake, between the elevational bands of 670 – 800 m. The SBSmk2 subzone extends from the Chowika Creek in the north to within 10 km south of Mackenzie. This subzone is the driest of all Sub-Boreal Spruce units, as distinguished by the vegetation characteristic of mesic sites.

The SBSmk2 is characterized as Natural Disturbance Type 3 – 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 SBS ecosystems in this NDT experience a mean disturbance interval of approximately 125 years. Many of the mitigative efforts and focus will be within this subzone and NDT 3. [40]

**2. Wet Cool Sub-Boreal Spruce (SBSwk2) (Finlay and Pearce variants) – NDT 2**

Nearly 30% of the study area is within the Sub-Boreal Spruce Wet Cool (SBSwk2) BEC subzone; this subzone encompasses the remaining developed area within the District of Mackenzie. The SBSwk2 occurs along Williston Lake and in major drainage areas within the Rocky Mountains from the Narraway River in the south to the Peace Arm of Williston Lake in the north between the elevational bands of 750 – 1200 m. This subzone is characterized by the wettest climate but has a similar temperature regime as the other sub-boreal units.

The SBSmk2 is characterized as a Natural Disturbance Type 2 – ecosystems with infrequent stand-initiating events. Historically, these ecosystems were generally represented by even-aged stands with patches of uneven-aged stand structure due to infrequent wildfire regime. Wildfires occurring in these areas ranged in size from 20 to 1,000 ha and resulted in a patchwork of primarily mature forests with intermixed patches of younger forests. The SBS ecosystems in this NDT experience a mean disturbance interval of 200 years. Although the fire frequency is not high and fires are generally not large, pre-planning and preparation are essential to reduce the negative impacts of a wildfire. [40]

**3. Moist Cool Sub-Boreal Spruce (SBSmk1) (Mossvale variant) - NDT3**

A small proportion of the study area is characterized by the Sub-Boreal Spruce Moist Cool (SBSmk1) BEC zone; this subzone encompasses Gagnon, the newest development area within the District of Mackenzie. The SBSmk1 occurs on the northwestern plateau of Prince George and in valleys in the interior of the Omineca Mountains between the elevational bands of 750 -1070 m, depending on aspect and slope. This subzone is characterized by moist cool summers and generally long snowy winters.

The historical wildfire regime characteristic of SBSmk1 is similar to that of SBSmk2. [40]

**4. Wet Cool Engelmann Spruce – Subalpine Fir (ESSFwk2) (Misinchinka variant) - NDT1**

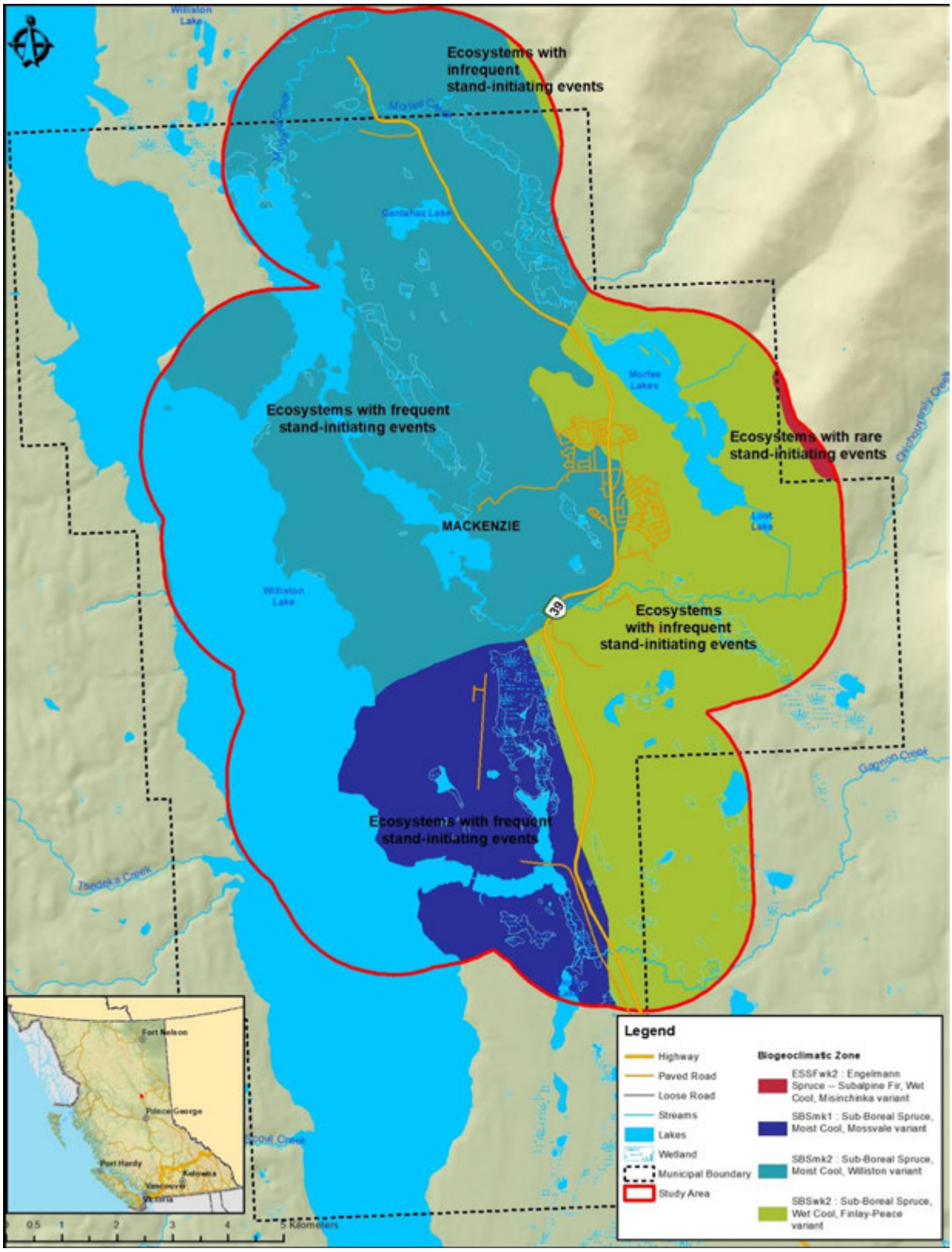
Less than 1 percent of the total study area is represented by the Engelmann Spruce – Subalpine Fir Wet Cool (ESSFwk2) BEC zone; this subzone covers a sliver in the eastern portion of the study area and is

topographically restricted to the higher elevations. The ESSFwk2 occurs in the Misinchinka, Hart and Park ranges of the Rocky Mountains between Morkill River in the south, and the Ospika Arm of Williston Reservoir to the north. This subzone is found between the elevational bands of 950 - 1300 m and is characterized by a wet and warm climate comparative to other ESSF subzones, and significant snow cover of greater than 3 m average depth.

The ESSFwk2 is characterized as a Natural Disturbance Type 1 – ecosystems with rare stand-initiating events. Historically, these ecosystems were generally represented by uneven-aged or multi-storied forest stands, with rare and small disturbances caused by fire, wind and/or landslides. The ESSF ecosystems in this NDT experience a mean disturbance interval of 350 years. Mitigation efforts should not be focused in this subzone; suppression is the appropriate response. [40]

**Table 7. BEC zones and natural disturbance types found within the AOI.**

| Biogeoclimatic Zone | Natural Disturbance Type | Area (ha) | Percent (%) |
|---|---|---|---|
| SBSmk1: Sub-Boreal Spruce, Moist Cool, Mossvale variant | NDT3 | 2,519 | 16% |
| SBSmk2: Sub-Boreal Spruce, Moist Cool, Williston variant | NDT3 | 8,416 | 54% |
| SBSwk2: Sub-Boreal Spruce, Wet Cool, Finlay-Pearce variants | NDT2 | 4,524 | 29% |
| ESSFwk2: Engelmann Spruce – Subalpine Fir, Wet Cool, Misinchinka variant | NDT1 | 50 | <1% |
| **TOTAL** | | **15509** | 100% |




**Map 3. Biogeoclimatic Zones of the AOI.**

### *Forest Health Issues and Fire Regime*

In recent years, an ongoing spruce beetle (IBS) infestation has been expanding in the Omineca Region.[43] Since 2013, the Omineca Forest Region has experienced an increase in area infested by the spruce beetle from 7,653 ha to 210,000 hectares currently.[44] The majority of the infected area is primarily found in the eastern valleys of the Mackenzie Timber Supply Area. The spruce beetle is a native pest typically confined to a two-year life cycle, but early warm spring weather can lead to one-year life cycles. Populations are usually kept in check by climatic conditions (sufficiently cold weather periods), predation, and lack of susceptible hosts. Recent weather patterns (warm springs, dry summers, and warmer winters) and windstorms leading to windthrow (increasing availability of preferred host material) are all contributing factors to the current increase in spruce beetle populations.[45] Although, spruce beetles generally infest downed trees, such as those in avalanche and windthrow areas, increases in population can lead to infestation of healthy and mature trees. Furthermore, attack may not be evident for a year or more after infestation has occurred, which can create complexity in beetle monitoring and management.[46] Fuel management in spruce stands should take into account the stands' susceptibility to both biotic (such as spruce beetle) and abiotic (such as windthrow) forest health factors, as well as the interaction between the two.

Mountain pine beetle (MPB) has been the most visible forest health factor impacting the study area in the last decade[47]. However, the Mackenzie TSA has experienced a general decline of mountain pine beetle attack to approximately 31,959 ha in 2015. The majority of the study area overlaps a large polygon categorized as a trace mortality polygon (trace is equivalent to <1% of trees in polygon recently killed). Since 2005, 178 new polygons were identified in the study area with various levels of mortality. Of these pest infestation polygons, nearly 657 ha were identified as experiencing severe mortality, the majority of which are located in the southern portion of the study area.[48] Much of the pine beetle-killed trees

[43] Ministry of Forests, Lands, and Natural Resource Operations. Omineca Spruce Beetle Outbreak. https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-health/forest-pests/bark-beetles/spruce-beetle/omineca-spruce-beetle.

[44] Ministry of Forests, Lands and Natural Resources Operations. 2017. Spruce Beetle Document Series, Mackenzie Natural Resource District. https://www.for.gov.bc.ca/ftp/DMK/external/!publish/SpruceBeetle/Documents/Omineca%20Region%20Spruce%20Beetle%20Document%20Series/v1%20Document%20Series%20MNRD%20April%202017.pdf

[45] Ministry of Forests, Lands, and Natural Resource Operations. Spruce Beetles in British Columbia. N.d. http://www2.gov.bc.ca/assets/gov/environment/air-land-water/land/forest-health-docs/spruce-beetle-docs/spruce_beetles_factsheet.pdf.

[46] Colorado State Forest Service. 2014. Quick Guide Series: Spruce Beetle. https://csfs.colostate.edu/media/sites/22/2014/02/Spruce-Beetle-QuickGuide-FM2014-1.pdf

[47] Forest and Range Evaluation Program. 2014. Multiple Resource Value Assessment (MRVA). Mackenzie Natural Resource District. https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/mrva-mackenzie-district.pdf

[48] iMapBC, 2017. http://maps.gov.bc.ca/ess/sv/imapbc/

nearest to the community have been removed through fuel management and sanitation projects. There are some polygons within the study area which have high fuel loading due to fallen pine beetle mortality and other natural disturbances; 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 Aspen serpentine leafminer, and western balsam bark beetle. The incidences of these forest health factors are relatively minor (scattered, small patches, and relatively low mortality). 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.

### *Human Development and Natural Events*

Since the establishment of the District of Mackenzie, there have been numerous anthropogenic and natural changes that have occurred on the landscape. The following is a list of notable changes observed within the District of Mackenzie AOI and a description of associated implications regarding wildfire behaviour.

1) Williston Lake is a reservoir created by the W.A.C. Bennett Dam in 1968 and is the largest lake in BC and the seventh largest in the world by volume[49]. The Finlay, Parsnip and Peace rivers feed into the Williston Lake, which spans 250 km from north to south and 150 km from east to west. Many of the impacts related to the creation of the reservoir were associated with the flooding of large tracts of forested land, most of which were settled at the time by the Tsay Keh Dene Nation.
2) The forest industry has been and continues to act as the main economic driver within the District of Mackenzie. As a result, historical and current harvesting and silviculture regimes within the study area have led to a mosaic of stand ages and structures, which result in potentially complex wildfire behaviour.
3) The establishment of the McLeod Lake Mackenzie Community Forest in 2009 led to a shift in management objectives on forested lands within the District of Mackenzie and adjacent lands. Specifically, a significant change associated with the shift in forest management objectives within the MLMCF lands, has been the active harvesting of stands impacted by the MPB. Additionally, the MLMCF has made it one of its mandates to emphasize fuel management within its license area.

[49] W.A.C. Bennett Dam. https://en.wikipedia.org/wiki/W._A._C._Bennett_Dam

4) Fuel Treatments have been undertaken in various areas adjacent to the town centre and the subdivision of Gantahaz, between 2008 and 2011, as a means to reduce fuel loading created by the MPB epidemic. The majority of these fuel treatments have reduced fire behaviour potential to a low-moderate level. However, further monitoring and management of these areas will be required in the future in order to maintain the fire threat and behaviour potential at the current low-moderate levels.
5) The aforementioned forest health issues have led to aggressive sanitation efforts in MPB impacted stands across the AOI and current monitoring and/or salvage activities for IBS impacted stands. These natural disturbances have resulted in an abundance of fine, medium and coarse woody debris (collectively known as fuel loading) with long-lasting concerns about fuel hazard and potential for extreme wildfire behaviour during high or extreme fire weather.
6) Developed areas within the District of Mackenzie include the main community (town centre) mill area (industrial site), and the satellite intermix neighbourhoods of Gantahaz to the north and Gagnon to the south. The latter neighbourhood is the most recent rural development in the study area and is generally surrounded by moderate and high hazard fuels such as M-1/2 and C-3, respectively. Given their proximity and intermixed nature with forested areas, the residences within this neighbourhood are at a higher risk for potential extreme wildfire behaviour.

### 4.1.2 Fire Weather Rating

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.

Fire Danger Classes provide a relative index of how easy it is to ignite a fire and how difficult control is likely to be. The BC *Wildfire Act* [BC 2004] and *Wildfire Regulation* [BC Reg. 38/2005], which specify responsibilities and obligations with respect to fire use, prevention, control and rehabilitation, and restrict high risk activities based on these classes. 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. Ground crews easily contain fires 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.

It is important for the development of appropriate prevention programs that the average exposure to periods of high fire danger is determined. 'High fire danger' is considered as Danger Class ratings of 4 (High) and 5 (Extreme). Danger class days were summarized to provide an indication of the fire weather in the AOI. Considering fire danger varies from year to year, historical weather data can provide information on the number and distribution of days when the AOI is typically subject to high fire danger conditions, which is useful information in assessing fire risk.

Figure 1 displays the average frequency of Fire Danger Classes between the months of April through to October. The data summarized comes from the Mackenzie FS weather station, located in the District of Mackenzie. For the study area, there are four months in the summer where the danger class days indicate a high or extreme risk for a significant wildfire event (May, June, July, August, September), peaking in July and August when there is an average of 7 high or extreme (Danger Class 4 or 5) days. In boreal forests, there is substantial increased ignition and wildfire spread potential in the period between snow melt and prior to green-up when fuels are very dry and the spring flush of high moisture content foliage has not yet occurred. This period is usually in April and/or May. The wildfire risk during this period should not be underestimated.

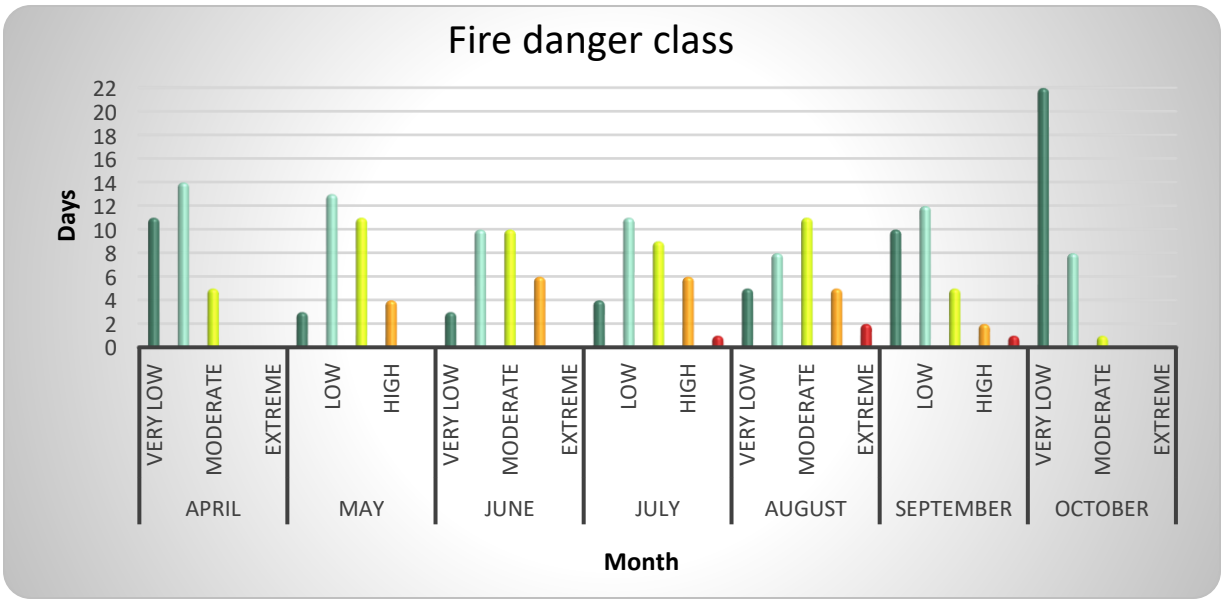



**Figure 1. Average number of danger class days (April to October) for the Mackenzie FS weather station. Summary of fire weather data for the years 1996-2016.**

### 4.1.3 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 1,400 years in the Northern Hemisphere.[50] Current and anticipated changes in mean climatic conditions in the Omineca Region are linked to increased frequency of natural disturbance events and potential unprecedented range expansion for climate-limited forest pests.[51] A recent example is the stand-replacing outbreak of the MPB, and the current expansion of spruce beetle throughout the Omineca region. Perimeters of previous and current pest outbreaks as well as historical fire regime within the AOI are presented below in Map 4 and Map 5.

Numerous studies outline the nature of these impacts on wildland fire in north central BC, 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

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

[51] BC Ministry of Forests, Lands and Natural Resource Operations. (2016). Omineca Region Extension Note. Adapting natural resource management to climate change in the Omineca Region: considerations for practitioners and Government staff. Available online at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/regional-extension-notes/ominecaen160222.pdf.

other natural disturbances are expected to be altered significantly with the changing climate.[52] Despite the uncertainties, trends within the data are visible. In the Prince George / Northern BC area, temperatures have been increasing at a rate much greater than the global average. Average winter and spring temperatures have increased causing more precipitation to fall as rain, rather than snow (potentially influencing timing and amount of run-off, soil and fuel moisture during early fire season).[53, 54]

Projections of future climate for the Prince George region (which encompasses the District of Mackenzie) were made from an ensemble of approximately 140 projections from 22 global circulation models (GCMs). The projections were made using three commonly-used scenarios from the Intergovernmental Panel on Climate Change (IPCC). For North Central BC[55], the following projections were made compared to the baseline data 1960 - 1990[56]:

- Annual and summer mean temperatures are expected to increase 1.6˚ – 2.5˚ C by the 2050s;
- Mean winter temperatures are expected to increase by up to 3.0˚ C in the Prince George region (2˚ – 2.5˚ C in the Mackenzie area);
- Annual mean precipitation is expected to increase 3 – 10% by the 2050s; the majority of the increase is expected during the winter and spring season.
- Summer mean annual precipitation in the Prince George and Peace Regions is projected to increase or decrease, which indicates the inherent uncertainty in the modelling, specifically in reference to precipitation. The modelling shows considerably more variability in precipitation than temperature.

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

[52] 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.

[53] Picketts, I., A. Werner, and T. Murdock for Pacific Climate Impacts Consortium. 2009. Climate Change in Prince George Summary of Past Trends and Future Projections.

[54] It is important to note that trends are impacted by modes of decadal variability, such as the Pacific Decadal Oscillation.

[55]GCM projections were run specifically for the Prince George area; the projections outlined in this document are those that were noted to be relatively uniform with in a 200 km area surrounding Price George. Projections outlined are based upon the mid-range ($25^{th}$ – $75^{th}$ percentile) of the ensemble.

[56] Picketts, I., A. Werner, and T. Murdock for Pacific Climate Impacts Consortium. 2009. Climate Change in Prince George Summary of Past Trends and Future Projections.

conclude that future conditions will include drier fuels and a higher frequency of extreme fire weather days.[57]

- The future daily fire severity rating (a seasonally cumulative value) is expected to have higher peak levels 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.[58]

- 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.[59, 60]

- More extreme precipitation events (increased intensity and magnitude of extreme rainfall) are expected, along with longer dry periods between major events (increased summer drought periods).[61,62] During large volume, extreme precipitation events in which much of the precipitation is expected to fall, there is higher likelihood of less infiltration of surface water into soils and therefore more runoff and drier soils.[63]

- Future climatic conditions may be more suitable for, or give competitive advantage to, new species of plants, including invasive species.[64]

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,

[57] 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.

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

[59] 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.

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

[61] Picketts, I., A. Werner, and T. Murdock for Pacific Climate Impacts Consortium. 2009. Climate Change in Prince George Summary of Past Trends and Future Projections.

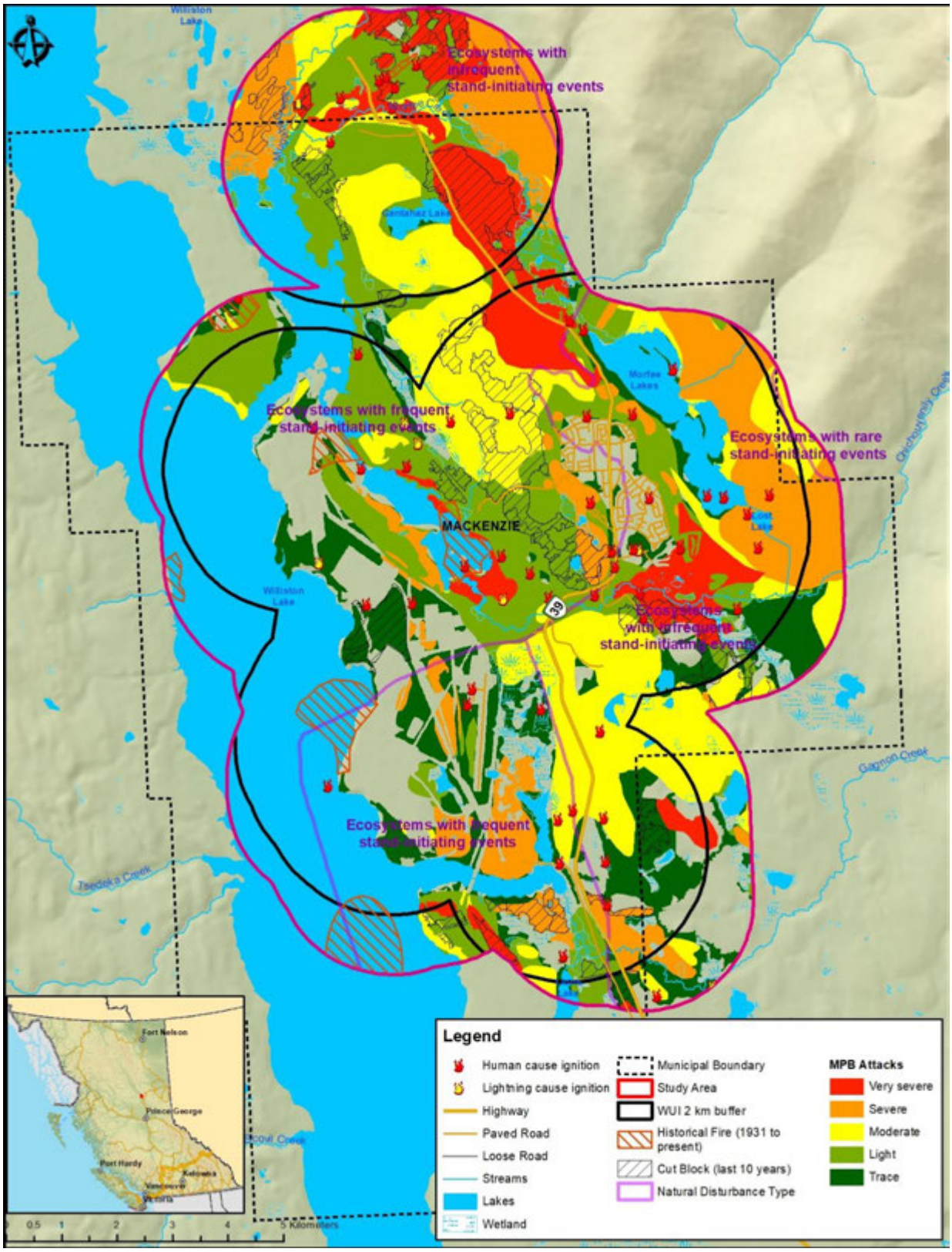
[62] British Columbia Agriculture & Food Climate Action Initiative. 2008.. Peace Region BC Agriculture and Climate Change Regional Adaptation Strategy Series.

[63] British Columbia Agriculture & Food Climate Action Initiative. 2008.. Peace Region BC Agriculture and Climate Change Regional Adaptation Strategy Series.

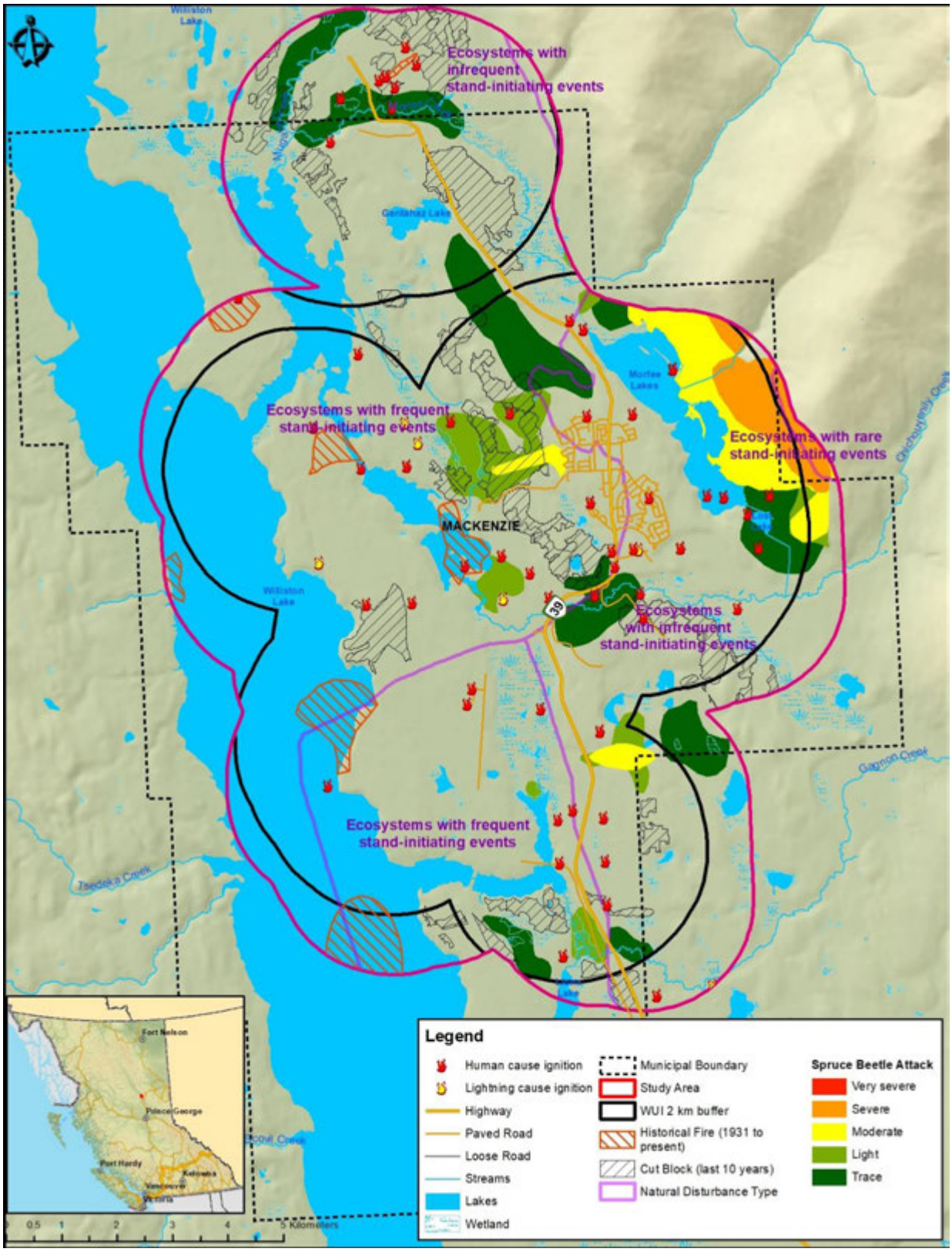
[64] Picketts, I., A. Werner, and T. Murdock for Pacific Climate Impacts Consortium. 2009. Climate Change in Prince George Summary of Past Trends and Future Projections.

and fire severity. Many of the projections noted above are expected to be disproportionately felt in northern latitudes.[65]

[65] All research noted, excluding the GCM ensemble, 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.




**Map 4. Fire Regime, Ecology and Climate Change (Mountain Pine Beetle Polygons).**




**Map 5. Fire Regime, Ecology and Climate Change (Spruce Beetle Polygons).**

## 4.2 PROVINCIAL STRATEGIC THREAT ANALYSIS (PSTA)

The Provincial Strategic Threat Analysis (PSTA) evaluates multiple data sets to provide a coarse (high-level) spatial representation of wildfire threats across BC. The information in this section is a synthesis of the BCWS' Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component.[66] Three inputs are combined to create the PSTA Wildfire Threat Analysis (WTA) Component:

1) **Historic fire density**: represents the ignition and fire spread potential based upon historic patterns (1950 - 2015) and fire density weighted by fire size (larger fire perimeters were given a higher weight in order to reflect the greater cost and damage usually associated with larger fires).
2) **Head fire intensity (HFI)**: represents the intensity (kW / m) of the fire front, a measure of the energy output of the flaming front. HFI is directly related to flame length, fire spread rate and fuel consumption and a fire's leading edge. There is a strong correlation between HFI, suppression effort required and danger posed to suppression personnel. The HFI used in the WTA was developed using the 90$^{th}$ percentile fire weather index value.
3) **Spotting impact**: represents the ability of embers or firebrands from a burning fire to be sent aloft and start new fires in advance of the firefront, or outside of the fire perimeter. Spotting is most associated with high intensity crown fires in coniferous fuels and structure losses. For the WTA, the spotting analysis is based on estimating the threat to a given point on the landscape from the fuels surrounding it, up to a distance of 2 km. Spotting distances greater than 2 km are rare and unpredictable.

The final wildfire threat analysis value was developed through an average weighting process of the aforementioned three layers: fire density 30%; HFI 60%; and spotting impact 10%. Water bodies were automatically given a value of 'no threat' (-1). The values were then separated into 10 classes (1 – 10) which represent increasing levels of overall fire threat (the higher the number, the greater the fire threat); threat class 7 is considered the threshold. Threat classes of 7 and higher are locations where the threat is severe enough to potentially cause catastrophic losses in any given fire season, when overlapping with values at risk. Classes were grouped into the following general threat class descriptions: low (1 – 3); moderate (4 – 6); high (7 – 8); and, extreme (9 – 10).

There are considerable limitations associated with the WTA Component based upon the accuracy of the source data and the modeling tools, the most notable being:

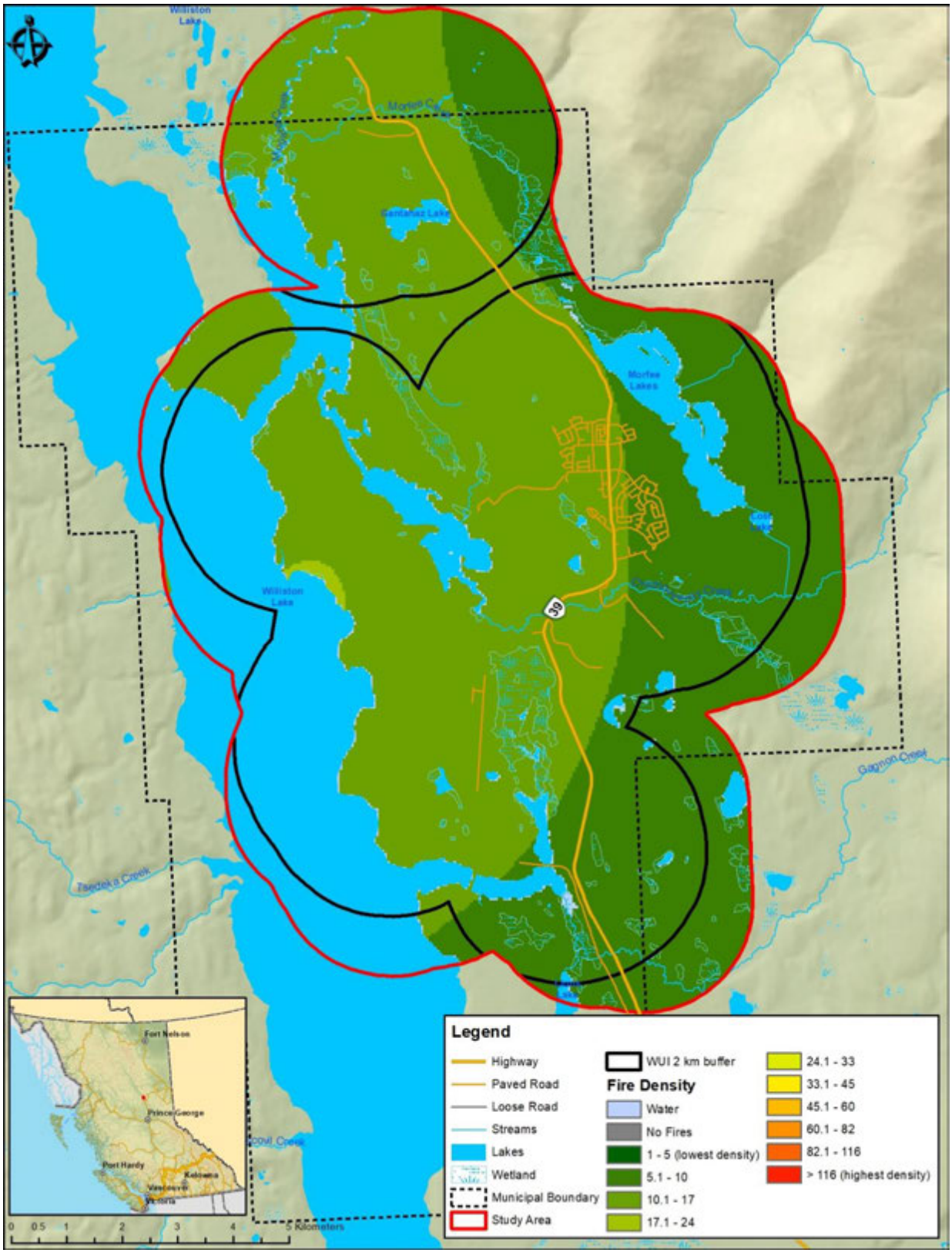
- Limited accuracy and variability of the fire history point data;

[66] BC Wildfire Service. 2015. *Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component*. Retrieved from: https://www.for.gov.bc.ca/ftp/!Project/WildfireNews/PSTA/Provincial_Strategic_Threat_Analysis_PSTA_2015_REPORT.pdf. Accessed January 9, 2018.

- Sensitivity to fuel type and the associated limitations of using fuel type approximations for fire behaviour modelling (see Section 4.3.1 for more details on fuel type limitations); and,
- 90$^{th}$ percentile rating for HFI, which represents a near worst-case scenario which may be artificial in some circumstances.

All parameters of the PSTA WTA are illustrated separately in Sections 4.2.2, 4.2.3, 4.2.4 below.

The WTA serves to provide a provincial-level threat assessment for resource and land managers and local governments in order to complete landscape fire management planning and strategically plan efficient and effective wildfire risk reduction initiatives (e.g. placement or prioritization of fuel treatment areas, identification of values at risk, FireSmart planning, etc.). The WTA is then validated at the stand level in order to produce a finer, more accurate assessment of local threat.



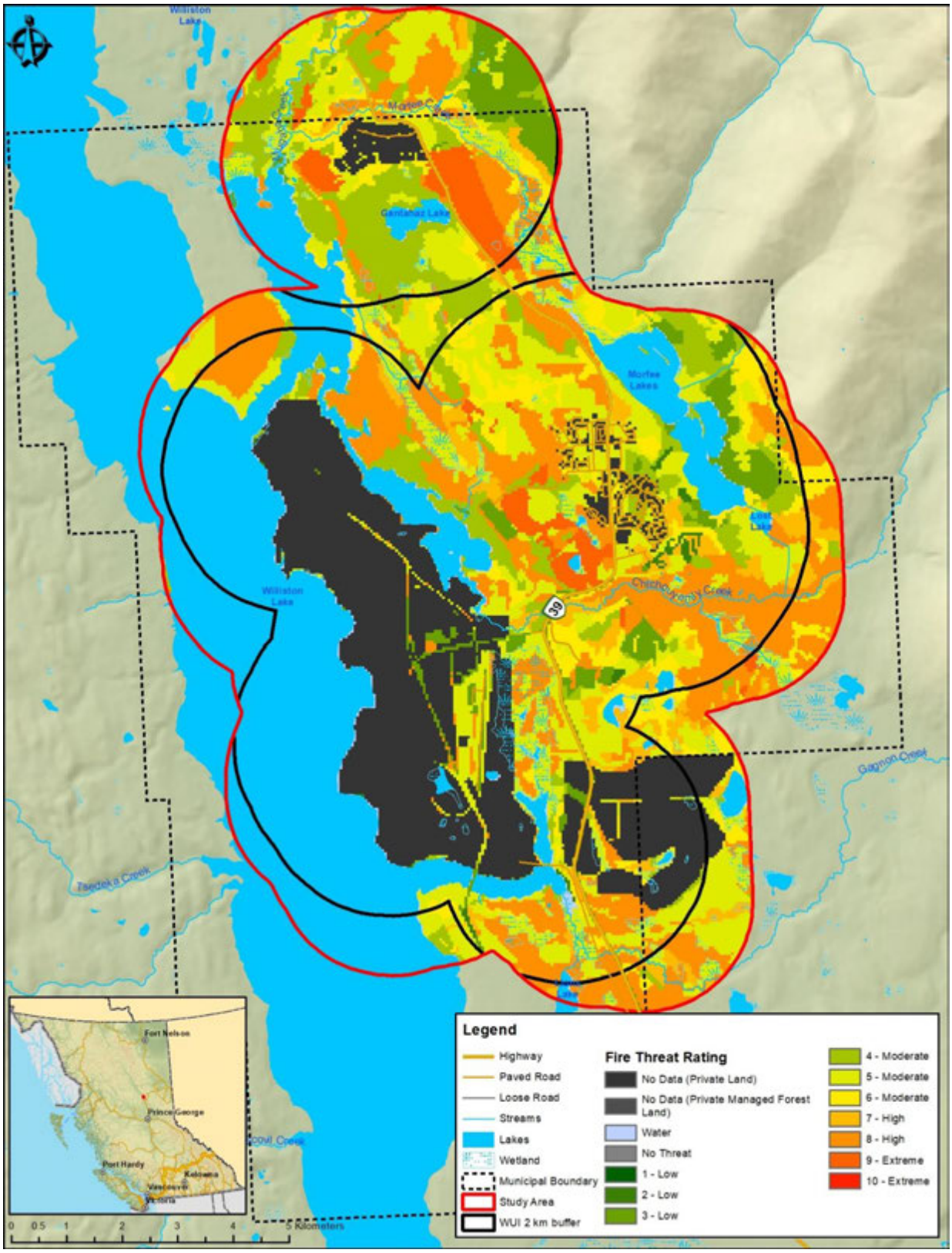

**Map 6. Historical Fire Density.**

### 4.2.1 PSTA Final Wildfire Threat Rating

Nearly half of the study area (32%) is categorized as a moderate wildfire threat rating in the provincial Wildfire Threat Analysis (Table 8). Water covers 24% of the study area and 8% is within the low threat classes. High and extreme threat ratings cover 22% of the study area; the most notable high threat areas are directly south of town centre along Chichouyenily creek, south of Gagnon, surrounding Gantahaz, and along both main and secondary access / egress routes (Parsnip West FSR and Highway 39 north between Mackenzie and Gantahaz).

**Table 8. Overall PSTA Wildfire Threat Analysis for the study area (rounded to the nearest hectare).**

| Threat Class | Area (ha) | Threat Class Description | Percent of study area |
|---|---|---|---|
| -3 | 2669.3 | No Data (Private Land) | 17% |
| -2 | 0.0 | No Data (Private Managed Forest Land) | 0% |
| -1 | 3716.6 | Water | 24% |
| 0 | 0.0 | No Threat | 0% |
| 1 | 0.0 | Low | 4% |
| 2 | 42.5 | | |
| 3 | 585.1 | | |
| 4 | 1352.1 | Moderate | 32% |
| 5 | 2747.0 | | |
| 6 | 938.3 | | |
| 7 | 604.1 | High | 20% |
| 8 | 2475.5 | | |
| 9 | 377.9 | Extreme | 2% |
| 10 | 0.0 | | |
| Total | 15508.5 | | 100% |




**Map 7. Provincial Strategic Threat Analysis.**

### 4.2.2 Spotting Impact

Spotting impact is modeled by fuel type and distance class from a given fuel type. The layer estimates the threat of embers impacting a given point on the landscape from the fuel types surrounding it.

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 in advance of the fire front. Firebrands can be transported long distances ahead of the wildfire, across fire guards and fuel breaks, and accumulate in densities that can exceed 600 embers per square meter. Combustible materials found adjacent or near to values at risk can provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

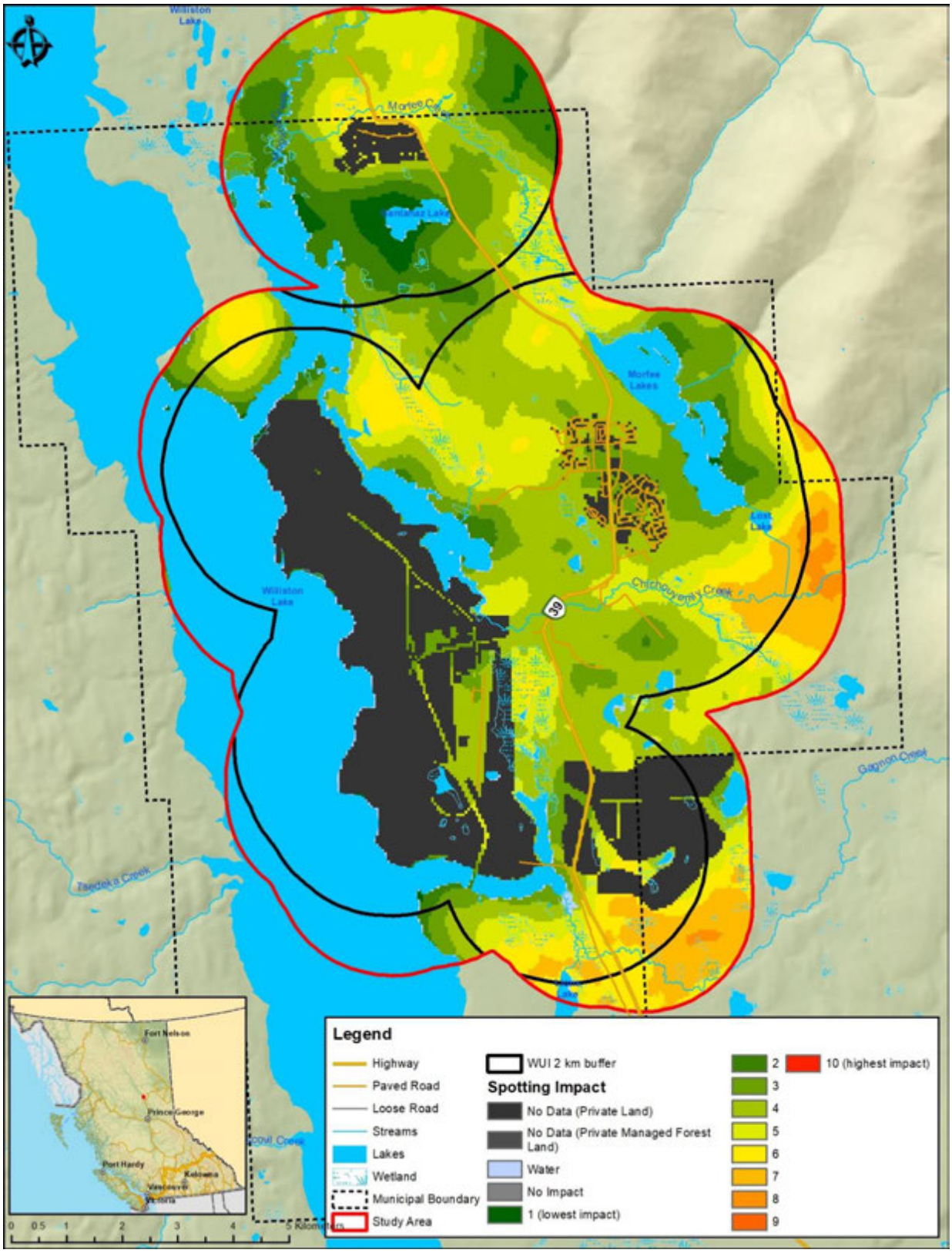
For example, an investigation of home destruction from the 2016 Fort McMurray, Alberta fire found that the vast majority of home ignitions in the interface (outer edges of urban neighbourhoods) were attributable to embers alighting on combustible material (home or adjacent areas).[67] Similarly, reports from the 2010 Fourmile Canyon fire outside Boulder, Colorado, found that only 17% of the 162 homes destroyed were attributed to crown fire.[68,69] 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.[69] 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 structure, or area adjacent to the structure, ignites.

Within the study area, those areas at highest risk of spotting are Gantahaz, southeast of town centre, and east of the mills along the Parsnip West FSR.

[67] 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

[68] 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/.

[69] 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.

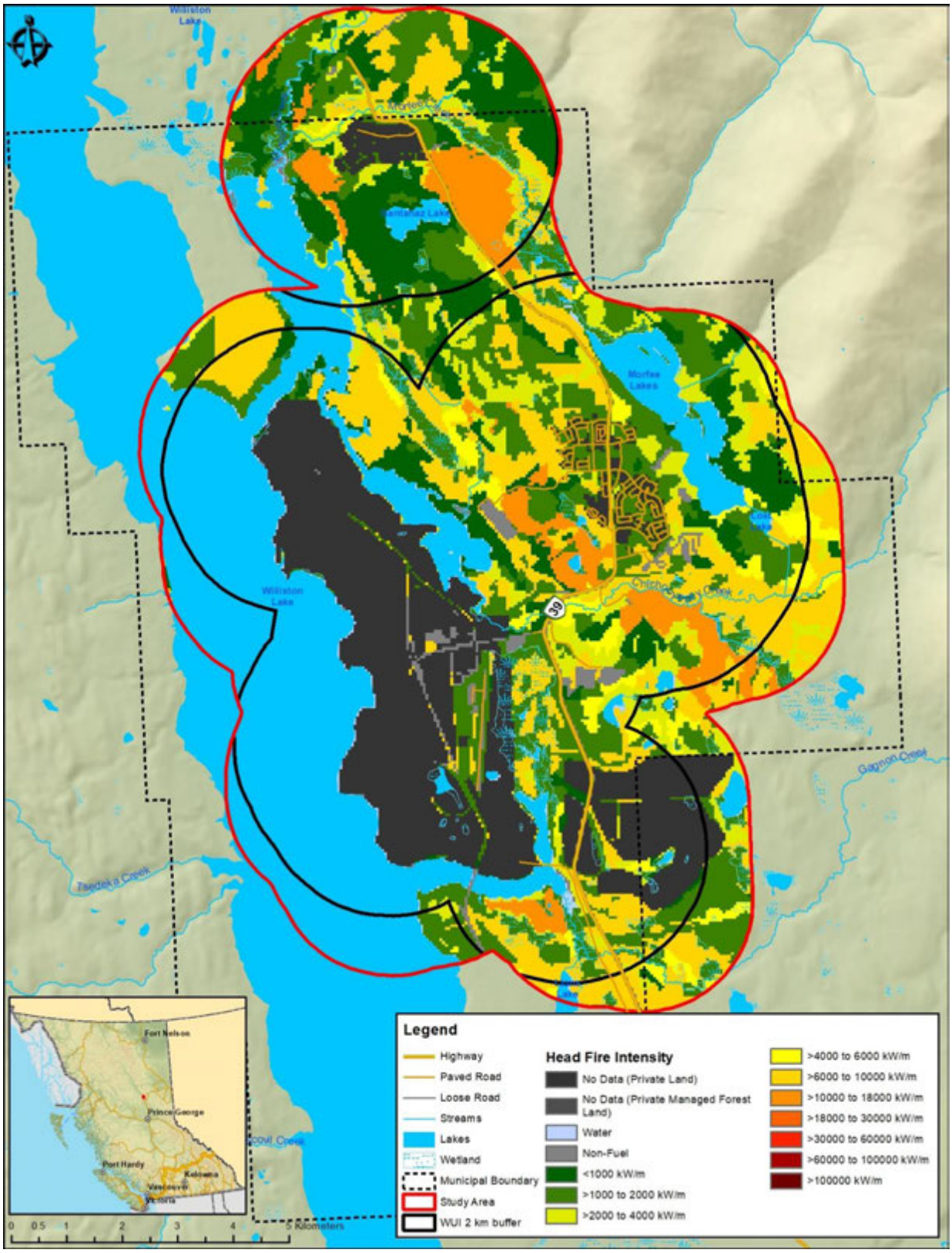



**Map 8. Spotting Impact within the Study Area.**

### 4.2.3 Head Fire Intensity

HFI is correlated with flame length and fire behaviour. The greater the fire intensity (kW / m), or HFI and fire intensity class, the more extreme the fire behaviour is likely to be and the more difficult the fire will likely be to suppress (Table 9 and Map 9).

In the study area, the highest fire intensity class is 6, which represents a highly vigorous surface fire with torching and / or continuous crown fire and flame length up to 18 m. Approximately 21% of the study area is fire intensity class 5, which is likely to exhibit vigorous surface fire with intermittent crowning and a flame length of 5 m. The highest HFI class areas are found surrounding Gantahaz, along the Parsnip West FSR, south of the mill area, and south of Gagnon. Sixty-seven percent (10,447 ha) of the study area is categorized into non-fuel or fire intensity class 2 – 3. These areas will likely have low to moderate fire behaviour (surface fires), which are generally able to be suppressed through direct action with ground crews.




**Map 9. Head Fire Intensity within the Study Area.**

**Table 9. Head Fire Intensity Classes and Associated Fire Behaviour**

| PSTA - HFI Class | Fire Intensity kW/m | Fire Intensity Class[70] | Flame Length (meters)[71] | Likely Fire Behaviour[72] |
|---|---|---|---|---|
| 1 | 0.01 – 1,000 | 2 | < 1.8 | Smouldering surface fire |
| 2 | 1,000.01 – 2,000 | 3 | 1.8 to 2.5 | Moderate vigour surface fire |
| 3 | 2,000.01 – 4.000 | 4 | 2.5-3.5 | Vigorous surface fire |
| 4 | 4,000.01 – 6,000 | 5 | 3.5 to 4.2 | Vigorous surface fire with occasional torching |
| 5 | 6,000.01 – 10,000 | 5 | 4.2 to 5.3 | Vigorous surface fire with intermittent crowning |
| 6 | 10,000.01 – 18,000 | 6 | 12.3 to 18.2 | Highly vigorous surface fire with torching and/or continuous crown fire |
| 7 | 18,000.01 – 30,000 | 6 | 18.2 to 25.6 | Extremely vigorous surface fire and continuous crown fire |
| 8 | 30,000.01 – 60,000 | 6 | >25.6[73] | Extremely vigorous surface fire and continuous crown fire, and aggressive fire behaviour |
| 9 | 60,000.01 – 100,000 | 6 | >25.6 | Blowup or conflagration, extreme and aggressive fire behaviour |
| 10 | ≥ 100,000 | 6 | >25.6 | Blowup or conflagration, extreme and aggressive fire behaviour |

### 4.2.4 Fire History

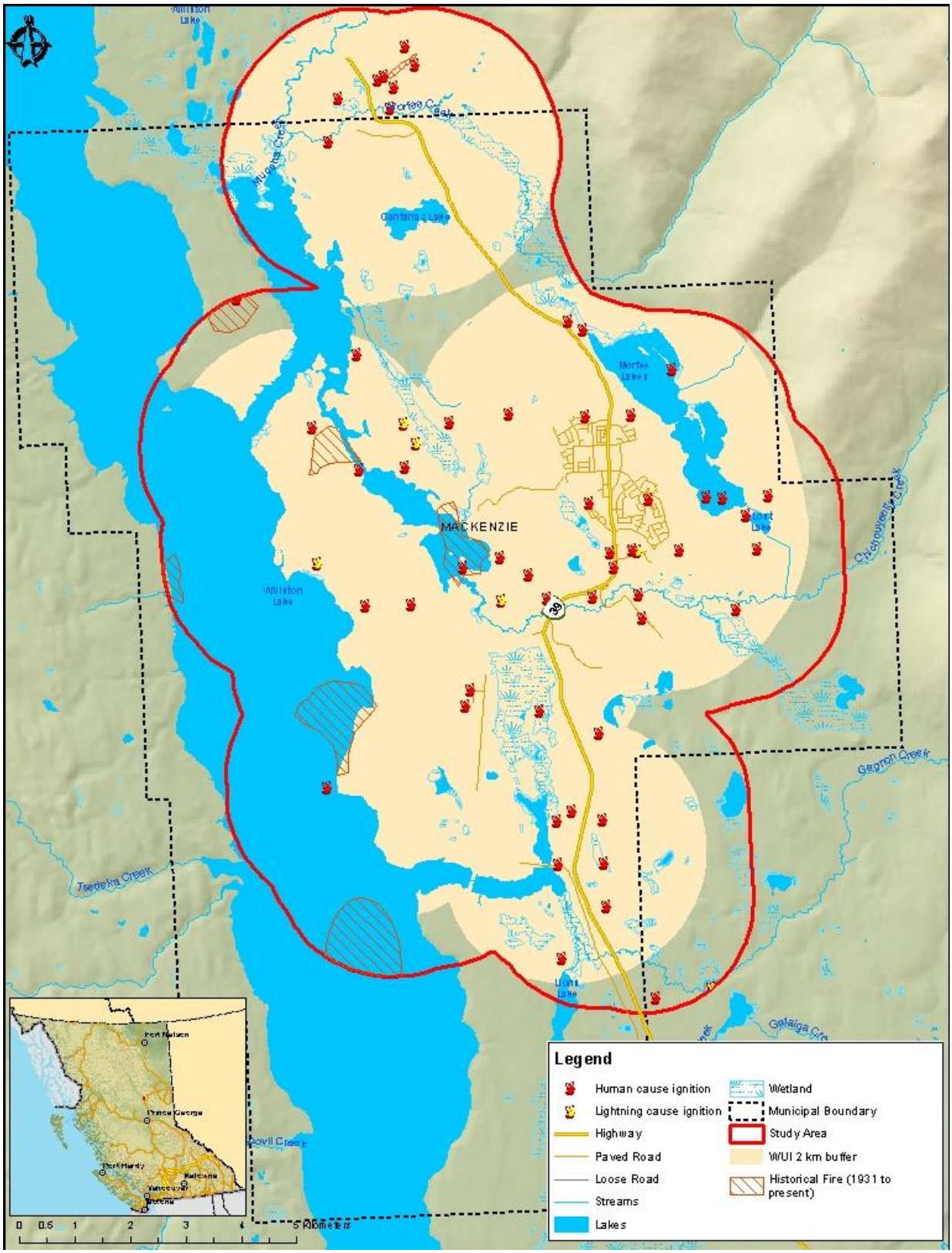
Fire ignition data for the study area is available 1955 – 2015; and fire perimeter data from 1931 – 2015. From the year 1955, there have been 78 fire incidents within the study area. Eleven of the 78 were smoke-chases or considered nuisance fires; 67 were fires requiring some degree of suppression. The highest rate of fires per decade occurred in the 1970s; ignitions have been decreasing since that decade.

Of the 78 incidents, 82% were human-caused; the percentage of human-caused fires in the study area is much greater than the provincial average, which is around 40%. This trend has increased in recent years; since the year 2000, 90% of the fires in the study area were human-caused. Of the human-caused fires (excluding nuisances and smoke chases), campfires (escape, noncompliance, or abandoned) were

[70] Head fire intensity should be classified by intensity class not fire rank. Fire rank is a visual description of conifer fires for air operations.
[71] For calculating Flame Length, Bryam (1959) was used for surface fire (<10 000 kW/m) and Thomas (1963) was used for crown fire situations (>10 000 kW/m).
[72] These characteristics will be different in open and closed forest fuel.
[73] With HFI over 30 000 kW/m the function of the equation are stretched beyond the expectation of the equation, fire is under the influence too many other factors.

the most common cause of ignition (20 fires or 30%), open burning and arson each accounted for 14 of the fires, and juveniles experimenting with fire caused 6 ignitions.

In 2014, two fires less than 5 km from the study area burned 198 ha and 143 ha. In 2010 there were two smaller fires that burned 5 km from the study area. The most recent major activity in the study area was in 2007 when a fire just north of Gantahaz burned 5 ha. The largest fire occurred in 1942, was ignited by lightning and burned more than 25,000 ha.




**Map 10. Fire History.**

## 4.3 LOCAL WILDFIRE THREAT ASSESSMENT

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.*[74]
- *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.*[75]

Additional information and details can be found in Appendix F.

WUI Threat Assessments were completed over five field days in October 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.

Field assessment locations were prioritized based upon:

- PSTA WTA class - Field assessments were clustered in those areas with WTA classes of 6 or higher.
- Proximity to values at risk – Field assessments were clustered in the intermix and interface, as well as around critical infrastructure.
- Prevailing fire season winds – More field time was spent assessing areas upwind (south, southwest and southeast) of values at risk.
- Slope position of value – More field time was spent assessing areas downslope of values at risk. Similarly, values at top of slope or upper third of the slope were identified as particularly vulnerable.
- Land ownership – Crown and municipal land was the main focus of field assessments.
- Previous mitigation efforts – Those areas which had previously had fuel reduction or modification were field assessed.
- Local knowledge – Areas identified as hazardous, potentially hazardous, with limited access / egress, or otherwise of particular concern as vulnerable to wildfire, as communicated by fire officials and BCWS zone staff.

[74] Strategic Wildfire Prevention Initiative.

[75] National Fire Protection Association.

- Observations – Additional areas potentially not recognized prior to field work were visually identified as hazardous and assessed during the week.

A total of 33 WUI threat plots were completed and more than 212 other field stops (qualitative notes, fuel type verification and/or photograph documentation) were made across the study area (Map 11). A complete enumeration of plots can be found in Appendix G.

### 4.3.1 Fuel Type Verification

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.[76] 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 refinement, for 20 years.[77] 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, and limitations in the data used to create initial fuel types.[77] Details regarding fuel typing methodology and limitations are found in Appendix H. 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 10 summarizes the fuel types by general fire behaviour (crown fire and spotting potential). In general, the fuel types considered hazardous in terms of fire behaviour and spotting potential are C-2, C-4, and M-3/4 with a high component of mortality. C-3 and C-7 can sometimes represent hazardous fuels, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth. C-5 fuel types have a moderate potential for active crown fire when wind-driven.[77] 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.[78] 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

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

[77] 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.

[78] Ibid.

assessment should occur every 5 – 10 years to determine the need for threat assessment updates and the timing for their implementation.

**Table 10. A summary of fuel types and associated hazard.[79]**

| Fuel Type | FBP / CFDDRS Description | Study Area Description | Wildfire Behaviour Under High Wildfire Danger Level | Fuel Type – Crown Fire / Spotting Potential |
|---|---|---|---|---|
| C-1 | Spruce-lichen woodland | Very open black spruce with *cladonia* lichen as a defining component of the fuel type structure. | Low to very high fire intensity and rate of spread. | High |
| C-2 | Boreal spruce | As identified by PSTA data. Pure spruce stands. | Almost always crown fire, high to very high fire intensity and rate of spread | High |
| 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 | High* |
| C-4 | Immature jack or lodgepole pine | Dense/ overstocked pole-sapling forest and young plantations (>8000 stems per hectare and 4- 12 m in height), 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 | High |
| 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 | Low |
| 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. Areas harvested 25+ years ago (and not achieving M-1/2 or C-3 fuel type characteristics), open stand type (>40% crown closure). | Surface fire spread, torching of individual trees, rarely crowning (usually limited to slopes > 30%), moderate to high intensity and rate of spread | Low |

[79] Fuel typing guided by Perrakis and Eade (2015).

| Fuel Type | FBP / CFDDRS Description | Study Area Description | Wildfire Behaviour Under High Wildfire Danger Level | Fuel Type – Crown Fire / Spotting Potential |
|---|---|---|---|---|
| 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. Areas harvested 7 – 24 years ago (dense or open and >4 m in height). | Rapidly spreading, high- intensity surface fire when cured | Low |
| 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) | <26% conifer (Very Low);<br>26-49% Conifer (Low);<br>>50% Conifer (Moderate) |
| D-1/2 | Aspen (leafless and green) | Deciduous stands | Always a surface fire, low to moderate rate of spread and fire intensity | Low |
| 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 | Low |
| W | N/A | Water | N/A | N/A |
| N | N/A | Non-fuel: irrigated agricultural fields, golf courses, alpine areas void or nearly void of vegetation, urban or developed areas void or nearly void of forested vegetation. | N/A | N/A |

**C-3 fuel type is considered to have a high crown fire and spotting potential within the study area due to the presence of moderate to high fuel loading (dead standing and partially or fully down woody material), and continuous conifer ladder fuels (i.e., hybrid spruce, Sx, lodgepole pine, Pl, and/or Balsam fir, Bl).*

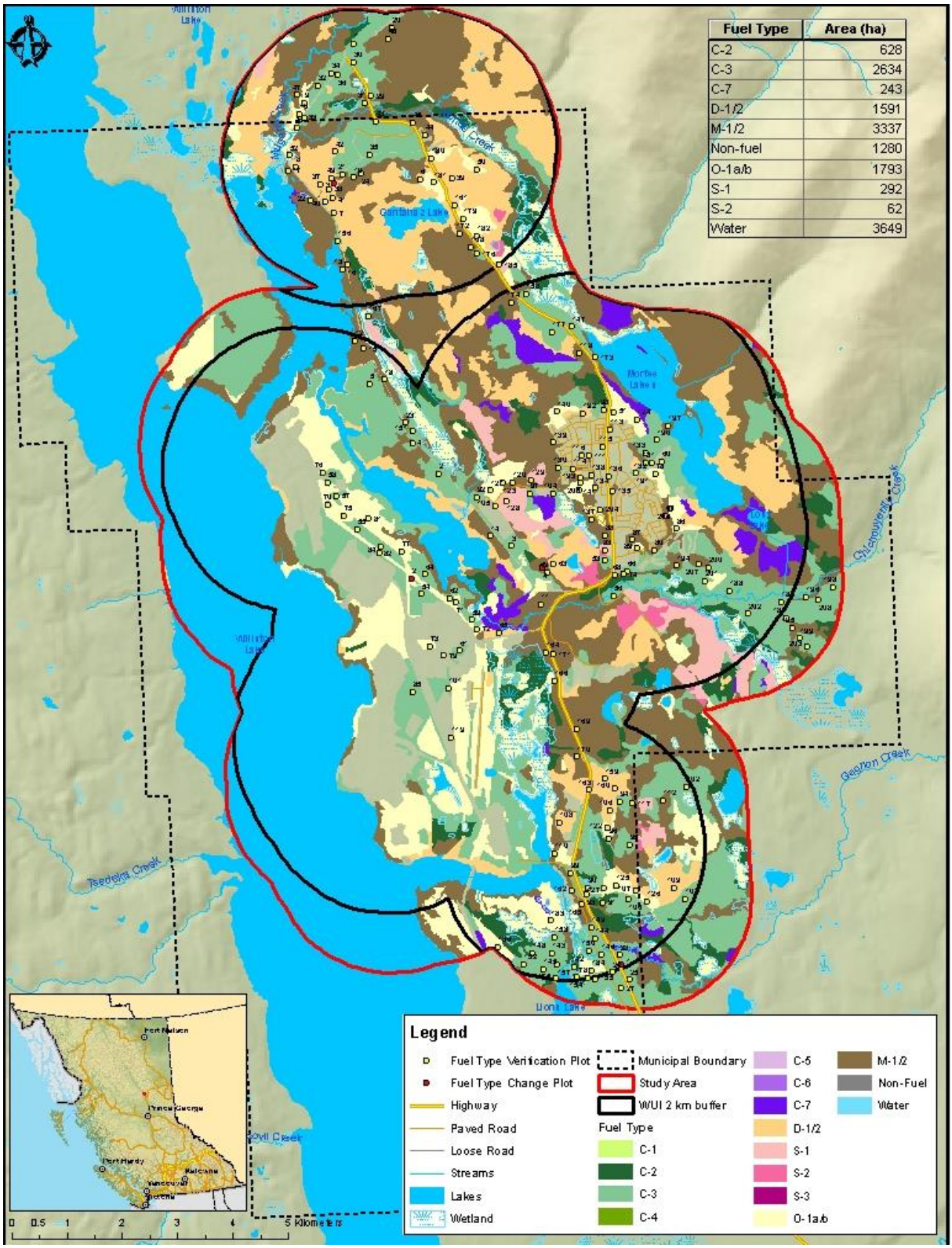
During field visits, four recurring patterns of fuel type errors were found in the provincial dataset. They were:

- M-1/2 fuel types inaccurately typed as D-1/2;
- C-3 fuel types inaccurately typed as M-1/2;

- C-3 fuel types inaccurately typed as O-1a/b; and,
- D-1/2 fuel types inaccurately typed as S-1.

These fuel type errors were identified in multiple polygons across the study area; approximately 20% of the fuel type polygons were updated. The other 80% of polygons retained the provincial fuel typing, many of these polygons were field verified. In the case where the polygon was not able to be verified or updated with confidence, polygons retained the provincial fuel type call.

All fuel type updates were approved by BCWS, using stand and fuel descriptions and photo documentation for the review process (see Appendix A for submitted fuel type change rationales).




**Map 11. Updated Fuel Type.**

### 4.3.2 Proximity of Fuel to the Community

Fire hazard classification in the WUI is partly dictated by the proximity of the fuel to developed areas within a community. More specifically, fuels closest to the community are considered to pose a higher hazard in comparison to fuels that are located at greater distances from values at risk. As a result, it is recommended that the implementation of fuel treatments prioritizes fuels closest to structures and / or developed areas, in order to reduce hazard level adjacent to the community. Continuity of fuel treatment is an important consideration, which can be ensured by reducing fuels from the edge of the community outward. Special consideration must be allocated to treatment locations to ensure continuity, as discontinuous fuel treatments in the WUI can allow wildfire to intensify, resulting in a heightened risk to values. In order to classify fuel threat levels and prioritize fuel treatments, fuels immediately adjacent to the community are rated higher than those located further from developed areas. Table 11 describes the classes associated with proximity of fuels to the interface.

**Table 11. Proximity to the Interface.**

| Proximity to the Interface | Descriptor* | Explanation |
|---|---|---|
| **WUI 100** | (0-100 m) | This Zone is always located adjacent to the value at risk. Treatment would modify the wildfire behaviour near or adjacent to the value. Treatment effectiveness would be increased when the value is FireSmart. |
| **WUI 500** | (101-500m) | Treatment would affect wildfire behaviour approaching a value, as well as the wildfire's ability to impact the value with short- to medium- range spotting; should also provide suppression opportunities near a value. |
| **WUI 2000** | (501-2000 m) | Treatment would be effective in limiting long-range spotting but short-range spotting may fall short of the value and cause a new ignition that could affect a value. |
| | >2 000 m | This should form part of a landscape assessment and is generally not part of the zoning process. Treatment is relatively ineffective for threat mitigation to a value, unless used to form a part of a larger fuel break / treatment. |

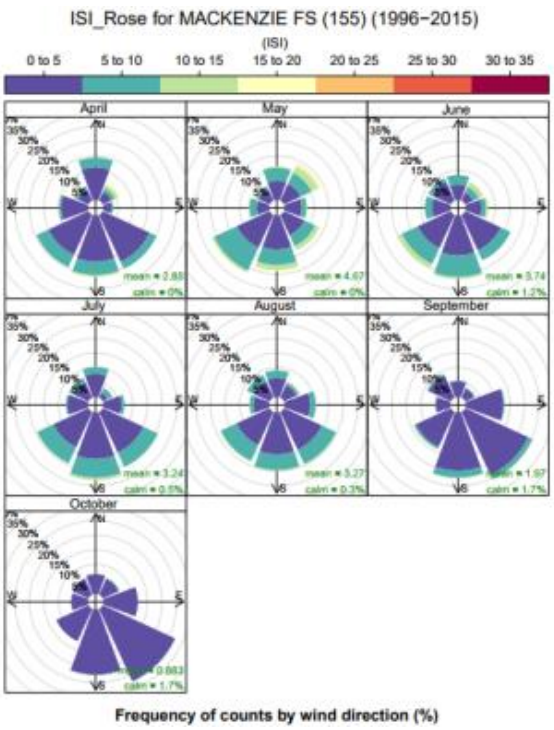
* Distances are based on spotting distances of high and moderate fuel type spotting potential and threshold to break crown fire potential (100m). These distances can be varied with appropriate rationale, to address areas with low or extreme fuel hazards.

### 4.3.3 Fire Spread Patterns (i.e., ISI Roses)

Wind speed, wind direction, and fine fuel moisture condition influence wildfire trajectory and rate of spread. Wind plays a predominant role in fire behaviour and direction of fire spread and is summarized in the Initial Spread Index (ISI) Rose(s) from the local representative BCWS weather station Mackenzie FS. The wind rose data is compiled daily and provides an estimate of prevailing wind directions and wind speed in the area of the weather station.

During the fire season (April – October) and from the hours of 6 am to 6 pm, southwesterly, southeasterly and southern winds dominate, with the average wind speeds being the highest in July and August (Figure 2). An average of daily wind readings for the fire season shows similar trends in

predominant wind direction during the fire season (Figure 2 and Figure 3). Potential treatment areas were identified and prioritized with the predominant wind direction in mind; wildfire that occurs upwind of a value poses a more significant threat to that value than one which occurs downwind. In consultation with the District of Mackenzie and partners such as the MLMCF manager, it was determined that there is considerable variability in wind conditions between the Mackenzie FS weather station location (town centre) and the industrial area / satellite development of Gantahaz. The establishment of additional weather monitoring stations is recommended for the aforementioned areas, in order to account for local wind variability and to support future wildfire hazard reduction recommendations.



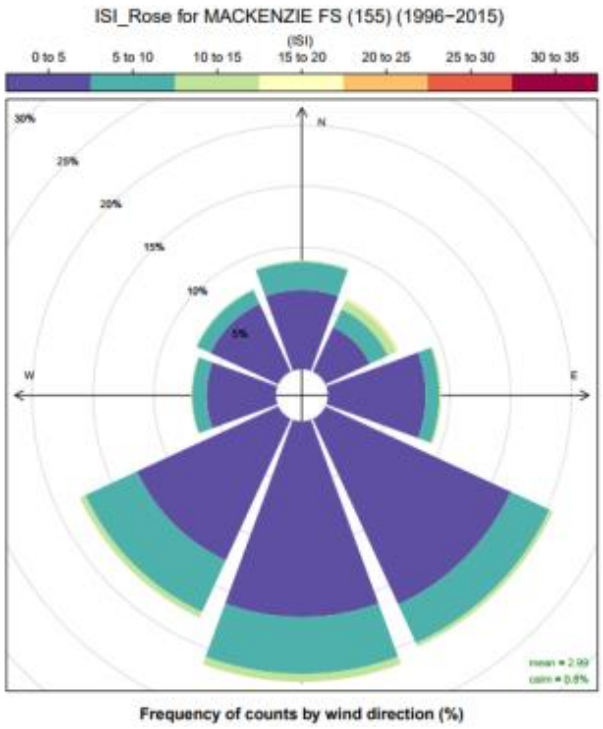




**Figure 2. Initial Spread Index (ISI) Roses (left).**

**Figure 3. Windrose showing average daily wind readings during the fire seasons (April 1 – October 31) 1996-2015 for the Mackenzie FS weather station in the District of Mackenzie (right).**

### 4.3.4 Topography

Topography is an important environmental component that influences fire behaviour. Considerations include slope percentage (steepness) and slope position where slope percentage influences the fire's trajectory and rate of spread and slope position relates to the ability of a fire to gain momentum uphill. Other factors of topography that influence fire behaviour include aspect, elevation and land configuration.

### *Slope Class*

Slope steepness affects solar radiation intensity, fuel moisture (influenced by radiation intensity) and influences flame length and rate of spread of surface fires. Table 12 summarizes the fire behaviour implications for slope percentage (the steeper the slope the faster the spread).

**Table 12. Slope Percentage and Fire Behaviour Implications**

| Slope | Percent of AOI | Fire Behaviour Implications |
|---|---|---|
| **<20%** | 93% | Very little flame and fuel interaction caused by slope, normal rate of spread. |
| **21-30%** | 4% | Flame tilt begins to preheat fuel, increase rate of spread. |
| **31-45%** | 2% | Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread. |
| **46-60%** | 1% | Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread. |
| **>60%** | 0% | Flame tilt preheats fuel and bathes flames into fuel well upslope, extreme rate of spread. |

### *Slope Position of the Value*

Slope position affects temperature and relative humidity. A value placed at the bottom of the slope is equivalent to a value on flat ground (see Table 12). A value on the upper 1/3 of the slope would be impacted by preheating and faster rates of spread (Table 13).

The town centre of Mackenzie is at the top of a gently sloping mound between Morfee Lake and Williston Lake. Although it would not be categorized as top of slope, fires burning in any direction of Mackenzie town centre would likely burn up towards the main developed portion of town, absent of wind.

On the larger topographic scale, Mackenzie and the surrounding industrial, commercial, recreational, and residential developments would be considered in the valley bottom. The community is nestled between lakes at the base of the foothills of the Rocky Mountains to the east.

**Table 13. Slope Position of Value and Fire Behaviour Implications**

| Slope Position of Value | Fire Behaviour Implications |
|---|---|
| **Bottom of Slope/ Valley Bottom** | Impacted by normal rates of spread. |
| **Mid Slope - Bench** | Impacted by increase rates of spread. Position on a bench may reduce the preheating near the value. (Value is offset from the slope). |
| **Mid slope – continuous** | Impacted by fast rates of spread. No break in terrain features affected by preheating and flames bathing into the fuel ahead of the fire. |
| **Upper 1/3 of slope** | Impacted by extreme rates of spread. At risk to large continuous fire run, preheating and flames bathing into the fuel. |

### 4.3.5 Local Wildfire Threat Classification

Using the verified and updated fuel types combined with field wildfire threat assessments, local wildfire threat for the study area was updated. Using the 2012 methodology, 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).

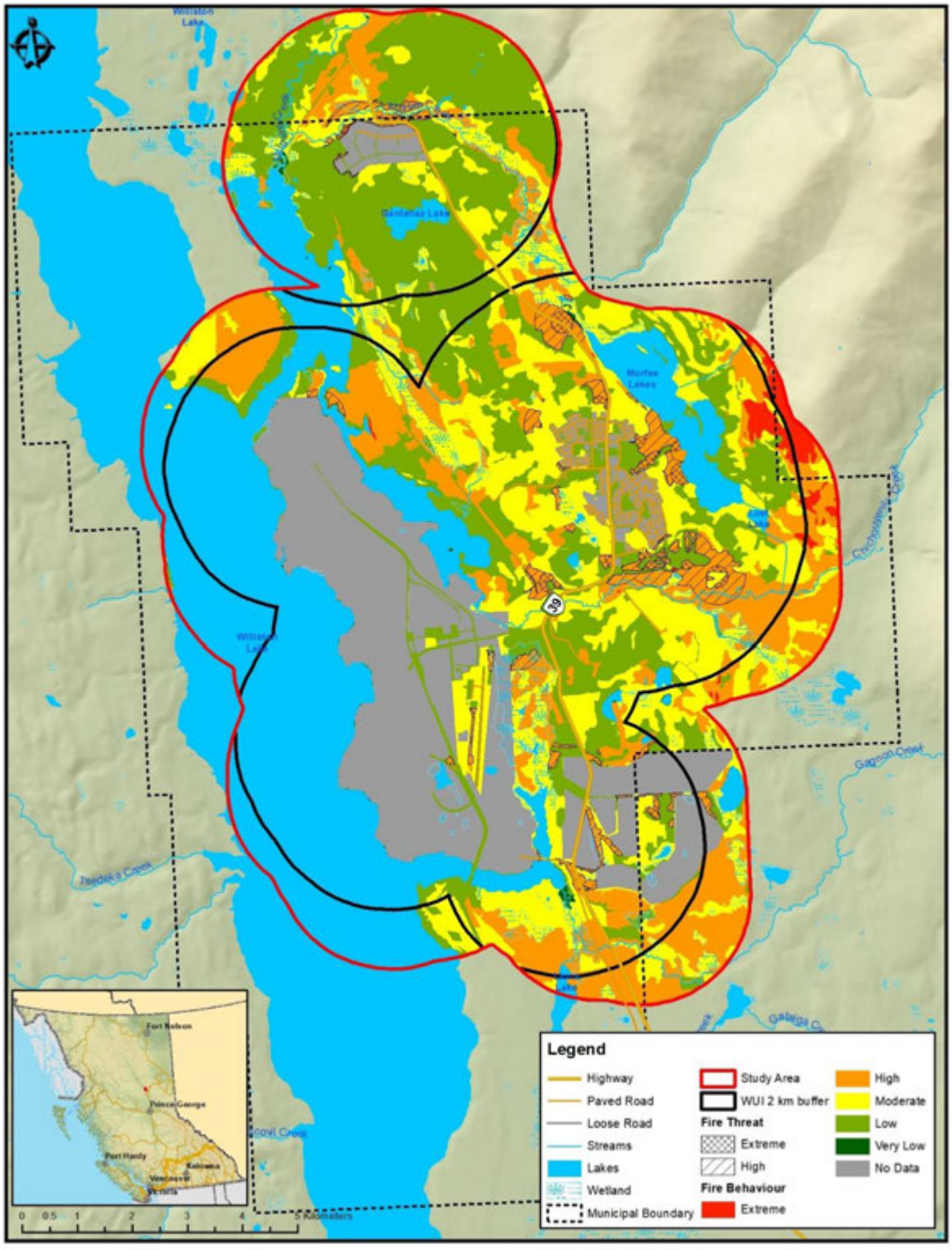
The result of the analysis shows that the study area is composed of a mosaic of low, moderate and high threat class stands; the variability in wildfire threat is dictated primarily by the level of natural and anthropogenic disturbances that have historically occurred and persist on the landbase. The study area is roughly 1% extreme threat class rating, 16% high, 20% moderate, 23% low wildfire behaviour threat class and 23% very low wildfire threat class (Table 14). The remaining 17% of the AOI is classified as private and as such has been allocated no fire threat data. Assessment of fire threat on private land is not funded by SWPI and is therefore outside of the scope of this CWPP.

The areas that represent the highest wildfire behaviour potential and greatest risk to the values of District of Mackenzie are areas of high and extreme threat class which are directly upwind (i.e., to the south and southwest) of the industrial mill area, the satellite developments of Gantahaz and Gagnon, and the town centre. It is recommended that mitigation efforts be focused in these areas.

For detailed methodology on the local threat assessment and classification, please see Appendix I – WUI Threat Assessment Methodology.

**Table 14. Fire behaviour threat summary for the study area**

| Fire Behaviour Threat Class | 2015 PSTA Data | 2017 CWPP |
|---|---|---|
| | Percent of Study Area | Percent of Study Area |
| **Extreme** | 2% | 1% |
| **High** | 20% | 16% |
| **Moderate** | 32% | 20% |
| **Low** | 4% | 23% |
| **Very Low/No Threat (Water)** | 24% | 23% |
| **No Data (Private Land / Private Managed Forest Land)** | 17% | 17% |




**Map 12. Local Fire Behaviour Threat Rating and WUI Threat Rating.**

# SECTION 5: RISK MANAGEMENT AND MITIGATION FACTORS

This section outlines a wildfire risk management and mitigation strategy that accounts for fuel types present within the community, local ecology, hazard, terrain factors, land ownership, and capacity of Local Government and First Nations. Wildfire risk mitigation is a complex approach that requires cooperation from applicable land managers/owners, which includes all level of governments (local, provincial and federal), First Nations and private landowners. The cooperative effort of the aforementioned parties is crucial in order to develop and proactively implement a wildfire risk mitigation program. Development of a successful wildfire risk mitigation strategy is dependent on hazard identification within the community, which accounts for forest fuels, high risk activities, frequency and type of human use, and other important environmental factors. The resulting wildfire risk management and mitigation strategy aims to build more resilient communities and produces strategic recommendations or actionable items that can be categorized as follows:

1. Fuel management opportunities to reduce fire behaviour potential in the WUI;
2. Applications of FireSmart approaches to reduce fire risk and impacts within the community; and,
3. Implementation of communication and education programs to inform and remind the public of the important role it plays in reducing fire occurrence and impacts within its community.

## 5.1 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 and structures (Priority Zone 3 and beyond). The principles of fuel management are outlined in detail in Appendix J.

Fuel treatments have been completed on approximately 326 ha within the study area since the development of the 2005 CWPP. These fuel treatments were directly adjacent to values at risk (residences in the town centre and upwind of the Gantahaz subdivision) and occurred on municipal and crown 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 (create 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 Home Ignition Zone (HIZ) can withstand or survive an ember shower without alighting. The HIZ is the area surrounding a home that dictates ignition potential of the structure. More detailed information about the HIZ and the FireSmart approach is provided in Section 5.2.1. 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.

Funds from public sources, such as Union of British Columbia Municipalities (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. Fortunately, the majority of the AOI within the District of Mackenzie is located on Crown lands, which largely reduces some of the challenges encountered in mitigation of fuels on private lands. The best approach to mitigate fuels on private lands is to urge private landowners to comply with FireSmart guidelines (as described below in Section 0) and to conduct appropriate fuel modifications using their own resources. The District is working with the MLMCF 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.

The fuel treatment opportunities identified in this document include the use of interface and primary fuel breaks, and interface fuel treatment as defined in Section 5.1.1, to reduce the wildfire potential around the District of Mackenzie. Fuel treatment approaches may include fuel removal, thinning and stand conversion. The latter has been shown to be effective at reducing wildfire potential in mixed-wood or conifer dominated stands and is recommended as a BMP to encourage a higher deciduous component. This approach generally involves a thin-from-below to reduce ladder fuels and crown fuels continuity, targeting the removal of conifer species and the retention of broadleaf species. Stand conversion fuel treatments are intricately linked to the establishment and enactment of fire management stocking standards within the WUI 2km buffer. The implementation of modified stocking standards plays a pivotal role in ensuring the success and effectiveness of stand conversion fuel treatments and associated reduction of fire hazard.[80]

Deciduous trees have higher foliar moisture content (>140%)[81] and higher crown base height than coniferous species and are associated with higher moisture fuelbeds.[82] Additionally, deciduous species such as aspen (*Populus tremuloides*) have lower concentrations of resins or essential oil contents than conifer species, which impacts the stand fire hazard by reducing the flammability and potential for sustained combustion.[83] An important caveat to note with regards to fire hazard in aspen or hardwood dominated stands is the seasonal flammability aspect, dictated by the foliar moisture content of the hardwoods, the presence or absence of understory vegetation and the moisture level of the litter and duff layers.[84] In the boreal forest region of Canada, the absence of hardwood foliage during the month of May, in particular, has been linked to microclimatic conditions which are conducive to increased fire behaviour.[84] More specifically, the fire behaviour potential is higher during this short, but critical transition period to full leaf-out conditions, due in part to the factors: 1) unrestricted penetration of solar radiation causing drying of surface litter and duff layers; 2) absence of high moisture content understorey vegetation which could otherwise dampen surface fire spread; and 3) unrestricted, ground-level effects of wind speed, which impact fine fuels moisture levels and potential propagation at the flame front.[84]

[80] Forest Practices Board. (2006). Managing Forest Fuels. Special Report. Available online at: https://www.bcfpb.ca/wp-content/uploads/2016/04/SR29-Managing-Forest-Fuels.pdf

[81] Johnson, E. A. (1996). *Fire and vegetation dynamics: studies from the North American boreal forest*. Cambridge University Press.

[82] Rothwell, R. L.; Woodard, P. M.; Samran, S. (1991). The effect of soil water on aspen litter moisture content. In: Andrews, Patricia L.; Potts,Donald F., eds. Proceedings, 11th conference on fire and forest meteorology; 1991 April 16-19; Missoula, MT. Bethesda, MD: Society of American Foresters: 117-123.

[83] Hély, C., Bergeron, Y., & Flannigan, M. D. (2000). Effects of stand composition on fire hazard in mixed-wood Canadian boreal forest. *Journal of Vegetation Science*, *11*(6), 813-824.

[84] Alexander, M. E. (2010). Surface fire spread potential in trembling aspen during summer in the Boreal Forest Region of Canada. *The Forestry Chronicle*, *86*(2), 200-212.

Wildfire research studies have shown that leafed-out deciduous leading stands will support lower intensity fires,[85] resulting in a lower amount of area burned, and act as natural fuel breaks during wildfires.[86,87] The conifer component within a stand and at the landscape level has direct implications on fire behaviour and area burned, where a higher conifer component is linked to increased head fire intensity and more intense fire behaviour potential in comparison to mixed-wood or deciduous stands.[83]

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 elements of public education (signage, community work days, public tours, active demonstrations of operations, etc.). Demonstration treatments may be valuable in the District, particularly in the easternmost portion of the Secondary School Woodlot (W0672), which is located in proximity to the satellite development of Gagnon. This area is characterized by a patchwork of hazardous fuel types: dense immature pine stands (C-3), dense immature to mature spruce leading stands (C-2) and stands with considerable fuel accumulations due to MPB grey-attack, and dead standing pine (C-3). This area has the potential to be utilized for educational purposes to demonstrate fuel treatments.

Additional areas of concern identified during the CWPP development process were as follows: 1) the vulnerability of the Morfee aquifer (Mackenzie domestic water source supply) to wildfire and potential implications for future proposed fuel treatment; and 2) the area between Gantahaz Lake and the town centre, and its associated fire threat. Future CWPP updates should include a more detailed assessment of potential wildfire impacts on water quantity/quality and provide fuel treatment recommendations to support protection of the Morfee drainage. Due to concerns voiced regarding previous impacts of MPB in the area between Gantahaz Lake and town centre, it is recommended that the District investigate the area and ground truth the fuel types and risk rating. This investigation will evaluate the requirement for hazard reduction and rationalize the establishment of potential future fuel treatment polygons.

### 5.1.1 Priority Treatment Units

Funding opportunities from UBCM and SWPI are currently limited to Crown Provincial, Regional District, or Municipal land. This does not preclude other current and future funding opportunities or potential industrial partnerships.

[85] Hély, C., Flannigan, M., Bergeron, Y., & McRae, D. (2001). Role of vegetation and weather on fire behavior in the Canadian mixedwood boreal forest using two fire behavior prediction systems. *Canadian journal of forest research*, *31*(3), 430-441.

[86] Bevins, Collin D. (1984). Historical fire occurrence in aspen stands of the Intermountain West. Missoula, MT: Systems for Environmental Management. Cooperative Agreement 22-C-4-INT-31. 23 p.

[87] Fechner, Gilbert H.; Barrows, Jack S. (1976). Aspen stands as wildfire fuel breaks. Eisenhower Consortium Bulletin 4. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 26 p. In cooperation with: Eisenhower Consortium for Western Environmental Forestry Research.

The potential treatment areas represent moderate, high or extreme fire hazard areas which are close to values at risk (structures or infrastructure) and are located on Crown Provincial, Regional District, or Municipal land. Recommendation for treatment in areas of moderate fire hazard areas were limited to areas which would increase efficacy of, and / or create continuity between, previously treated areas (link treatment areas to each other or to low / no fuel areas). All polygons identified for potential treatment have been prioritized based on fire hazard, operational feasibility, estimated project cost, type and number of values at risk, common fire weather (wind direction), and expected efficacy of treatment. Although potential treatment areas have been ground-truthed during field work, additional refinement of the polygons will be required at the time of prescription development. 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.

Recommended potential treatment areas within the study area are enumerated in Table 15 and displayed in Map 13.

### *Fuel Treatment Types*

The intent of establishing a fuel break is to create a fire suppression option that is part of a multi-barrier approach to reduce the risk to values (*e.g.*, structures). A fuel break in and of itself, is unlikely to stop a fire under most conditions. The application of appropriate suppression tactics in a timely manner with sufficient resources, is essential for a fuel break to be effective. Lofting of embers (*i.e.*, "spotting") over and across a fuel break is a possibility (increasing with more volatile fuel types and fire weather) and has the potential to create spot fires beyond the fuel break that can expand in size and threaten values at risk, or land directly on or near structures and ignite them. To address spotting, fuels between the fuel break and the values at risk should be evaluated and treated to create conditions where extinguishment of spot fires is possible and FireSmart Standards should be applied to structures and associated vegetation and other fuel to reduce the risk of structures igniting. A multi-barrier approach that reduces the risk to values can include: establishing multiple fuel breaks (Interface Fuel Break and Primary Fuel Break), addressing fuels between the fuel break and structures (Interface Fuel Treatments), and applying FireSmart Standards to structures and the surrounding vegetation. Fuel breaks require periodic maintenance to retain their effectiveness.

**Interface Fuel Break:**

Fuel breaks on Crown Land immediately adjacent to private land and in close proximity to the wildland urban interface and/or intermix areas, are termed "Interface Fuel Breaks". Interface Fuel Breaks are designed to modify fire behaviour, create fire suppression options, and improve suppression outcomes. Interface Fuel Breaks are approximately 100 meters wide and when treated with appropriate fuel reduction measures, they can break the crown fire threshold and reduce the risk of a crown fire reaching private lands and structures. Interface Fuel Break width can be varied to allow for alignment and to take advantage of natural and man-made fire resilient features that enhance effectiveness. Surface fire spread across the fuel break and spotting over the fuel break, are both concerns and rely on suppression actions to be effective. In order to reduce potential fire intensity and

spotting, fuel on private land between the Interface Fuel Break and structures should be treated according to FireSmart vegetation management standards. Structures in interface areas should be constructed or retrofitted to FireSmart design standards.

**Interface Fuel Treatment:**
An Interface Fuel Treatment is the treatment of patches of fuels between the Primary Fuel Break and the wildland urban interface. To address the possibility of surface fire spread across, and/or spotting over the Primary Fuel Break, hazardous fuel between the Interface Fuel Break and the Primary Fuel Break should be treated to reduce fire intensity and create suppression options where practical and economically feasible. High hazard fuel types (C2, C3, C4, C7 [with ingrowth], and M1/2 fuel types with 50% or more conifer) in closest proximity to the Interface Fuel break are generally the highest priority. Where feasible, treatments can be linked in a linear configuration and tied into fire resistant features to create additional suppression opportunities.

**Strategic Anchor Locations:**

Fuel breaks should be tied into existing features where fire is less likely to spread, (*e.g.*, roads, railways, hydro and transmission lines, gas pipelines, wetlands, lakes, irrigated fields, non-fuel areas, etc.) to develop potential suppression opportunities.

**Primary Fuel Break:**
Primary Fuel Breaks are located on Crown Land in strategic locations beyond the Interface Fuel Break. The location of Primary Fuel Breaks depends on land ownership (Crown vs. private), existing natural and man-made features, fuel types, and wind patterns. Primary Fuel Breaks are designed to modify fire behaviour and create fire suppression options that reduce the risk of a crown fire reaching a community and/or adjacent private lands. Primary Fuel Breaks may be located to completely surround a community or be strategically placed upwind of communities and perpendicular to fire season winds. Primary Fuel Breaks have sufficient width and appropriate fuel reduction measures to break the crown fire threshold and reduce fire intensity such that overstory fire moves to the ground surface and spread rates are reduced. While there are no absolute standards for fuel break width or fuel manipulation in the literature and fuel break width will vary based on fuel type, topography, and expected fire behaviour[88], a 300-metre fuel break width is generally recommended. Fuel breaks should be designed to take advantage of natural and man-made fire resilient features and topography to enhance effectiveness. Surface fire spread across, and spotting over the fuel break are both concerns, and depend on the application of suppression resources to be effective.

[88] Agree, J.K., Bahro, B., Finney, M.A., Omi, P.N., Sapsis, D.B., Skinner, C.N., van Wagtendonk, J.W., Weatherspoon, C.P. The use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management, 127 (2000), 55-66.

### Table 15. Fuel Treatment Summary Table

| FTU # and Stratum | Geographic Area | Priority | Total Area (ha) | Treatment Unit Type/ Objective | Local Fire Threat (ha) | | | Overlapping Values / Treatment Constraints* | Treatment Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Extreme / High | Mod | Low | | |
| 2 | South of Gagnon/Hwy 39 | High | 82.2 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands that lower overall wildfire behaviour in the Gagnon development WUI, reduce fuel loading and potential for extreme crown fire. | 50.2 | 28.4 | 3.5 | The proposed area overlaps a small area in the eastern portion of woodlot W0672, also known as the Secondary School Woodlot. Additionally, the area overlaps FDU 1 of CONIFEX Mackenzie Forest Products Inc., and FDU 4 of BC Timber Sales. Any future fuel treatments within this polygon must first consult with the woodlot W0672 manager, CONIFEX and BCTS during the prescription development phase and prior to implementation to ensure all concerns are addressed. | Treatment area is located <120 m south of private residences in Gagnon, and directly upwind of the values at risk. Fuels are a mosaic of moderate to extreme hazard fuels, ranging from M-1/2 to C-3 and C-2. Adjacent intermix private land has very little defensible space in the event of an extreme wildfire event. |
| 3 | Northeast of Laurier Drive / John Dahl Regional Park | High | 7.3 | **Interface Fuel Treatment Objective:** Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 7.3 | 0 | 0 | The proposed area overlaps with John Dahl Regional Park and high use mountain bike trails. Fuel management activities within this polygon must consult with the District of Mackenzie Parks department and any recreation group with interest in the area or the public during the prescription development phase and prior to implementation. | Treatment area is located between 200-300m east of residential properties and immediately adjacent to a critical infrastructure. Continuous forest cover characterized as high hazard C-3 fuel type. This area has high surface and both standing and partially elevated fuels from bark beetle mortality. Area has high daytime use due to overlap and adjacency with mountain biking trails and John Dahl Regional Park. Polygon would link and expand upon previously treated areas. The southwestern most portion of the proposed treatment area overlaps a previously treated area that requires additional fuel reduction (i.e., thinning, pruning and surface fuel reduction). |

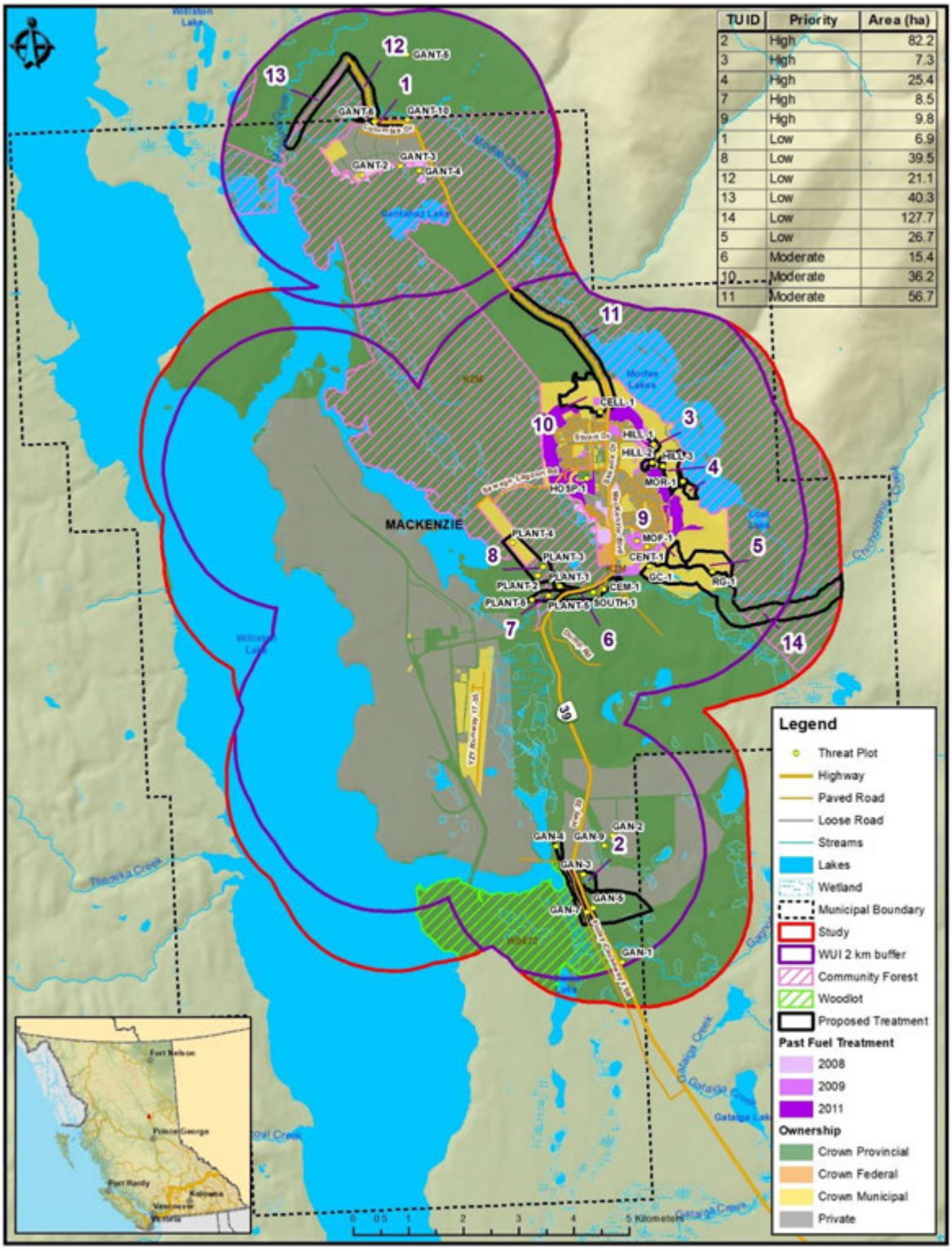
| FTU # and Stratum | Geographic Area | Priority | Total Area (ha) | Treatment Unit Type/ Objective | Local Fire Threat (ha) | | | Overlapping Values / Treatment Constraints* | Treatment Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Extreme / High | Mod | Low | | |
| 4 | Morfee Lake Road | High | 25.4 | **Interface Fuel Treatment Objective**: Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 16.2 | 9.1 | 0.1 | The proposed area is not constrained by any particular spatially explicit land designations or tenures. However, the area is located in a high visibility watershed area, given its adjacency to the Morfee Lake day-use area. Any future fuel treatment activities will require consultation with the public during the prescription phase and prior to implementation to ensure its success. | Treatment area is adjacent to three critical infrastructures and overlaps an area of high recreational value near Morfee Lake. Similar to proposed treatment polygon #3, this area is characterized by high hazard C-3 fuel type, with continuous ladder and crown fuels, and moderate levels of standing and partially elevated fuels due to IBS mortality. The area experiences high seasonal use for recreation purposes and is the main access route to the Morfee Lake beaches. Polygon would link and expand upon previously treated areas. |
| 7 | BC Hydro Morfee Substation Road | High | 8.5 | **Interface Fuel Treatment Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 4.2 | 3.9 | 0.4 | The eastern two thirds of the proposed area overlap with the MLMCF tenure area. Consultation with the MLCMF Manager must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Treatment area is located immediately adjacent and upwind of critical infrastructure - the BC Hydro Morfee Substation. The treatment area is characterized by moderate to high hazard fuels (M-1/2 fuel type) with high conifer component and patchy ladder fuels. Moderate coarse woody and partially elevated fuels are present throughout this polygon due to previous MPB disturbance. |
| 9 | Cicada Road to Rodeo Grounds Road | High | 9.8 | **Interface Fuel Treatment Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 3.4 | 0.0 | 6.4 | The proposed area is not constrained by any particular spatially explicit land designations or tenures. | Treatment area is located immediately south and upwind of the town centre and adjacent to the Mackenzie Golf and Country Club. This polygon is characterized by high hazard C-3 fuel type stands, with high mortality (grey attack) resulting from previous MBP disturbance. Patchy conifer ladder fuels are present throughout the polygon. However, despite vigorous understorey regeneration, stand crown closure is approximately 20% as most Layer 1 trees are in the grey attack stage due to MPB disturbance. |

| FTU # and Stratum | Geographic Area | Priority | Total Area (ha) | Treatment Unit Type/ Objective | Local Fire Threat (ha) | | | Overlapping Values / Treatment Constraints* | Treatment Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Extreme / High | Mod | Low | | |
| 6 | Hwy 39 and Parsnip East Forest Development Road | Moderate | 15.4 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 3.8 | 7.2 | 4.4 | The proposed area overlaps FDU 1 of CONIFEX Mackenzie Forest Products Inc. Consultation with the licensee must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Proposed treatment area is located southwest and upwind of Mackenzie town centre and multiple values at risk. The area is a spruce leading (C-2 fuel type) stand characterized by continuous ladder fuels and moderate to high levels of partially elevated and down fuels. |
| 10 | North of Town Centre | Moderate | 36.3 | **Interface Fuel Treatment Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 14.2 | 17.6 | 4.5 | The proposed area overlaps in the northern most part of the polygon with FDU 1 of CONIFEX Mackenzie Forest Products Inc. Consultation with the licensee must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Proposed treatment area is located north of town centre and within 200 m of multiple private residences and critical infrastructure. The area is a Balsam fir (Bl) and hybrid spruce (Sx) leading (mix of C-3 and C-2 fuel type) stand characterized by continuous ladder fuels and moderate to high levels of partially elevated and down coarse woody fuels. |
| 11 | North of Town centre (100 m linear feature along Hwy 39) | Moderate | 56.7 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 27.8 | 12.5 | 16.4 | The proposed area overlaps with FDU 1 and FDU 3 of MLMCF and FDU 1 of CONIFEX Mackenzie Forest Products Inc. Consultation with these licensees must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Proposed treatment area is located north of town centre along Hwy 39. A landscape level fuel break is recommended in order to bolster the access/egress route to the subdivision of Gantahaz. This area is a mix of C-3 and M-1/2 fuel types, with a minor component of D-1/2. A small portion in the southern area of the polygon overlaps a previous treatment area that requires additional thinning and pruning. |

| FTU # and Stratum | Geographic Area | Priority | Total Area (ha) | Treatment Unit Type/ Objective | Local Fire Threat (ha) | | | Overlapping Values / Treatment Constraints* | Treatment Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Extreme / High | Mod | Low | | |
| 14 | South of town centre along southern edge of Rodeo Ground Road and onto Parsnip East Forest Development Road. 300 m width | Moderate | 127.6 | **Primary Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 112.7 | 11.2 | 3.7 | The proposed area overlaps with FDU 1 of MLMCF, FDU 1 of CONIFEX Mackenzie Forest Products Inc., and BC Timber Sales Mackenzie FDU. Consultation with these licensees must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | The proposed treatment area is located south of town centre along Parsnip East Forest Development Road, and near the Rodeo Grounds. This area has been recommended for the implementation of a landscape level fuel break due to hazardous fuels present in the area. The stands characteristic of this area are primarily C-3 fuel type with high levels of partially elevated and down fuels, resulting in high risk for extreme crown fire behaviour. Ladder fuels are patchy to uniform throughout the area. Additionally, the proposed area was strategically selected given its location upwind of town centre. |
| 1 | North of Gantahaz / Parsnip Forest Development Road | Low | 6.9 | **Interface Fuel Treatment Objective**: Fuel treatment will result in residual stands that lower overall wildfire behaviour in the WUI, reduce fuel loading and bolster access / egress route into and out of Gantahaz. | 2.8 | 4.1 | 0 | The proposed area overlaps the MLMCF tenure area. Given its proximity to private residences, fuel treatment in this polygon will consider burning setback requirements as dictated by the Open Burning Smoke Control Regulation, Municipal bylaws and the Wildfire Act. Additionally, consultation with the MLCMF Manager must occur during the prescription development phase and prior to implementation to ensure that any concerns are addressed. | Treatment area is Immediately adjacent to (<60m) north of private residences in Gantahaz. Although downwind, the proposed treatment area has patchy conifer hazardous fuels which increase wildfire risk to private residences in Gantahaz. This treatment would ensure that the access/egress route in and out of Gantahaz is bolstered. |
| 5 | Rodeo Grounds Road | Low | 26.7 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 19.8 | 0.4 | 6.5 | The proposed area has a minor overlap with the MLMCF tenure area in the easternmost portion of the polygon. Consultation with the MLCMF Manager must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | High hazard C-3 fuel type throughout the proposed treatment area, with continuous ladder fuels and high levels of standing and partially elevated fuels due to previous MPB disturbance. Area is located upwind of the Mackenzie town centre and is adjacent to and surrounding a high use area for public events, resulting in a heighted risk of ignition. |

| FTU # and Stratum | Geographic Area | Priority | Total Area (ha) | Treatment Unit Type/ Objective | Local Fire Threat (ha) | | | Overlapping Values / Treatment Constraints* | Treatment Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Extreme / High | Mod | Low | | |
| 8 | Parsnip Forest Development Road and Sewage Lagoons | Low | 39.5 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that will reduce continuity of fuel loads, crown and surface fire behaviour, and wildfire risk. | 25.4 | 12.9 | 1.2 | The westernmost strip along the Parsnip West FSR and the bottom half of the proposed polygon overlap with the MLMCF tenure area. Consultation with the MLCMF Manager must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Treatment area surrounds the BC Hydro Morfee Substation and is located at approximately 270 degrees of prevailing wind conditions, southwest of town centre. The proposed polygon is characterized by high hazard C-3 fuel type stands, with moderate to high levels of standing, partially elevated and downed woody material resulting from the previous MPB disturbance. Treatment of this area will develop defensible space around a critical infrastructure. |
| 12 | Northern part of Hwy 39 / Gantahaz – 100 m linear feature along the road system | Low | 21.1 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 10.8 | 8.4 | 1.9 | The proposed area overlaps with FDU 2 of MLMCF, FDU 1 of Kwadacha Natural Resources Agency Ltd., FDU 1 of Mackenzie Fibre Management Corporation and FDU 1 of CONIFEX Mackenzie Forest Products Inc. Consultation with these licensees must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Proposed treatment area is located north of Gantahaz along Hwy 39. A landscape level fuel break is recommended in order to bolster the access/egress route to and from the subdivision of Gantahaz. This area is a mix of C-3 and M-1/2 fuel types and is adjacent to many residential properties. |
| 13 | Intersection of Highway 39 and Parsnip West Forest Development Road - 100 m linear feature along the road system | Low | 40.3 | **Interface Fuel Break Objective:** Fuel treatment will result in residual stands with characteristics that lower overall wildfire behaviour, reduce fuel loading and potential for extreme crown fire. | 21.5 | 10.4 | 7.6 | The proposed area overlaps with FDU 2 of MLMCF, FDU 1 of Kwadacha Natural Resources Agency Ltd., FDU 1 of Mackenzie Fibre Management Corporation, FDU 1 of Three Fathers Limited Partnership, and FDU 1 of CONIFEX Mackenzie Forest Products Inc. Consultation with these licensees must occur during the prescription development phase and prior to implementation of fuel treatment activities to ensure that any concerns are addressed. | Proposed treatment area is located north of Gantahaz along Parsnip Forest Development Road at the intersection with Hwy 39. A landscape level fuel break is recommended in order to bolster the access/egress route to and from the subdivision of Gantahaz. This area is a mix of C-3 and M-1/2 fuel types and is adjacent to many residential properties. |

*Although none of the proposed polygons have direct overlap with a known archaeological site, there is always a limited potential for unknown archaeological sites to exist within the areas of interest. Consultation with the McLeod Lake Indian Band should occur during the prescription development phase and implementation to ensure that such sites are protected if encountered during the implementation phase. Additionally, all proposed polygons overlap a polygon, historically known to contain the Northern Mountain Population of Caribou (Williston Lake, Mackenzie "Scott" Herd). Given the specie's Blue-listed status in BC, any fuel treatment activities within the proposed polygons must consider habitat requirements for this ungulate.




**Map 13. Fuel Treatment.**

### 5.1.2 Maintenance of Previously Treated Areas

The District of Mackenzie has shown leadership in completing fuel management projects within the study area to reduce the associated wildfire hazard. These activities have been implemented on over 325 ha of land (Map 13). These polygons are in various states of hazard, some of which require additional fuel management activities (maintenance) in order to maintain or to re-attain moderate, or lower, threat class ratings. Maintenance activities may include additional thinning, conifer regeneration reduction, or surface fuel continuity reduction (removal of excess coarse woody debris).

Maintenance of previously treated polygons should be a priority for District of Mackenzie. All polygons that were previously treated were assessed during field visits; polygons were prioritized for maintenance activities, such as reducing and/or removing standing dead, reducing surface fuels, or additional thinning (overstorey reduction and thinning suppressed conifers or conifer regeneration) (

Table 16). The return interval for maintenance activities depends upon site productivity and type and intensity of treatment. Less productive areas can likely withstand a longer frequency between maintenance activities, while more productive areas would require treatments more often.

**Table 16. Maintenance schedule for previously treated polygons within the study area. Priority 1 = high, 2 = moderate, 3 = low, 4 = no maintenance activities anticipated for the next five years.**

| Treatment Year | Polygon Name/ Treatment Unit | Area (Ha) | Plot Name and Threat Rating | Priority | Target timeline for return (years from 2018) | Comment |
|---|---|---|---|---|---|---|
| 2010 | AP3199-23 23/1 | 4.9 | CELL-1 (High) | 1 | 1 - 3 | Additional thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities should include removal of small diameter standing mortality and surface fuel removal. Polygon is located adjacent to the Rogers Cell Tower, a critical communication infrastructure surrounded by high hazard C-3 fuel type. |
| 2010 | AP3199-28 28/3 | 3.6 | LEM-1 (High) | 1 | 1 - 3 | Additional thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities should include removal of small diameter standing mortality and surface fuel removal. Polygon is located within <200 m northwest of private land residences. |
| 2009 | AP2777-1 | 15.1 | MOF-1 (Moderate), CENT-1 (Moderate) | 2 | 3 - 5 | Additional thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities should include removal of small diameter standing mortality, debris pile and surface fuel removal. Polygon is located between the mobile park and south of the main town centre development. |
| 2008 | AP2391-1 | 1.9 | Walk through | 4 | 5 - 10 | No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2023 – 2028. |
| 2008 | AP2391-2 | 0.8 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-3 | 1.2 | GANT-3 (Low) | 4 | 5 - 10 | |
| 2008 | AP2391-4 | 0.6 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-5 | 0.9 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-6 | 1.1 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-7 | 2.4 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-8 | 1.8 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-9 | 2.0 | GANT-2 (Low) | 4 | 5 - 10 | |
| 2008 | AP2391-10 | 2.2 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-11 | 1.2 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-12 | 1.3 | Walk through | 4 | 5 - 10 | |
| 2008 | AP2391-13 | 3.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-1 / 1 | 0.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-2 / 1 | 1.2 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-3 / 1 | 0.7 | Walk through | 4 | 5 - 10 | |

| Treatment Year | Polygon Name/ Treatment Unit | Area (Ha) | Plot Name and Threat Rating | Priority | Target timeline for return (years from 2018) | Comment |
|---|---|---|---|---|---|---|
| 2010 | AP3199-4 / 2 | 0.1 | Walk through | 4 | 5 - 10 | No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2023 - 2028 |
| 2010 | AP3199-5 / 2 | 0.2 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-7 / 1 | 8.8 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-8 / 2 | 7.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-9 / 2 | 1.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-10 / 1 | 2.9 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-11 / 1 | 7.7 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-12 / 2 | 1.2 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-13 / 1 | 1.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-14 / 2 | 1.2 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-16 / 1 | 2.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-17 / 2 | 5.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-18 / 2 | 0.6 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-19 / 2 | 1.2 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-20 / 1 | 7.0 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-21 / 1 | 13.4 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-22 / 3 | 1.8 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-24 / 1 | 10.4 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-25 / 2 | 1.6 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-26 / 1 | 1.9 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-27 / 2 | 1.9 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-29 / 1 | 8.5 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-30 / 5 | 1.5 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-31 / 4 | 3.3 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-32 / 2 | 1.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-33 / 1 | 3.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP3199-34 / 3 | 6.6 | Walk through | 4 | 5 - 10 | |
| 2009 | AP2777-1 | 8.7 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-1 | 1.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-2 | 0.9 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-3 | 0.59 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-4 | 0.1 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-5 | 0.5 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2776-6 | 0.4 | Walk through | 4 | 5 - 10 | |

| Treatment Year | Polygon Name/ Treatment Unit | Area (Ha) | Plot Name and Threat Rating | Priority | Target timeline for return (years from 2018) | Comment |
|---|---|---|---|---|---|---|
| 2010 | AP2776-7 | 3.8 | Walk through | 4 | 5 - 10 | No maintenance activities anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2023 - 2028 |
| 2009 | AP1886-1 | 13.5 | Walk through | 4 | 5 - 10 | |
| 2009 | AP1886-2 | 10.1 | Walk through | 4 | 5 - 10 | |
| 2009 | AP1886-3 | 5.9 | Walk through | 4 | 5 - 10 | |
| 2009 | AP1886-4 | 12.9 | Walk through | 4 | 5 - 10 | |
| 2009 | AP1886-5 | 2.5 | Walk through | 4 | 5 - 10 | |
| 2010 | AP2306-1 | 4.7 | Walk through | 4 | 5 - 10 | |
| | **Total** | **326** | | | | |

### Table 17. Summary of Fuel Management recommendations.[89]

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| **Objective**: Reduce wildfire threat on public lands through fuel management. | | | |
| 1 | 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) or other sources (i.e., biomass energy technologies) |
| 2 | High | Consider developing a rationale for reduced stocking standards applicable to the District of Mackenzie AOI, by employing a qualified wildfire management professional, and in consultation with the Fuel Management Specialist (Prince George Fire Centre) and MFLNRORD. Engage partners such as the MLMCF, CONIFEX, BC Timber Sales and all other licensees to apply the MFLNRORD approved reduced fire management stocking standards in the AOI to reduce interface wildfire threat. | $3,000 |
| **Objective:** Maintain previously treated areas under an acceptable level of wildfire fire threat (moderate). | | | |
| 3 | High | Apply for funding for maintenance activities prioritized and scheduled in this CWPP. | UBCM SWPI Funding/ Municipal Funding |
| 4 | Moderate | Monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise. | UBCM SWPI Funding/ Municipal Funding |
| **Objective:** Improve emergency access / egress and public safety in the event of an evacuation through reduction of hazardous fuels / landscape level fuel treatment. | | | |
| 5 | High | The District should work with the Ministry of Transportation and Infrastructure (MOTI), MFLNRORD, and the Regional District of Fraser Fort George (RDFFG) to assess the entirety of Hwy 39 and reduce hazardous fuels within 100 m of either side of the road, where possible. This is to increase public safety / improve emergency access in the event of an evacuation or wildfire event. | FESBC funding; person hours are dependent upon District role within the project |

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

## 5.2 FIRESMART PLANNING AND ACTIVITIES

This section provides detail on general FireSmart goals and objectives for wildfire loss reduction and summarizes the following: 1) the current level of FireSmart implementation and uptake within the community; 2) identified FireSmart subdivisions and/or acceptance into the FireSmart Canada Community Recognition Program (FSCCRP); and 3) recommended potential FireSmart activities that can be applied within the AOI at a future date.

### 5.2.1 FireSmart Goals and Objectives

FireSmart® is the comprehensive nationally accepted set of principles, practices and programs for reducing wildfire losses.[90] 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[91], 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 Protection Association (NFPA). 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.
- 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.[92]

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

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

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

- There are 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.[92]
- 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 the mosaic of land ownership (Figure 4).
- The ultimate root of the WUI interface problem is the vulnerability of structures and homes to ignition during wildfire events, in particular vulnerability to 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.

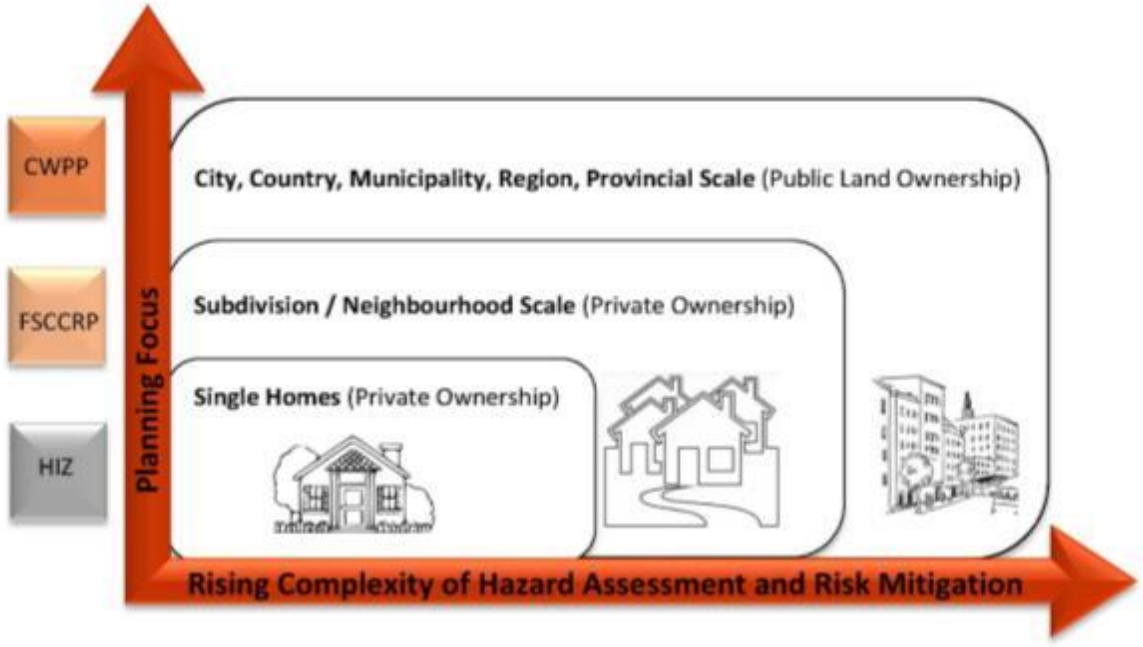



**Figure 4. Diagram of the various, coordinated levels of the FireSmart program.[93] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.**

### *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

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

is referred to as the Home Ignition Zone (HIZ).[94,95] 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 K.

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 wildfire, across fire guards and fuel breaks, and accumulate 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.

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.[95] Increasing ignition resistance would reduce the number of homes simultaneously on fire; extreme wildfire conditions do not necessarily result in WUI fire disasters.[96] 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 can be an 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

[94] 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.

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

[96] 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/.

practices to quickly filter downwards onto the property of individual residents to further mitigate wildfire hazards at the single-home scale within the HIZ.

### *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, 4) overwhelms suppression efforts and capabilities, and 5) leads to unprotected homes, and therefore 6) considerable structure loss (Figure 5).

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.[97] More than two simultaneous structure fires would overwhelm the resources and capacity of the emergency fire rescue.

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.[97]


**Figure 5. Wildland/urban interface disaster sequence.[98] 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.**

## 5.2.2 Key Aspects of FireSmart for Local Governments

Reducing the fire risk profile of a community through FireSmart implementation requires coordinated action from elected officials, municipal planners, developers, private land owners and industrial

[97] Calkin, D., J. Cohen, M. Finney, M. Thompson. "*How risk management can prevent future wildfire"*

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

managers. This Section presents various options of FireSmart practices, which when enacted, provide avenues for reducing fire risk within the community. An evaluation of the current level of FireSmart implementation within the District of Mackenzie is also presented in this Section.

### *Communication, Education and Partnerships*

Communicating effectively is a key aspect of any education strategy. Communication materials must be audience specific and delivered in a format and through mediums that reach the target audience. Audiences should include home and landowners, school students, local businesses, elected officials, District staff, local utilities, and forest tenure holders. Education and communication messages should be 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.

FireSmart information material is readily available and simple for municipalities to disseminate. It provides 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 illustrates the vulnerability of individual houses to wildfire.

The District has undertaken some public education outreach and FireSmart initiatives in schools, the community, and on-line. These can be expanded upon and/or adapted to further enhance wildfire preparedness and education. The District should consider expanding their current school fire education program to include an increased element of wildfire preparedness education to be presented annually in elementary schools. Programming could include volunteer / advocacy work from professional foresters, wildland firefighters or prevention officers, and District staff. The District should consider holding a wildland specific Fire Prevention Day or Week, or similarly formatted event, in the spring prior to the wildfire season. Timely educational materials to increase preparedness would be most effective immediately prior to the fire season.

A full list of recommendations pertaining to the Communication, Education and Partnerships strategy is presented in Section 5.3.

### *Vegetation management*

Some examples of actionable items for the District of Mackenzie with regards to vegetation or fuel management and the FireSmart approach include: 1) policy development and implementation of FireSmart maintenance for community parks and open spaces; 2) implementing fire resistant landscaping requirements as part of the development permitting process; and 3) provision of collection services for private landowners with a focus on pruning, yard and thinning debris.

Since the 2005 CWPP the District of Mackenzie has engaged in a proactive vegetation management strategy, specifically targeting high-use areas near values at risk, within and immediately adjacent to the town centre. Many forested public spaces within the town centre have had some level of fuel reduction

treatment conducted, with a prime example being the Tree Crusher site and adjacent treed space. A recommended maintenance schedule for previously treated areas is provided in Section 5.1.2. The District does not currently enforce FireSmart landscaping requirements within development permits. More detailed recommendations regarding municipal policies and bylaws are provided below in Planning and Development.

### *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 planning and development objectives for the District of Mackenzie are:

- 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).

Both the 2005 CWPP, as well as the OCP, do not explicitly consider the establishment of a development permit (DP) area to address wildfire risk mitigation. It is recommended that the District 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. [99] 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 Mackenzie; conserve the visual and ecological assets of the forests surrounding Mackenzie; reduce the risk of post-fire landslides, debris flows, and erosion, *etc*.). The following components should be considered during the OCP review and DP area development process in order 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.
- Use of FireSmart landscaping (low flammability plants, appropriate spacing and low flammability aggregates/ ground cover based on FireSmart principles).
- Underground servicing.

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

- 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.
- 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). This Act establishes the province as the sole authority to set building requirements and limits local government authority to set building requirements in their bylaws. Section 5 of the *Building Act* provides an exception to the above limitation to local governments by giving them 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.[100]

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

**Table 18. Summary of recommendations for municipal policy and planning.**

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| **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). | | | |
| 6 | High | Review the Official Community Plan (OCP); consider including wildfire as a natural hazard development permit area. A recommended development permit area for the District of Mackenzie would include all areas within the District Boundary that are located within 50 m of high and extreme wildfire behaviour threat class areas. Review similar DPs established in other jurisdictions and use as models for various aspects of the DP process. The following aspects should be considered in the OCP review and wildfire DP development: 1) Establish DP objectives (e.g. minimize risk to property and people from wildland fires; minimize risk to forested area surrounding Mackenzie; and conserve the visual and ecological assets of the forests surrounding Mackenzie; etc.; and 2) Where possible, it is recommended to mandate FireSmart construction materials, some of which may be beyond BC Building Code within the established wildfire hazard development permit area. In order to meet objectives, consider including the following elements: 1) minimum setbacks from forested edge based on FireSmart, 2) fuel management based upon qualified professional recommendations, 3) landscaping to FireSmart guidelines, 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. | ~40-80 hours |
| 7 | High | Ensure that DP permit applications are provided to MFD for opportunity for input prior to approval. As more wildfire DP applications are received, the importance of communication and integration between MFD and the Planning Department will increase. | Dependent on the number of DP applications |
| 8 | 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, avoid wildlife attractants, and reduce wildfire hazard. Consider including the landscaping standard as a requirement of Development Permit within the applicable 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 Municipal Office 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 |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| 9 | Moderate | 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, 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 |

### *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. n-street parking can also contribute to the hazard on these roads, which are already unlikely to have a high capacity under heavy smoke conditions.[101] When the time for evacuation is limited, poor access has contributed to deaths associated with entrapments and vehicle collisions during wildfires.[102] 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.[66]

For new development in rural settings where hydrants are limited or unavailable (or it is otherwise determined by the MFD that adequate or reliable water supply systems may not exist), the NFPA 1142 should be used to help determine minimum requirements for alternative water supply (natural or artificial). Alternative water sources, such as dry hydrant systems, water usage agreements for accessing water on private land, cisterns or other underground storage, *etc*., should be reviewed by the District (MFD) prior to development approval.

[101] 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.

[102] 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

**Table 19. Summary of recommendations for Subdivision Design.**

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| **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). | | | |
| 10 | Moderate | Review Subdivision Bylaw No. 780, 1993, with consideration towards:<br>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 (i.e., NFPA 1141 can be used as a reference). Two routes for access / egress are recommended.<br>2) Emergency response access, specifically working towards minimizing long cul-de-sacs, and allowing emergency vehicle turn around.<br>3) Hydrant placement to ensure that the Bylaw includes hydrant placement (and spacing) standards acceptable to the District and to allow for effective fire suppression. | ~30-40 hours per development |
| 11 | Moderate | Review water availability for new developments in rural settings. All new developments within the Fire Service Area should meet the minimum requirements for water availability, as set out in NFPA 1142. | ~5 - 10 hours per development |

### *Increasing Local Capacity*

Local capacity for emergency management and efficient response to wildland urban interface fires can be enhanced by addressing the following steps:

- Development and/or maintenance of Structural Protection Units (SPUs) which can be deployed in the event of a WUI fire;
- Conducting a comprehensive review of Emergency Management BC SPU deployment procedures for the purpose of fighting interface fires;
- Provision of sprinkler kits to community residents (at a cost); and
- Engage in annual cross-training with adjacent fire departments and/or BCWS in order to increase both local and regional emergency preparedness with regards to structural fire and wildfire training.

A detailed account of current local capacity for the District of Mackenzie and recommendations to address gaps is provided in SECTION 6 .

### *FireSmart Compliance within the Area of Interest*

As could be expected, there is a wide range of FireSmart compliance on private properties in the District of Mackenzie. There are large differences in the degree to which FireSmart best practices are visible within individual HIZs, and in neighbourhoods throughout the District. Landscaping in the study area is also in a range of FireSmart compliance. Generally speaking, most homes within the Gantahaz development do not maintain 10 m defensible space, while those in the development of Gagnon could not be assessed as the new subdivision has many private roads which are gated. Bark mulch is commonly used as a landscaping material within the HIZ. Accumulations of conifer foliage in roof corners and gutters are not uncommon. Firewood stacked adjacent to or directly under structures during the fire season increases the hazard of some homes within the study area. Storage of combustible items under decks, carports, and other horizontal surfaces is also common. On the other hand, many residences are surrounded by lawn, agricultural fields, 10 m defensible space, and/or hardscaping (rocks), all of which are FireSmart compliant. The town centre displays the highest FireSmart compliance rate.

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 study area. Ultimately, these also impact the vulnerability of structures 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 (both on private land and adjacent Crown or District-owned land); 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.

District neighbourhoods were unofficially surveyed during field work. The following observations were made:

- Wildfire hazard levels range from moderate to high across neighbourhoods within the study area;
- The bulk of hazards are associated with conditions of natural and landscaped vegetation immediately surrounding residential properties;
- For new development, where landscaping is not yet completed, educational approaches may aid in promoting fire resistant landscaping options and achieving defensible space in the HIZ;
- Hazards are magnified in some neighbourhoods due to the poor access (private and gated roads) and distance from nearest water supply or fire hydrant location;
- All neighbourhoods have good opportunities to mitigate risk through individual and collective action.

### 5.2.3 Priority Areas within the Area of Interest for FireSmart

This Section identifies priority areas within the District of Mackenzie that would benefit from FireSmart planning and activities.

**Table 20. Summary of FireSmart Priority Areas.**

| Area ID | FireSmart Y/N | FireSmart Canada Recognition Received Y/N | Recommended FireSmart Activities |
|---|---|---|---|
| Priority Area #1: Gagnon Subdivision | Unknown | N | Given the limited access to private properties in the Gagnon subdivision, only the following general FireSmart recommendations can be provided:<br>1) Provide guidance to ensure landscaping to an established FireSmart standard;<br>2) Incentivise private landowners to engage in retrofitting homes with building materials and design based on NFPA 1144 or FireSmart standards;<br>3) Encourage prompt removal of combustible construction materials or thinning / fuel management waste from private properties; and<br>4) Coordinate monthly or bi-monthly yard waste removal days during the fire season to reduce WUI fire hazard. |
| Priority Area #2: Gantahaz Subdivision | N | N | The following is a non-extensive list of FireSmart activities for which the District can engage Gantahaz residents:<br>1) Provide guidance to ensure landscaping to an established FireSmart standard;<br>2) Incentivise private landowners to engage in retrofitting homes with building materials and design based on NFPA 1144 or FireSmart standards;<br>3) Encourage prompt removal of combustible construction materials or thinning/ fuel management waste from private properties; and<br>4) Coordinate monthly or bi-monthly yard waste removal days during the fire season to reduce WUI fire hazard. |
| Priority Area #3: Critical infrastructure | Y | N | Based on field observations, most critical infrastructure has been FireSmarted with general setback from forested areas. Consider conducting frequent (2-5 years) maintenance treatments to ensure the wildfire risk remains moderate. It is recommended that fuel treatments be considered for areas adjacent to critical infrastructure in order to bolster the effect of previous FireSmart treatments. FireSmart treatments may include thinning from below to reduce ladder fuels and crown fire potential, pruning of retained trees to 3m, and reducing surface fuels. Additionally, consider adding regular brushing activities to the maintenance treatment schedule to control weeds and grasses around critical infrastructure. |

## 5.3 COMMUNITY 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 community forest tenure holders, 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 Section 5.2.1, 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 the development of this Plan, it is evident that District 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. 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 reduce or avoid ignitions from industrial sources.

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 District should consider formalizing an Interface Steering Committee to coordinate wildfire risk reduction efforts.

### Table 21. Summary of Communication and Education recommendations.

| Item | Priority | Recommendation / Next Steps | 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. | | | |
| 12 | High | This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings. | 1 – 6 hours, depending on method of distribution |
| 13 | High | Periodic 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 Mackenzie'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) |
| 14 | High | Review current social media effectiveness and develop a social media strategy to ensure that its full power 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 in an accurate and timely manner. [103] | ~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. |
| 15 | High | Continue to 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. | ~4 hours. May be eligible for UBCM/ SWPI grant. |
| 16 | Moderate | Work towards recognition as a FireSmart community and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications. | FireSmart Grant (when funding is available). |

[103] Appendix M has general communication and social media information.

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| 17 | Moderate | Facilitate the FSCCRP uptake within the District and enhance its applications by including the following: 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 |
| 18 | Moderate | Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk. | ~1.5 hours / assessment |
| 19 | Moderate | Encourage schools 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) (Mackenzie Fire Zone), as well as MFD 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 (field trips, guest speakers, *etc*.). | ~20 - 40 hours |
| **Objective:** To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding the proactive WUI risk mitigation activities. | | | |
| 20 | Very High | Develop and work with all key stakeholders (Industrial operators, Community Forest representatives, MFLNRORD, BCWS, recreational groups/ representatives, District staff) to formalize an Interface Steering Committee. 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) Development of large, landscape level fuel breaks; 2) Public education and awareness needs; 3) Multi-disciplinary, multi-jurisdictional fuel treatment projects/ hazard abatement projects; 4) Development of a funding strategy; and, 5) 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 |

## 5.4 OTHER PREVENTION MEASURES

In addition to fuel treatment and community communication and education, fire prevention in the District of Mackenzie is also addressed via the following avenues: 1) public display of danger class rating signs throughout the AOI; 2) fire ban alignment with provincial fire bans; 3) potential enforcement of restricted access to back country areas similar to provincial requirements; and 4) enforcement of local bylaws such as the Fire Protection Services and Unsightly Premises bylaws. The aforementioned activities are either currently being applied or have potential to be applied in order to reduce the potential and / or threat of wildfire ignitions within the AOI.

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. Additionally, concerns have been raised by the District with regards to the presence of large sawdust piles in the industrial zone of the AOI. A cooperative approach for addressing the industrial area concerns must be undertaken by the District and pertinent industrial partners.

**Table 22. Summary of recommendations regarding communication with industry.**

| Communication with Industry | | | |
|---|---|---|---|
| **Item** | **Priority** | **Recommendation / Next Steps** | **Estimated Cost ($ or hours/ year)** |
| **Objective:** To reduce the risk of ignition from industrial sources. | | | |
| 21 | High | Work with industrial operators to ensure that industrial sawdust piles are properly disposed of or utilized, so as to reduce fire hazard within the industrial area. Work with industrial operators to ensure that high risk activities, such as grubbing/brushing work are restricted during high fire danger times to reduce chance of ignitions. Industrial operators include CN Rail, BC Hydro, Fortis BC, CANFOR, CONIFEX and other private land holders. | 2 - 4 hours |
| 22 | 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 CN Rail, BC Hydro, and private land holders. | 2 - 4 hours |

| Communication with Industry | | | |
|---|---|---|---|
| **Item** | **Priority** | **Recommendation / Next Steps** | **Estimated Cost ($ or hours/ year)** |
| 23 | 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 fuel breaks. | 2 - 4 hours |

# SECTION 6: WILDFIRE RESPONSE RESOURCES

This Section provides a high-level overview of the local government resources accessible for emergency response and preparedness use. Accordingly, in emergency situations when multiple fires are burning in different areas of the Province, resource availability may be scarce. Therefore, local government preparedness and resource availability are critical components of efficient wildfire prevention and planning. Deployment of provincial resources occurs as per the process detailed in the *Provincial Coordination Plan for Wildland Urban Interface Fires* document[104]. The aforementioned document establishes a protocol for collaborative and integrated emergency management in the event of WUI fires within British Columbia.

## 6.1 LOCAL GOVERNMENT AND FIRST NATION FIREFIGHTING RESOURCES

Firefighting efforts and effectiveness can be affected by access to secondary power sources, water pressure and supply, and existing local government contingency plans. In the event of a wildfire emergency situation and loss of power, the District of Mackenzie has access to mobile diesel generators to power critical infrastructure such as the Fire Hall and the EOC. However, should a wide-scale outage occur, known vulnerabilities to secondary power sources include mechanical failure and potential fuel shortages. Although the local government has not identified any issues with water pressure within areas that have fire hydrant service, there are known limitations to water supply in the subdivision of Gantahaz and Gagnon. Specific limitations of the District water system with regards to wildfire suppression are detailed in Section 6.1.2.

The MFD has informal mutual aid agreements with the RDFFG and Bear Lake Fire Department (more detail is provided in Section 6.1.1). In the event of a WUI fire emergency, the MFD and District of Mackenzie will call upon mutual aid from either the Bear Lake Fire Department or the BCWS.

[104] Provincial Coordination Plan for Wildland Urban Interface Fires. 2016. Available online at: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/provincial-emergency-planning/bc-provincial-coord-plan-for-wuifire_revised_july_2016.pdf

### 6.1.1 Fire Department and Equipment

Fire protection within the study area is the responsibility of MFD, a composite department made up of approximately 40 members: 2 career staff and 40 volunteer members. The Fire Service Area includes the entirety of the District of Mackenzie boundary: more than 21,270 ha of land. Much of this area is considered wildland and is inaccessible to the MFD. Outside the municipal boundary and contracted response area, the MFD has an informal mutual aid agreement with the RDFFG and the Bear Lake Fire Department. These fire departments are located within 2 and 1-hour driving time, respectively, from the District of Mackenzie, which results in particularly long response times. Mutual aid is utilized at an average rate of once per year beyond fire protection zones.

MFD members undergo significant training. All members receive NFPA 1051 (equivalent to OFC-WFF 1), wildland fire protection training for structural firefighters, and in-house training for SPP-115, site preparation training and structure protection in the urban interface. MFD completes one practical wildland fire training session per year and annual cross-training with BCWS crews, as schedules allow. This practical training covers pump, hose, hydrant and air tanker awareness training. This level of training displays MFD commitment to wildfire preparedness. Cross-training with the BCWS enables the MFD to prepare its responders with technical and practical firefighting experience in order to action both structural and wildland fires.

MFD responds to an average of 112 calls per year, of which only 3 are wildland fires. On an average year, 3-4 fires are worked cooperatively between MFD and BCWS. MFD has a working relationship with the BCWS Mackenzie Zone. BCWS participates in the annual Mackenzie Trade Fair Show and provides FireSmart information to the community of Mackenzie. Additionally, BCWS conducts fuel abatement, trail clearing, prescribed and pile burning around the community, and participates in fire prevention education initiatives at the local schools. Communication frequency depends largely on time availability during more active fire seasons, although regular communication is generally not a challenge.

The MFD owns three Type 1 structural firefighting engines that have a four-person carrying capacity and include a pump that operates at 1000-gallons per minute, and a 400-gallon tank. Additionally, the MFD have a skid pack and wildland gear to action Rank 1-3 wildland fires, but would require additional support from BCWS with higher Rank fires. The MFD is working on acquiring a Type 2 structural protection unit (SPU) and associated equipment. Seven members of the MFD have received SPU training. 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 District of Mackenzie recognizes the lack of a seamless and integrated emergency evacuation procedure with regards to industrial areas within the AOI. It is recommended that the District works with Industrial partners to develop a cooperative emergency response plan that includes high-level

evacuation procedures for the industrial sites located centrally within the AOI and immediately to the east of Williston Lake. The concern in this area stems from the fact that it is heavily populated during day-time hours as the majority of the workforce in Mackenzie travels to this particular area to access various industrial facilities. Although Williston Lake acts as a large landscape level fuel break due to its sheer width and size, the industrial zone is still susceptible to wildland fire from the south or south east. Additionally, access to this area is limited – main access route is via Mill Road off of Hwy 39; therefore, there are egress concerns and a high potential for a bottleneck to occur in case of an evacuation.

### 6.1.2 Water Availability for Wildfire Suppression

Water is the single most important suppression resource. In an emergency response scenario, it is critical that a sufficient water supply be available for fire suppression purposes. The Fire Underwriters Survey summarizes their recommendations regarding water works systems fire protection requirements, in *Water Supply for Public Fire Protection* (1999).[105] Some key points from this document include the need for:

- Duplication of system parts in case of breakdowns during an emergency;
- Adequate water storage facilities;
- Distributed hydrants, including hydrants at the ends of dead-end streets; and
- Piping that is correctly installed and in good condition.
- Water works planning should always take worst-case-scenarios into consideration. The water system should be able to serve more than one major fire simultaneously, especially in larger urban centers.

The District water sources from wells near Morfee Lake and provides an infiltrative source of domestic water for the municipality. Two pumping stations supply the District's water tower, which is located in proximity to the Little Mac Ski Hill. Two smaller residential water systems supply the residential subdivision of Gantahaz. Industrial areas within the AOI are tasked with supplying their own water needs.

Water service within the community is an important component of emergency response for a wildland urban interface fire in the event of a large-scale emergency, and in particular for structural fires. It should be noted; however, that a fuel free zone may provide equivalent benefits to firefighting resources as water availability in the event of a wildfire. For suppression within the District, hydrants are available in the development of Gantahaz and the town centre and are tested annually. The industrial area of the AOI also maintain hydrant service, but has a limited capacity and slow recharge reservoir. The rural, less dense and sprawling Gagnon development located in the southern portion of the District does not have hydrants. However, the MFD has installed a 5,000-gallon underground water tank that can be used in the event of a fire occurring in the Gagnon Subdivision. Additionally, the tank is located subsurface,

[105] http://www.scm-rms.ca/docs/Fire%20Underwriters%20Survey%20-%201999%20Water%20Supply%20for%20Public%20Fire%20Protection.pdf

reducing the risk of freezing, and increasing accessibility for using in winter for the purpose of fighting structural fires. The District's water service is gravity fed and is therefore less vulnerable to shortages in water supply due to power outages in the event of a wildfire.

The District can draft from natural water sources, such as Williston Lake or Morfee Lake, when necessary for fire suppression purposes. The natural water sources are known and mapped. These water sources provide the District with two large capacity reservoirs of water, and given their size, they are not assumed to be immediately vulnerable to drought conditions or climate change.

The District's core area is served by a central sewer collection system, while additional facultative lagoons are adequately sized to handle future anticipated increases in usage demand within the community. Other District of Mackenzie developments are serviced as follows: 1) residences within the rural subdivisions of Gantahaz and Gagnon are serviced by individual on-site septic tanks; and 2) industrial areas operate sewage disposal permits from the Ministry of the Environment and are similarly self-sufficient.

Recommendations include: installing reservoir or hydrant systems in areas of poor water availability where feasible (Gagnon development) and ensuring new developments have sufficient hydrant coverage. Hydrant coverage and locations should be reviewed by the MFD. Improving water availability in identified areas and mapping alternative water sources is ongoing and should continue.

Full assessments of the water availability and vulnerability of water sources was not possible under the scope of this report. Back-up power sources should be installed for vulnerable critical infrastructure to ensure the District can continue to operate at an acceptable level during a wildfire event. Completion of a Fire Flow/ Water Supply Vulnerability Assessment for the District water system will identify those areas that may have insufficient or unreliable water supplies.

### 6.1.3 Access and Evacuation

The District of Mackenzie is situated on Highway 39, which is the only reliable, paved access to and from Mackenzie. The District of Mackenzie does not currently have a shelter in place location, in the event it is safer to stay in the community, rather than evacuate south or north. The District held an EOC activation mock examination in May 2017, which included the Emergency Management Team, and was used to identify gaps in the Initial Response Plan[106].

Road networks in a community serve several purposes including providing access for emergency vehicles, providing escape/evacuation routes for residents, and creating fuel breaks. Access and evacuation during a wildfire emergency often must happen simultaneously and road networks should

[106] District of Mackenzie – November 2017 Committee Agenda
https://mackenzie.civicweb.net/document/34406/Committee%20of%20the%20Whole%20-%2014%20Nov%202017.pdf?handle=5B3F6FB61615496695A176E6D64E7ABC

have the capacity to handle both. If wildfire were to block Highway 39, evacuation of District of Mackenzie would be difficult. Smoke and poor visibility, car accidents, wildlife, and other unforeseen circumstances can further complicate evacuations and hinder safe passage.

Within the study area, some of the critical infrastructure is reached via narrow, forested roads, which may impede suppression efforts and response times. Furthermore, there is significant land within the Fire Service Area which is inaccessible by roads, but for which the MFD is responsible for suppression. Review of the Fire Service Area and the accessibility, the risks and benefits of the current boundary is recommended.

Emergency access and evacuation planning is of particular importance in the event of a wildfire event or other large-scale emergency. The District of Mackenzie has developed an Emergency Evacuation Brochure that provides a map of potential evacuation routes, and general emergency preparedness information. It is recommended that the District develop a detailed evacuation plan that includes the following provisions:

- Mapping and identification of safe zones, marshaling points and aerial evacuation locations;
- Planning of traffic control and accident management;
- Identification of volunteers that can assist during and/or after evacuation;
- Development of an education/communication strategy to deliver emergency evacuation procedures to residents.

Recreation trails built to support ATVs can provide access for ground crews and act as fuel breaks for ground fires, particularly in natural areas. Strategic recreational trail development to a standard that supports ATVs, and further to install gates or other barriers to minimize access by unauthorized users can be used as a tool that increases the ability of local fire departments to access interface areas.

The creation of a map book or spatial file that displays the trail network available for the MFD to access during an emergency or for fire suppression planning must accompany any fire access trail building activities. In order to effectively use the trails as crew access or as fuel breaks during suppression efforts, it is recommended to develop a Parks Access Plan, or Total Access Plan. This plan should be made available to the MFD and the BCWS in the event that they are aiding suppression efforts on an interface fire in Mackenzie. The plan should include georeferenced maps with associated spatial data and ground-truthed locations of potential optimal firebreaks, identify the type of access available for each access route, identify those trails that are gated or have barriers, and provide information as to how to unlock / remove barriers. The plan should also identify those natural areas where access is insufficient. Access assessment should consider land ownership, proximity of values at risk, wildfire threat, opportunities for use as fuel break / control lines, trail / road network linkages where fuel-free areas or burn off locations can be created, and requirements for future maintenance activities such as operational access for fuel treatments and other hazard reduction activities.

In addition to providing the safest, quickest, and easiest access routes for emergency crews, a Total Access Plan would minimize the need for using machinery or motorized access in an otherwise undisturbed area. This would reduce the risk of soil disturbance and other environmental damage, as well as reduce rehabilitation costs.

**Table 23. Summary of Evacuation and Access recommendations.**

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| **Objective**: To improve access and egress and enhance emergency preparedness. | | | |
| 24 | High | Complete / participate in regular testing of, and updates to, the evacuation plan. | ~ 30 - 40 hours to plan and stage; 8 hours to complete testing |
| 25 | High | Consider developing a community wildfire pre-planning brochure that addresses the following: 1) locations of staging areas 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of the area of interest. | ~ $10,000 - $15,000 budget to complete (contractor estimate) |
| **Objective**: To expand the view of the trail system to include one with a wildfire lens. | | | |
| 26 | High | Develop a Total Access Plan for the District to create, map and inventory trail and road network in natural areas for suppression planning, identification of areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and / or changes. | ~ Budget of $8,000-10,000 to build plan, map, populate attributes, and update. |
| 27 | High | Include a qualified professional with experience in operational wildland / interface fire suppression in the planning and strategic siting of future trails and parks. | 10 – 20 hours to review current trails / map, provide recommendations |

### 6.1.4 Training

The District of Mackenzie Fire Department maintains a current level of structural protection training, as described in Section 6.1.1. With seven employees trained in both wildland interface and SPU use, the District is adequately prepared to respond to a WUI fire Rank 1 through 3. According to the Office of Fire Commissioner, a new course on Engine Operations in the Wildland Urban Interface is currently being developed, and expected to be released in the spring of 2018, which is a 1-day course that combines the SPP-WWF-1, the S115 and S215 (personal communication with Tom Boechler, Structure Protection Specialist). It is recommended that the MFD consider providing employees this course upon release through the Officer of Fire Commission to ensure currency with techniques, applications and procedures

for wildfire urban interface fire suppression. Provision of training opportunities for structural firefighters in the realm of wildland firefighting is critical to building capacity for suppression and emergency management at the local level.

The MFD maintains communication with BCWS throughout the year, as required by the fire season demands. Additionally, the MFD conducts bi-annual mock exercises in partnership with BCWS, where information and technical/practical knowledge are shared, such as: fireline construction, Mark 3 pump operations, sprinkler protection, skid pack operations and portable water tank deployment, and wildland hose operations. Additional training options could include engaging adjacent Fire Departments (i.e., Bear Lake Volunteer Fire Department or Prince George Fire Department) to conduct joint training so as to further strengthen regional emergency response and firefighting training.

**Table 24. Summary of training and capacity improvement recommendations.**

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| **Objective**: To improve structural and wildfire equipment and training available to Mackenzie Fire Rescue. | | | |
| 28 | High | The District should work on continuing annual cross training opportunities with BCWS. Interface training could include completion of a mock wildfire simulation in coordination with BCWS. Training could be coordinated with other fire departments in the area to enhance regional firefighting capabilities. It is recognized that BCWS crew resources are limited and their availability and is highly dependent upon the current fire season and other BCWS priorities. | Cost and time dependent upon training exercise (scope, number of participating members, etc.). |
| 29 | High | Continue to engage in regular cadence of communication with the BCWS Mackenzie Fire Zone to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities. | ~4 hours / year |
| 30 | High | Ensure that the District maintains the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs). The OFC is currently developing additional wildfire-specific Officer-level training courses; the District 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 (NFPA 1051, equivalent to SPP-WFF 1 currently implemented, and inhouse training for SPP-115). |

| Item | Priority | Recommendation / Next Steps | Estimated Cost ($ or person hours) |
|---|---|---|---|
| 31 | High | Review the 2017 fire season local/regional application of fire bans, motorized vehicle and/or back country bans (on Crown and private land) and the potential for implementing an evacuation alert/order. Identify potential improvements for future application and develop a sound protocol for execution. | ~2 – 6 hours |

## 6.2 STRUCTURE PROTECTION

The District of Mackenzie is currently working on acquiring a Type 2 cargo trailer SPU, which would be deployed in the event of an interface fire to provide protection for 20-30 structures. The MFD maintains a current level of training in both wildfire and structural firefighting (see Section 6.1.1 for additional detail). An important consideration in protecting the WUI zone from fire is ensuring that homes can withstand an interface fire event. Structure protection is focused on ensuring that building materials and construction standards are appropriate to protect individual homes from interface fire. Materials and construction standards used in roofing, exterior siding, window and door glazing, eaves, vents, openings, balconies, decks, and porches are primary considerations in developing FireSmart neighbourhoods. Housing built using appropriate construction techniques and materials, and with fire resistant landscaping are less likely to be impacted by interface fires.

While many BC communities established to date were built without significant consideration with regard to interface fire, there are still ways to reduce home vulnerability. Changes to roofing materials, siding, and decking can be achieved over the long-term through voluntary upgrades, as well as changes in bylaws and building codes. The FireSmart approach has been adopted by a wide range of governments and is a recognized process for reducing and managing fire risk in the wildland urban interface. More details on FireSmart construction can be found in Appendix L.

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. 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 steps that residents can start working on immediately.[107]

The following link accesses an excellent four-minute video demonstrating the importance of FireSmart building practices during a simulated ember shower:
http://www.youtube.com/watch?v=_Vh4cQdH26g.

The structure protection objectives for the District are to:

- Encourage private homeowners to voluntarily adopt FireSmart principles on their properties and to reduce existing barriers to action; and,

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

- Enhance protection of critical infrastructure from wildfire (and post-wildfire impacts).
- Enhance protection of residential / commercial structures from wildfire.

**Table 25. Summary of Emergency Response recommendations.**

| Structure Protection and Planning (Section 6.2) | | | |
|---|---|---|---|
| **Item** | **Priority** | **Recommendation / Next Steps** | **Estimated Cost ($ or person hours)** |
| **Objective:** Improve the FireSmart conditions of Mackenzie by encouraging home and property owners to voluntarily increase FireSmart compliance and improve suppression abilities for interface areas. | | | |
| 32 | High | Consider working with Mackenzie local distributors and homeowners within the Gantahaz and Gagnon areas. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include:<br>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).<br>2) Advocating for a FireSmart branding in the retail stores (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.<br>3) Compile a database of local service providers and retailers which 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 |
| 33 | High | Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. Programs may include scheduled community chipping opportunities, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends. Programs should be available during times of greatest resident activity (likely spring and fall). | Time dependent upon program. May be eligible for UBCM/ SWPI grant. Additional time for advertisement of program availability will be required |

| Structure Protection and Planning (Section 6.2) | | | |
|---|---|---|---|
| **Item** | **Priority** | **Recommendation / Next Steps** | **Estimated Cost ($ or person hours)** |
| **Objective:** Enhance protection of critical municipal infrastructure from wildfire. | | | |
| 34 | High | Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized. | ~20 hours to complete vulnerability assessment and upgrading dependent upon project(s) chosen |
| 35 | High | Consider completing a fire flow / water vulnerability assessment for each water system to identify areas where water availability may be improved and provide recommendations to reduce District's vulnerability. | $10,000 |
| 36 | High | Consider updating the District of Mackenzie Hazard Risk and Vulnerability Assessment (2005) by conducting detailed hazard assessments and proactively (in advance of wildfire) developing response plans for stabilization and rehabilitation of burn areas in watersheds that are vulnerable to post-wildfire debris flows and floods. | $25,000 |
| **Objective:** Enhance protection of residential/commercial structures from wildfire. | | | |
| 37 | High | Complete the acquisition of the Type 2 SPU for the District of Mackenzie. | $100,000 - $150,000 depending on configuration |

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# APPENDIX A – WILDFIRE THREAT ASSESSMENT – FBP FUEL TYPE CHANGE RATIONALE

Attached separately as a PDF package.

# APPENDIX B – WILDFIRE THREAT ASSESSMENT WORKSHEETS AND PHOTOS

Attached separately as a PDF package.

# APPENDIX C – MAPS

Attached separately as a PDF package.

# APPENDIX D – SUMMARY OF 2005 CWPP RECOMMENDATIONS

The following recommendations were provided as part of the 2005 CWPP for the District of Mackenzie developed by EMERGEX.

**High priority recommendations:**

- Immediately enact specific sections of the Wildfire Act and Wildfire Regulation as municipal bylaws for the 2005 field season.
- Pursue avenues to reduce fuel loading adjacent to and within the townsite.
- Develop a plan to modify forest fuels within the townsite and within a 100 metre zone around the townsite.
- Seek a UBCM grant for a fuel reduction "pilot project".
- Conduct a survey of existing conditions (including species, terrain, sensitive areas, and proximity to infrastructure) in the interface zone.

**Medium priority recommendations:**

- Enact bylaws specific to the Municipality in time for the 2006 field season.
- Provide specialized training in BCERMS and Interface Fire Response to identified key staff.
- Include all harvesting inside and adjacent to the Municipal area within the Community Forest License development planning process and make fuels management an integral part of the plan.
- Pursue Federal financial assistance for 'operational beetle management' and 'worker training' within the municipal area.

**Low priority recommendations:**

- Develop and maintain a District of Mackenzie/Forest Service joint Fire Prevention Program within and adjacent to the municipality to deal with the emerging slash disposal and open burning challenges.
- Reduce urban wildland interface fire risks attributed to existing municipal bylaws and legislations.
- Address the regulation of subdivision and other development to ensure that interface fire risk is managed.
- Work with other agencies to develop a joint program for emergency management training.
- Develop a strategy/policy that fosters a multi-agency all hazards approach to emergency preparedness response and management.
- Develop a comprehensive watershed management plan that addresses wildfire impacts and mitigation options.
- Work with Forest Service to amend the stocking standards and/or acceptable species guidelines within the Municipal boundary.
- Form an Interagency Fuel Management Team to address current and emerging issues within the Municipal area.

# APPENDIX E – WATERSHED VULNERABILITY – 2005 CWPP

The following is an excerpt from the 2005 CWPP produced by EMERGEX, regarding watershed vulnerability in the District of Mackenzie.

Fire effects and post-fire conditions and processes on local watershed resources may result in adverse ecological consequences. Wildfires in the vicinity of the District of Mackenzie may affect both local watersheds and watercourses, including the Morfee Lakes watershed. It is important to note that the District of Mackenzie drinking water supply consists of three wells, located beside Morfee Lakes. Wildfires in this area may pose a risk Morfee, Gaitaga, Heather and Dina Lakes are popular fishing locations within proximity to the District of Mackenzie and are susceptible to fire induced changes to water quality and potential threat to fish and aquatic life. Some post-fire environmental changes include increased sedimentation and turbidity, increased stream temperatures and increased concentrations of nutrients resulting from surface runoff, all of which could impact spawning and rearing habitat. It is important to note that mesic sites (i.e. a type of habitat with a moderate or well balanced supply of moisture), such as the area surrounding the District of Mackenzie, re-vegetate more rapidly than non-mesic sites. However, mesic sites may be exposed to greater and more intense rainfall which may increase the degree of erosion and sedimentation in local watersheds and watercourses. Wildfires can result in the removal of vegetation and alterations to physical soil properties, which will typically result in erosion in previously undisturbed forested landscape until a sufficient layer of organic debris has built up. Since root systems of top-killed shrubs and trees assist in maintaining soil stability, erosion may not occur immediately; instead, it may be delayed several years following a fire (Wright and Bailey, 1982). Whether or not erosion occurs is dependent on fire-influenced changes and a variety of topographical factors, including slope and aspect in addition to climatic factors such as rate and amount of precipitation. Increased susceptibility of soil to overland flow and subsequent surface erosion in the first decade following a wildfire has been well documented. The magnitude and frequency of mass wasting events and sediment transport may also increase following a fire event. Overall, a variety of factors including slope steepness, aspect, soil texture, vegetation recovery time, the amount of residual litter and duff and climatic factors such as the timing, intensity, and amount of precipitation, all interact with one another to determine a sites susceptibility to erosion. Past studies have found post-fire erosion to be facilitated by wind, water, and/or gravity. This includes all of the following types of erosion: raindrop splash, sheet and rill erosion, soil creep, and mass wasting.

# 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 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 6.

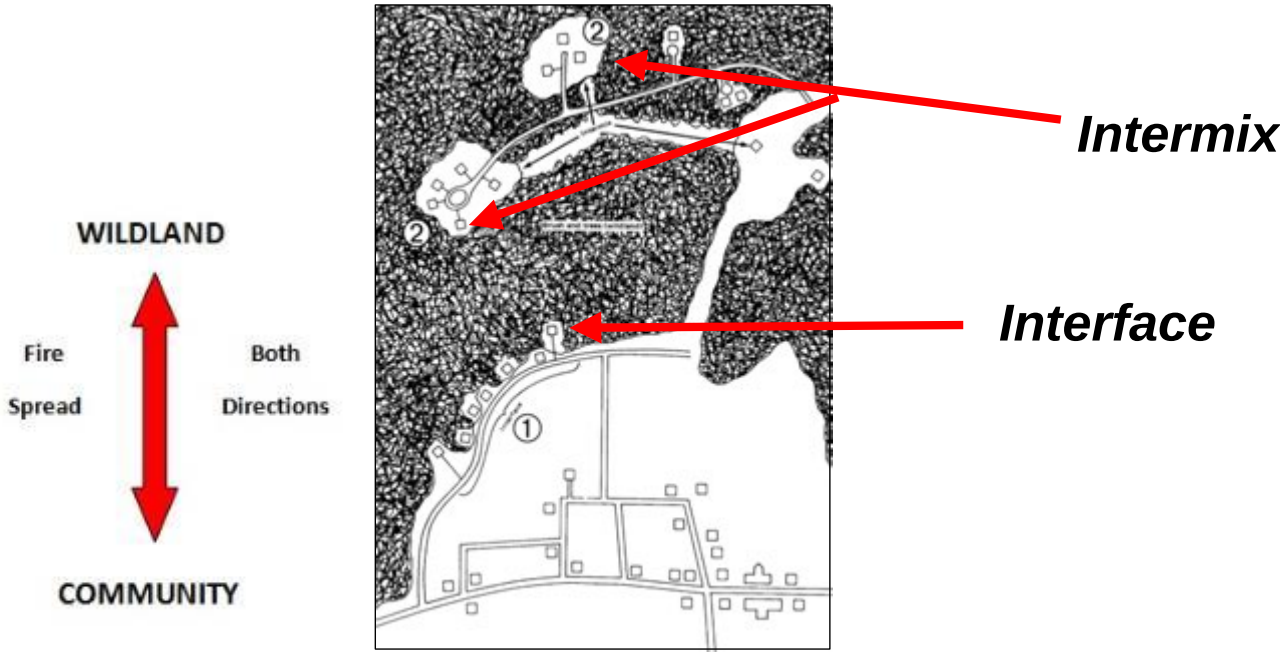


**Figure 6. Illustration of intermix and interface situations.**

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 7).

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 8).

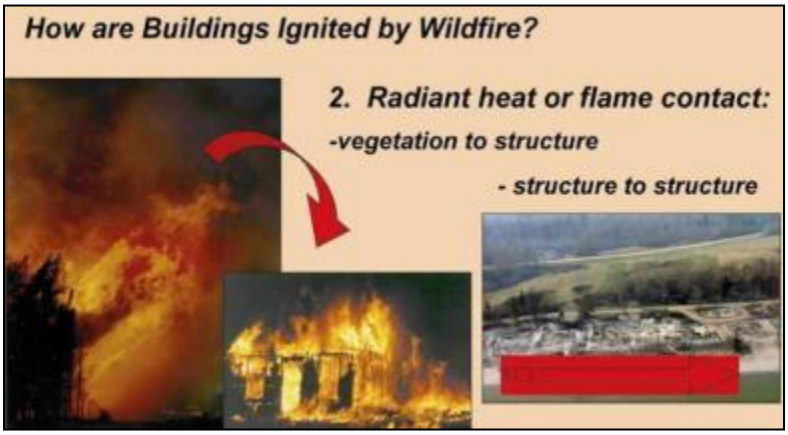


**Figure 7. Firebrand caused ignitions: burning embers are carried ahead of the fire front and alight on vulnerable building surfaces.**


**Figure 8. 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 9).

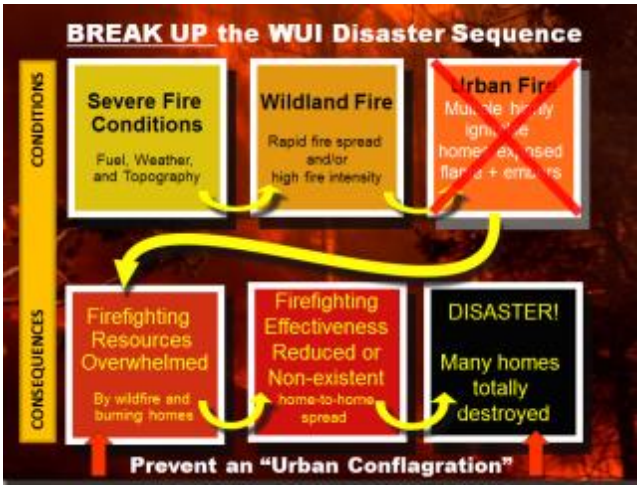


**Figure 9. WUI disaster sequence.**

# APPENDIX G – WUI THREAT PLOT LOCATIONS

Table 26 displays a summary of all WUI threat plots completed during CWPP field work. The original WUI threat plot forms and photos will be 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 26. Summary of WUI Threat Assessment Worksheets.**

| WUI Plot # | Geographic Location | Wildfire Behaviour Threat Class | WUI Threat Class |
|---|---|---|---|
| CELL-1 | Northwest of intersection between McIntyre Drive and Hwy 39. | Moderate | Extreme* |
| CEM-1 | South of Parsnip East Forest Development Road / Hwy 39 | Moderate | Extreme |
| CENT-1 | Centennial Drive / Parsnip Crescent | Moderate | Extreme |
| GAN-1 | Hwy 39 / Secondary School Woodlot | High | Moderate |
| GAN-2 | Gagnon | Moderate | N/A |
| GAN-3 | Hwy 39 / Finlay Causeway (Gagnon) | Moderate | N/A |
| GAN-4 | Hwy 39 / Finlay Causeway (Gagnon) | Moderate | N/A |
| GAN-5 | Hwy 39 (Gagnon) | Moderate | N/A |
| GAN-7 | Hwy 39 (Gagnon) | Moderate | N/A |
| GAN-9 | (Gagnon) | Moderate | N/A |
| GANT-2 | South of Alberta Drive (Gantahaz) | Moderate | Extreme |
| GANT-3 | Southwest of Alberta Drive and Hwy 39 (Gantahaz) | Moderate | Extreme |
| GANT-4 | Southwest of Alberta Drive and Hwy 39 (Gantahaz) | Moderate | N/A |
| GANT-5 | Southeast of Mugaha Mainline and Parsnip Forest Development Road (Gantahaz) | Moderate | N/A |

| WUI Plot # | Geographic Location | Wildfire Behaviour Threat Class | WUI Threat Class |
|---|---|---|---|
| GANT-6 | South of Parsnip Forest Development Road / North of Columbia Drive (Gantahaz) | Moderate | N/A |
| GANT-10 | North of Parsnip Forest Development Road intersection with Hwy 39 (Gantahaz) | High | Extreme |
| GC-1 | Cicada Road/Golf Course | High | Extreme |
| HILL-1 | Laurier Drive / John Dahl Regional Park | High | High |
| HILL-2 | Laurier Drive / John Dahl Regional Park | High | Extreme |
| HILL-3 | South of Laurier Drive / John Dahl Regional Park | Moderate | N/A |
| HOSP-1 | Centennial Drive / Hospital | Moderate | Extreme |
| LEM-1 | Lemoray Drive | Moderate | High |
| MOF-1 | Cicada Road | Moderate | High |
| MOR-1 | Morfee Lake Road / Morfee Beach | High | High |
| PLANT-1 | BC Hydro Morfee Substation / Hwy 39 | High | Extreme |
| PLANT-2 | Parsnip West Forest Development Road / BC Hydro Morfee Substation | High | Extreme |
| PLANT-3 | Parsnip West Forest Development Road / BC Hydro Morfee Substation | Moderate | N/A |
| PLANT-4 | Parsnip West Forest Development Road / Sewage Lagoons | High | Extreme |
| PLANT-5 | Parsnip West Forest Development Road / BC Hydro Morfee Substation | Moderate | N/A |
| PLANT-6 | Parsnip West Forest Development Road / BC Hydro Morfee Substation | High | Extreme |
| RG-1 | Rodeo Grounds Road | High | High |
| SOUTH-1 | South of Parsnip East Forest Development Road / Hwy 39 | Moderate | N/A |

*Note that WUI threat scores are only collected for untreated polygons that rate high or extreme for Wildfire Behaviour Threat score. WUI threat scores are collected regardless of Wildfire Behaviour Threat score for treated polygons.

# APPENDIX H – FUEL TYPING METHODOLOGY AND LIMITATIONS

The initial starting point for fuel typing for the study area was the 2017 provincial fuel typing layer provided by BCWS as part of the *2015 Provincial Strategic Threat Analysis* (PSTA) data package. This fuel type layer is based on the FBP fuel typing system. 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 threat class for parts of the private land within the industrial area of the District of Mackenzie and in the Gagnon development was not available. Fuel types within the study area have been updated using orthoimagery of the study area with representative fuel type calls confirmed by field fuel type verification. Polygons not field-verified were assigned fuel types based upon similarities visible in orthophotography to areas field verified. Where polygons were available from the provincial fuel typing layer, they were utilized and updated as necessary for recent harvesting, development, etc.

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. However, given that the FBP system was almost entirely developed for boreal and sub-boreal forest types, the latter of which occurs within the study area, it is expected that the AOI fuel typing should correspond to the fire behaviour pattern particular to this region. 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.

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 each directly applies to the study area: recent clearcuts with piles slash where slash types probably do not represent current forestry practices.

In some cases, 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.[108]

[108] Ibid.

# APPENDIX I – 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 (2012) 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 32 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 212 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 27 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.

**Table 27. Description of variables used in spatial analysis for WUI wildfire threat assessment.**

| 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 | |

| WUI Threat Sheet Attribute | Used in Analysis? | Comment |
|---|---|---|
| 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 and 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 4.3.1) impacts the threat assessment, as well.

# APPENDIX J– 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 10 and Figure 11). 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 12). 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.

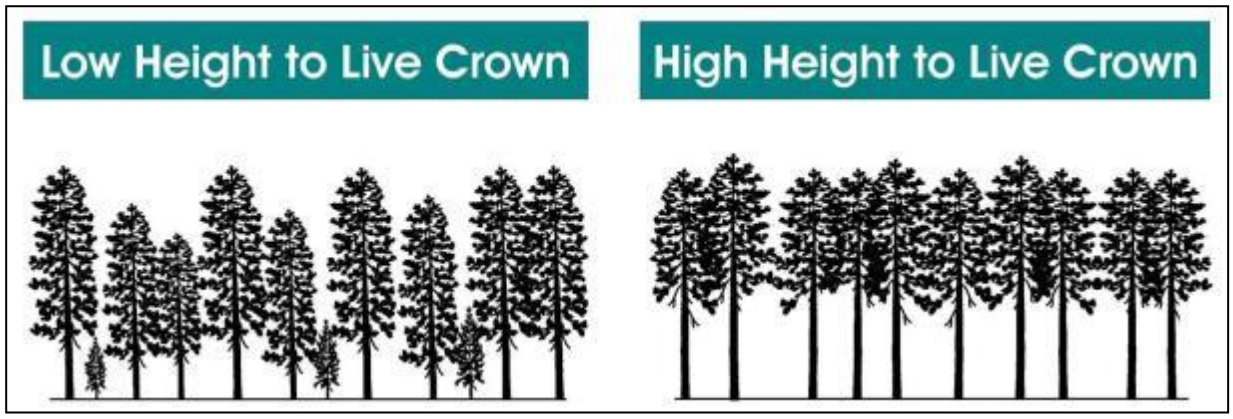


**Figure 10. Comparison of stand level differences in height-to-live crown in an interior forest, where low height to live crown is more hazardous than high height to live crown.**

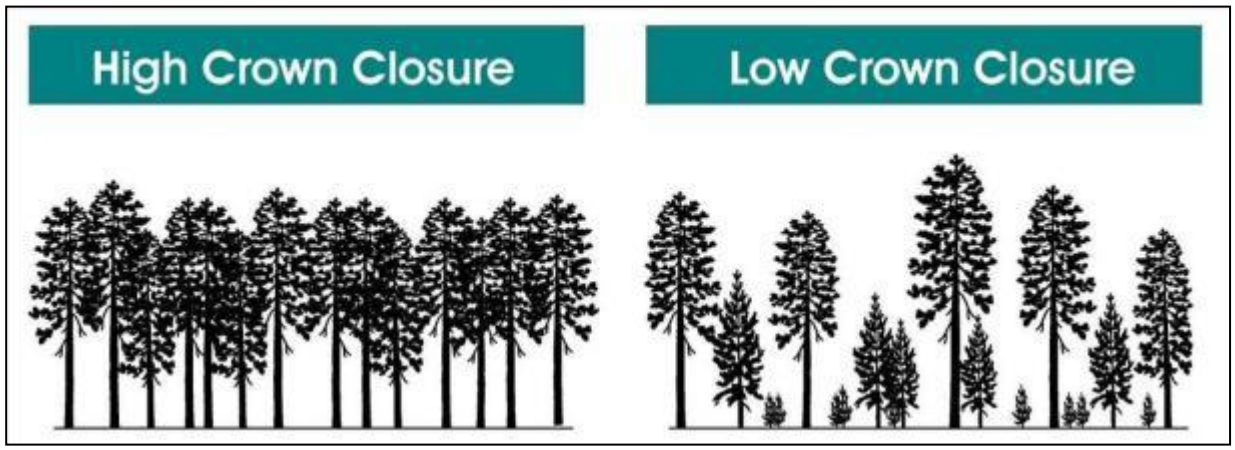


**Figure 11. Comparison of stand level differences in crown closure, where high crown closure/continuity contributes to crown fire spread, while low crown closure reduces crown fire potential.**

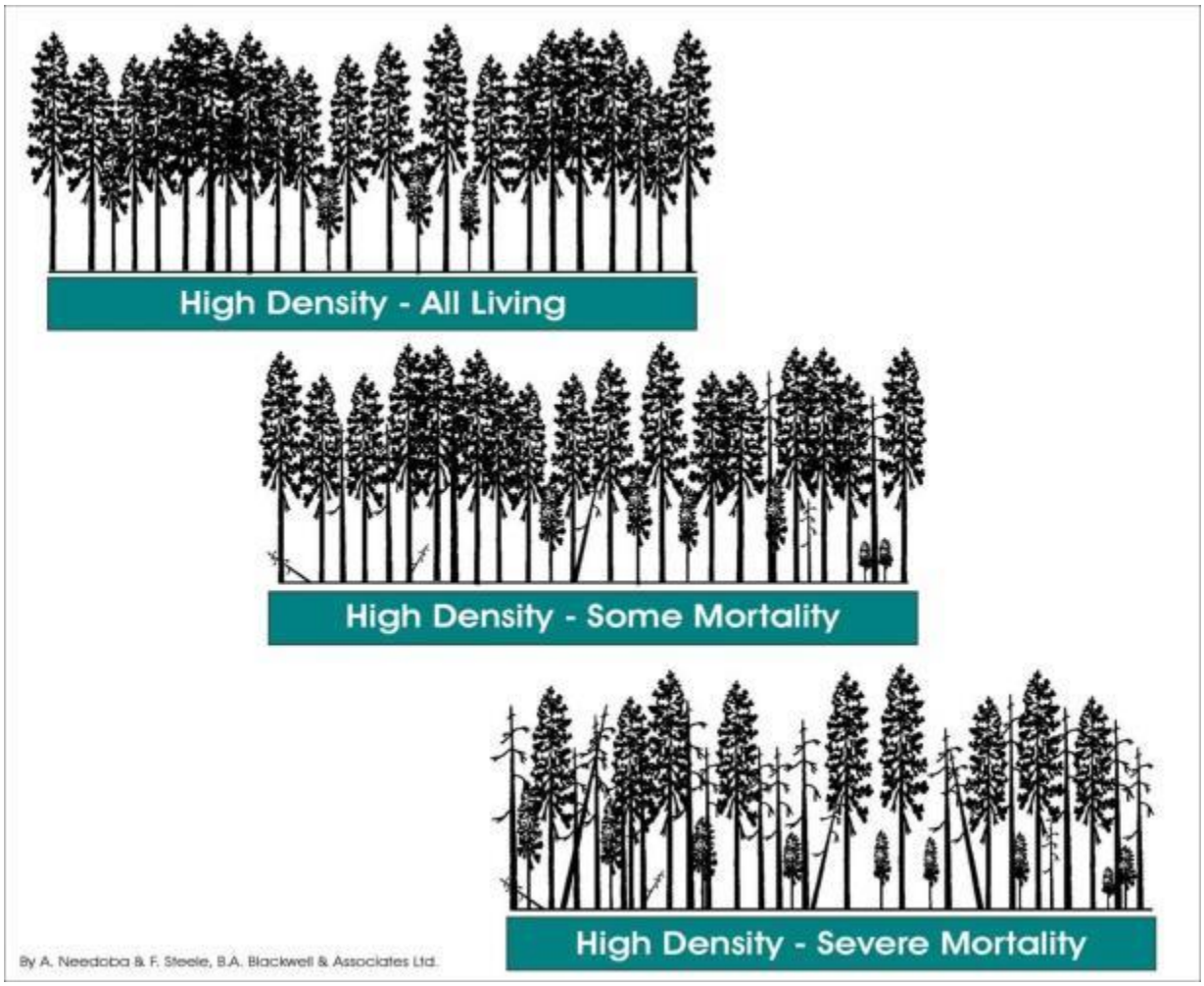


**Figure 12. Comparison of stand level differences in density and mortality, and the distribution of live and dead fuels in these types of stands.**

Thinning is a preferred approach to fuel treatment (Figure 13.) 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.

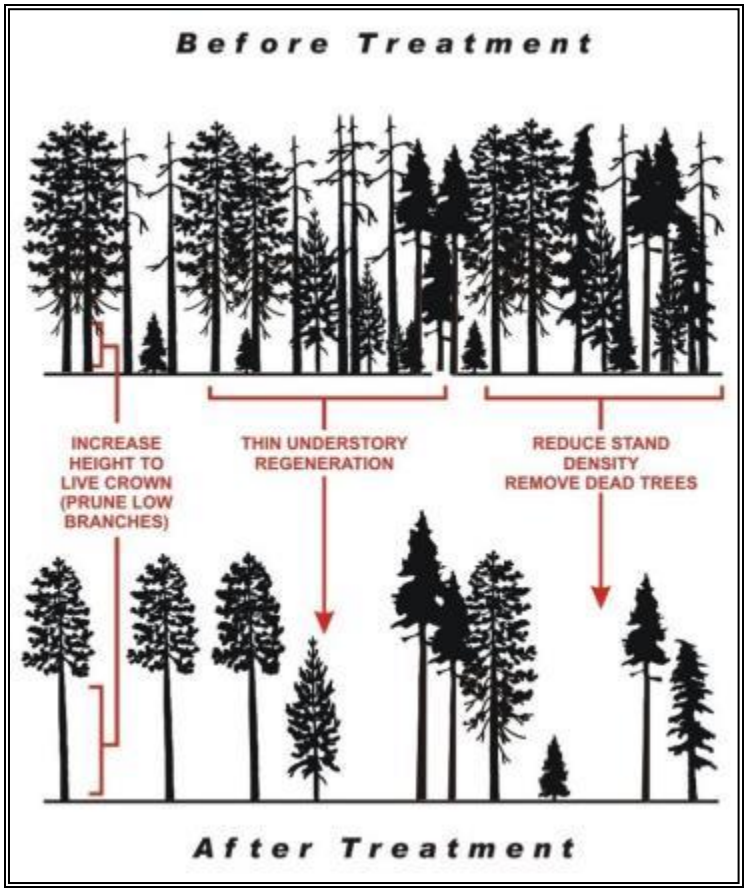


**Figure 13. Illustration of the principles of thinning to reduce the stand level wildfire hazard.**

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 District. 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 K – 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 14. Illustration of FireSmart zones.** (Figure adapted from FireSmart)

# APPENDIX L – 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[109].

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.[110,111] 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 stuctures. .

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

[109] 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

[110] Ibid.

[111] Using the FireSmart hazard assessment system.

that open into attic spaces should resist ember intrusion with non-combustible wire mesh no larger than 3 mm.

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.[112]

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

## 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 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 3b.

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 M – COMMUNICATION AND EDUCATION

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, District 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.[113] 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.[114]

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 is more likely to use social media to get updates on 'newsworthy items'.[115]

[113] Pew Research Center Journalism and Media. Social media news use: Facebook leads the pack. May 25, 2016. Accessed November 17, 2017 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/.

[114] 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.

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