



Community Wildfire Protection Plan

Regional District of North Okanagan

CWPP Update - January 2019



**Regional District of North Okanagan
Community Wildfire Protection Plan – Update
January 2019**

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<p><i>(Affix seal/stamp and sign)</i></p> <div style="text-align: center;"></div> <p><i>"I certify that the work described herein fulfills the standards expected of a member of the Association of British Columbia Forest Professionals and that I did personally supervise the work."</i></p> <p><i>Supervision certification statement</i></p>	

Executive Summary

The Community Wildfire Protection Plan (CWPP) has been a foundational element of the Strategic Wildfire Prevention Initiative (SWPI), and now the Community Resiliency Investment (CRI) program and serves to paint the complete wildfire picture for communities in British Columbia. The Regional District of North Okanagan (RDNO) has long had a relationship with the surrounding environment, including wildland fire. Most recently during the 2018 fire season, RDNO residents endured weeks of smoke and anxiety as several large-scale wildfires burned within close proximity to member communities. To reframe the wildfire issues faced by the community, and to position the municipality to make continued use of prevention funding under CRI, the RDNO retained Davies Wildfire Management Inc to undertake an updated CWPP.

As a partial indicator of potential future wildfire activity, a fire history analysis was completed. Although the occurrence rate of wildfires within the RDNO area of interest (AOI) is rather inconclusive, with some Electoral Areas showing declines in occurrence rates while others show gradual increases, within the entire regional district boundary person-caused wildfires have been in decline and lightning fires are at a steady rate of occurrence. However, an analysis of five BC Wildfire Service (BCWS) fire weather stations in the surrounding region indicate a gradual increase in the number of Danger Class 4 and 5 days per year for all stations, with the exception of the Mabel Lake 2 station, which curiously displays a declining rate.

Geospatial analysis of provincial fuel type layers and the provincial strategic threat analysis (PSTA) outputs further characterize the wildfire impacts that RDNO continues to face. Although parts of the RDNO is relatively well-protected by orchards or large fields dominated by agricultural crops, as well as Kalamalka and Mabel Lakes, continued emphasis needs to be placed on the responsibilities of private property holders to manage their fuel hazards. This includes residential property owners and the steps they can take to manage their landscaping and structure characteristics to make their homes less ignitable during a wildfire.

On the response side of the wildland urban interface (WUI) fire equation, the RDNO Volunteer Fire Departments cover a large area in the North Okanagan prone to extreme fire conditions. As interagency partners in wildfire response, they should be afforded the opportunity to participate in wildfire training courses alongside their BC Wildfire Service counterparts.

RDNO will continue to face wildfire pressures, and these should be expected to increase in a changing climate. By maintaining a proactive focus on wildfire prevention and mitigation efforts, and through continued advocacy at the local and provincial levels, the community can continue to find ways to grow and thrive in an active wildfire environment.

Summary of CWPP Recommendations

- **Recommendation 1 (Public Engagement):** When developing wildfire-related communications for the public, consider including the ecological and cultural role that fire has played on the regional landscape.
- **Recommendation 2 (Prevention and Preparedness):** Consider approaching the BC Wildfire to explore the possibility of re-establishing a fire weather station on the Aberdeen Plateau (outside the AOI for this CWPP update).
- **Recommendation 3 (Prevention and Public Engagement):** Maintain a link from the Regional District of North Okanagan website to the BC Wildfire Service Danger Class webpage to enable the public to check the RDNO fire weather station Danger Class.
- **Recommendation 4 (Preparedness and Governance):** On an annual basis, consider preparing a Danger Class report to help characterize past fire danger and assist decision makers in representing wildfire-related challenges faced by RDNO.
- **Recommendation 5 (Prevention):** The application of prescribed fire in areas surrounding RDNO should be supported as a proactive method of fuels management that can result in less smoke output than similar areas burning under wildfire conditions.
- **Recommendation 6 (Prevention and Public Engagement):** Wildland urban interface threat reduction should be promoted as a mutually beneficial strategy between private property owners and governments. Private property owners and governments alike need to take responsibility for the wildland fuel under their ownership.
- **Recommendation 7 (Prevention and Governance):** Consider lowering or removing the subdivision threshold of four or more lots with regards to the wildfire DPA requirements in Areas B and C.
- **Recommendation 8 (Prevention and Governance):** When drafting or updating wildfire DPA requirements and guidelines, incorporate FireSmart practices and disciplines, particularly with regards to landscaping.
- **Recommendation 9 (Prevention and Public Engagement):** RDNO should continue to pursue FireSmart projects, as it remains the best available option for generating public interest and action regarding hazard reduction on private property.
- **Recommendation 10 (Prevention and Public Engagement):** Establish a wildfire safety and hazard reduction page on the Regional District website to highlight the FireSmart program and simple actions that homeowners can take to reduce their homes' ignitability. Engage in public education information sessions throughout the RDNO associated with wildfire management and/or FireSmart.
- **Recommendation 11 (Prevention):** Consider the identified interface and landscape fuel breaks summarized in Tables 17 and 18, respectively, for treatment prescription and implementation.
- **Recommendation 12 (Operations and Preparedness):** Consider the development of pre-attack wildfire response plans that highlight natural water sources that can be used where hydrants are lacking. In addition, areas with limited access (single access roads, no turnarounds etc.) may also be beneficial to include in pre-attack plans.

- **Recommendation 13 (Operations):** As interagency partners in wildfire suppression operations, RDNO departments should consider pursuing seats in basic and intermediate wildfire training opportunities with the BC Wildfire Service, beyond S-100.
- **Recommendation 14 (Operations and Preparedness):** RDNO should consider acquiring Type 2 Structure Protection Units for Silver Star and Lumby that can be used locally or deployed under cost recovery elsewhere when conditions allow.

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1. Introduction

The Community Wildfire Protection Plan (CWPP) program was initiated by the Province of British Columbia as a response to key recommendations contained in the Firestorm 2003 Provincial Review (Filmon, 2004). The CWPP program has been administered by the Union of BC Municipalities (UBCM) as a foundational component of the overarching Strategic Wildfire Prevention Initiative (SWPI) suite of funding programs since 2004 (Union of BC Municipalities, 2018). Recently, the provincial government announced that SWPI programs and funding would be rolled into the Community Resiliency Investment (CRI) program (BC Government News, 2018). The CWPP program continues to be available to all local governments and First Nations in BC (Union of BC Municipalities, 2018).

1.1 Purpose

A CWPP is intended to provide the basis for all future wildfire mitigation actions in a community. As such, the content of a CWPP provides a clear description of the wildfire environment, wildfire risks to the community, as well as strategic and operational recommendations to reduce risk and increase the community's resilience to wildfire threats.

A comprehensive awareness of the factors of the wildfire environment is the foundation upon which future hazard identification and mitigation efforts can proceed. In the intervening years since the adoption of the most recent CWPP, the regional and provincial wildfire picture has come into greater focus. Several high-profile wildland urban interface (WUI) fires have since impacted the community and surrounding area. Further afield, significant wildfire disasters have occurred in other parts of Western Canada.

With these persistent factors in mind, the CWPP remains a cornerstone of wildfire mitigation for communities. The intended outcome of the CWPP planning process is to provide the community with a detailed framework to further efforts that will:

- Reduce the likelihood of a wildfire entering the community;
- Reduce the impacts and/or losses to property and critical infrastructure;
- Reduce negative economic and social wildfire impacts to the community.

1.2 CWPP Planning Process

Davies Wildfire Management Inc. (DWM) was retained as the consulting firm to conduct the CWPP update. Andrew Low, RPF, and John Davies, RPF, supervised the field assessments, analysis and report compilation as forest professionals qualified in all aspects of wildland fire management. All consultations were through the Regional District of North Okanagan (RDNO) Manager of Protective Services, Alastair Crick.

2. Local Area Description

The Regional District of North Okanagan is one of 27 regional districts in British Columbia. Incorporated by Letters Patent issued on November 9, 1965, the RDNO is currently comprised of

six member municipalities (Armstrong, Coldstream, Enderby, Lumby, Spallumcheen, and Vernon) and five Electoral Areas (Areas B, C, D, E, and F). The first people to inhabit the north Okanagan area were the Inkumupulux and Splotsin of the Syilx/Okanagan and Secwepemc nations, respectively. The Okanagan Indian Band is the northernmost member of the eight community Okanagan Nation Alliance, while the Splotsin are the southernmost tribe of the Shuswap Nation.

2.1 CWPP Area of Interest

The area of interest (AOI), as used in CWPP terminology, essentially describes the study area. The UBCM guidance for defining the AOI is rather flexible, ranging from simply the extent of wildland urban interface (WUI) as the minimum, to taking a wider view consisting of the local government's legal boundary, with an added 2 km buffer beyond.

The AOI for the RDNO CWPP update was selected through consultation with the UBCM and RDNO staff. As the funding body, the UBCM wanted to ensure that work conducted on adjacent CWPPs would not be duplicated in the course of the RDNO CWPP update, given that portions of adjacent AOIs (e.g. Lumby and Coldstream) extended into portions of RDNO Electoral Areas (e.g. Area B, C, and D). Ultimately, the AOI was selected to include portions of Area B, C, D, and F (see Map 1), which collectively represent 146,746 ha included in the CWPP update.

2.2 Community Description

The RDNO is a diverse region in many respects. Ecologically, the region straddles the transition between the hot and dry Okanagan Valley and the cool, wet Monashee Mountains. Given a diverse ecology, the region invites a range of land use, including agriculture and forestry, as well as a multitude of tourism and recreational pursuits.

2.2.1 Governance and Administration

In British Columbia, Regional districts are governed by boards of directly and indirectly elected directors. Residents of unincorporated areas of a regional district elect a director to the board directly, while member municipal councils appoint elected council members to a board. Electoral Area Directors serve a three-year term, while Municipal Directors serve one-year terms.

The RDNO Board of Directors consists of 14 directors – one from each of the five electoral areas and one from each of the municipalities, except for the City of Vernon, which appoints four directors. Upon formation, the board selects a chairperson and establishes various committees pertaining to issues such as planning, environmental management, and regional growth.

2.2.2 Infrastructure and Services

The RDNO corporate office is headquartered in Coldstream where the following services are managed:

- Administration
- Community Services
- Protective Services
- Environmental Services
- Utilities

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- Inter-Regional Services
- Parks, Recreation and Culture
- Planning and Building

Portions of the RDNO are within the Fortis natural gas service area, while the entire regional district lies within the BC Hydro service area.

The RDNO is situated within the Okanagan health service area of the Interior Health Authority. The nearest hospital is the Royal Jubilee Hospital in Vernon, which is designated a service area (regional) hospital. Tertiary referral hospitals are in Kelowna and Kamloops. A number of health centres are located in the RDNO where a variety of services are provided, including (Interior Health, 2018):

- emergency health services;
- community care clinic;
- community nursing and nutrition services;
- adult day services;
- prenatal services and postpartum care;
- radiology, etc.

Table 1 Hospitals and health centres in RDNO.

Hospitals and Health Centres	Services
Vernon Jubilee Hospital	Regional hospital. Core medical and surgical specialty services to patients in the service area
Vernon Health Centre	Community health centre
Vernon Downtown Primary Care Centre	Primary health centre
Armstrong – Pleasant Valley Health Centre	Community health centre
Enderby Community Health Centre	Primary health centre
Lumby Health Unit	Community health centre

2.2.3 Economic Drivers

The 2016 Census employment data provide an indication of the economic drivers in the RDNO. As illustrated in Figure 1, the top five industries (retail, health care, construction, manufacturing, and accommodation/food services) employ 53% of the employed labour force in RDNO (Government of Canada, 2016).

These top sectors can be particularly sensitive to the impacts of wildfire on the region. For example, evacuations and smoke impacts, whether they are affecting the community directly or

the indirect effect of negative perception among potential visitors regarding fires elsewhere in the province can all lead to a decrease in visitation and tourist spending (Deacon, 2017). Wildfire smoke also contributes to increased health concerns among susceptible populations, resulting in increased strain on health care facilities (HealthLinkBC, 2017).

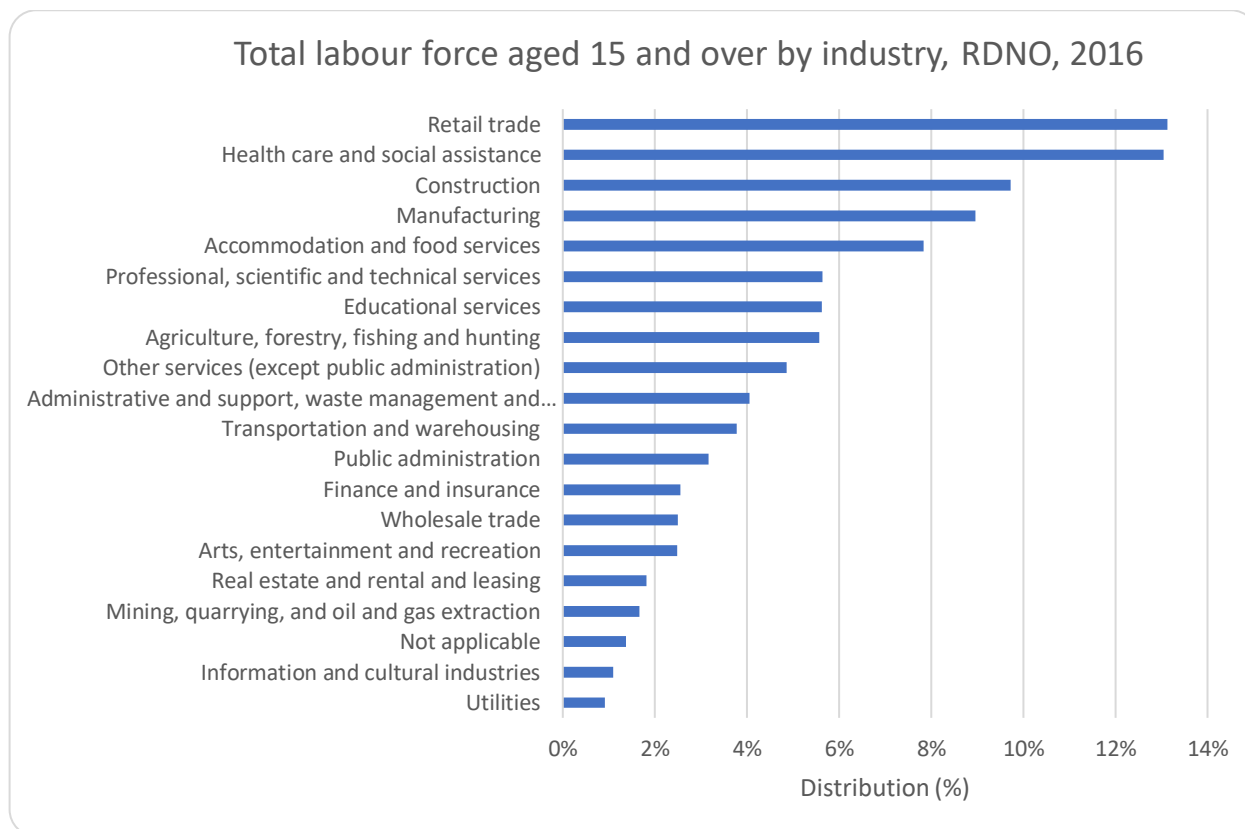


Figure 1 Employed labour force by industry in RDNO, as per the 2016 census.

2.2.4 Land Ownership

The AOI is comprised of 69% crown land with the bulk of the remainder consisting of private land (15%), no recorded ownership (9%), or First Nations IR (7%). Municipal ownership makes up a small proportion of land in the AOI (335 ha or 0.2%). Land ownership directly relates to the ability to carry out fuel management as CRI and FES funding is intended for mitigation activities on public land.

Table 2 Land ownership types within the RDNO AOI.

Type	Area (ha)	%
Crown Provincial	100,945.3	69%
Private	22,216.3	15%
None	13,325.2	9%
First Nation	9,645.0	7%
Municipal	334.6	0.2%
Unknown	158.7	0.1%
Crown Agency	69.1	0.05%
Mixed Ownership	52.2	0.04%
	146,746.6	100%

2.2.5 Firefighting Jurisdiction

The following fire departments serve portions of the AOI:

- B.X./Swan Lake Fire-Rescue
- Lumby and District Volunteer Fire Department
- Silver Star Fire Department
- Enderby and District Volunteer Fire Department provides service to Ashton Creek in the western portion of the Area F AOI.

2.2.6 Existing Evacuation and Egress Routes

There is currently no formalized evacuation route plan for the RDNO, but an application has been submitted to UBCM to fund the development of a comprehensive evacuation route plan for the Regional District. Should the funding be granted, this project will be completed in 2019.

2.3 Past Wildfires, Evacuations and Impacts

Wildfires have been a regular and natural disturbance agent in the North Okanagan for millennia. In recent years, RDNO has felt the effects of several wildfires, ranging from small fast-moving fires that are contained relatively quickly, to prolonged periods of large fires burning in the surrounding area. During the 2018 fire season, several wildfires in the eastern portions of the RDNO (managed as the Monashee Complex) resulted in prolonged smoke exposure, area closures and evacuation alerts. The 2018 fire season also saw several small fires closer to the WUI, including a small fire in Upper Brookside Creek in the BX area that was quickly contained.

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The North Okanagan has had its share of wildfires in the WUI in recent years, including small fires at Adventure Bay and Predator Ridge in 2016 that resulted in evacuation orders and alerts, respectively. The North Okanagan has also provided refuge for wildfire evacuees from other parts of the province, including several hundred in 2017. Fortunately, RDNO has been spared the widespread destruction of homes that other areas of the province have experienced. A detailed fire history analysis, including fire occurrence and annual area burned within the AOI is provided in Section 3. The more significant wildfires in the RDNO during 2018 are summarized in Table 3.

Table 3 Wildfires of some significance in RDNO during the 2018 fire season.

Fire number	Cause	Geographic	Size (ha)	Date of discovery
K42099	Lightning	Noisy Creek	168.9	August 31, 2018
K42705	Lightning	Woodward Creek	255.0	August 16, 2018
K42185	Lightning	Devil Creek	39.4	August 5, 2018
K42136	Lightning	Hound Creek	126.1	August 4, 2018
K42143	Lightning	E of Tsuius Mountain	43.5	August 4, 2018
K42067	Lightning	Whip Creek	504.0	August 3, 2018
K41813	Lightning	Mabel Creek	1,370.4	July 31, 2018
K41812	Lightning	Derry Drainage	43.4	July 31, 2018
K41791	Lightning	Sugar Mountain	394.3	July 31, 2018
K41809	Lightning	Proctor Rd	20.0	July 31, 2018
K42921	Lightning	Ingram Creek	32.0	July 31, 2018
K41258	Lightning	Upper Brookside Creek	1.2	July 16, 2018
K41117	Person	Cougar Canyon	0.01	July 6, 2018

2.4 Current Community Engagement

The RDNO has numerous examples of grass roots efforts to raise WUI fire safety awareness and advocacy for mitigation. For example, a dedicated group of residents in Kingfisher have long been promoting FireSmart practices and annually deploy a network of water barrels along the Enderby Mabel Lake Road at key locations during the fire season. Property owners at Silver Star have been working to address wildfire issues in their area for some time and it is reflected in the Silver Star Official Community Plan (OCP). Similarly, property owners at Cosens Bay have been actively

raising wildfire awareness in their area and promoting proactive measures. Though not the only examples of wildfire-conscious communities in the RDNO, these three communities are also currently involved in FireSmart community recognition projects to further promote awareness and private property mitigation.

Each of the fire departments in the AOI are also active participants and leaders of FireSmart principles in their respective protection areas. For example, BX – Swan Lake Fire Rescue, Silver Star Fire Department and the Lumby & District Volunteer Fire Department all regularly hold open houses, FireSmart information sessions and other public education and safety events for their communities.

2.5 Linkages to Other Plans and Policies

A few plans and policies exist at various levels of government that pertain to the response and recovery of WUI fires, as well as wildfire management in general. The following is a survey of the various plans and instruments.

2.5.1 Local Authority Emergency Plan

As with any local authority in BC, the RDNO maintains a local emergency plan as part of their emergency management program. The scope of the local emergency plan includes:

- emergency management organization;
- assignment of responsibilities;
- list of assisting/cooperating agencies;
- emergency notification procedures;
- emergency response implementation procedures;
- directory of vital services and resources;
- EOC procedures;
- communications procedures;
- alert/call out procedures;
- public information guidelines;
- evacuation guidelines;
- ESS guidelines;
- resource management (materiel and human);
- procedures for requesting provincial or federal assistance;
- procedures for the declaration of a local state of emergency;
- procedures for the expenditure of funds for emergency response and recovery; and
- management of livestock.

There is currently no formalized evacuation route plan for the RDNO, but an application has been submitted to UBCM in order to fund the development of a comprehensive evacuation route plan for the Regional District. Should the funding be granted, this project will be completed in 2019.

2.5.2 Affiliated CWPPs

The RDNO's original CWPP was completed in 2010. Communities with adjacent CWPPs to the RDNO include:

- Coldstream (2016)
- Enderby (2017)
- Lake Country (2017)
- Lumby (2013)
- Regional District of Central Kootenay (2006)
- Regional District of Central Okanagan (2008)
- Regional District of Kootenay-Boundary (2010)
- Vernon (2013)

2.5.3 Local Government Plans and Policies

The following official community plans within the AOI speak to various wildfire-related planning requirements:

- Area B & C OCP, Bylaw 2626, 2014 (RDNO, 2014):
 - Wildfire Interface Development Permit Area.
 - Development permit applications involving the construction of a building within the DPA must include a site plan and building plan indicating compliance with FireSmart principles.
 - Subdivision that would create four or more lots requires a wildfire hazard assessment and any recommendations must be incorporated into a restrictive covenant registered on the property title.
 - Subdivisions of three or less lots may not require wildfire development permits.
- Area D & E OCP, Bylaw 2485, 2011 (RDNO, 2012):
 - No explicit Development Permit Area for wildfire.
 - Wildfire policy requires a Wildfire Hazard Assessment Report for subdivision of land if development will create four or more parcels or dwelling units. Assessment report recommendations are written into a restrictive covenant registered on the property title.
 - Development that will create less than four lots or dwelling units simply requires the registration of a restrictive covenant on the property title outlining specific wildfire mitigation practices that the landowners should implement over the long term to reduce wildfire hazard in their development.
- Silver Star, Area C OCP, Bylaw 1925, 2004 (RDNO, 2004):
 - Wildfire Hazard Development Permit Area.
 - A wildfire hazard assessment and any recommendations must be incorporated into a restrictive covenant registered on the property title.
- Area F OCP, Bylaw 2702, 2016 (RDNO, 2016):
 - Wildfire Hazard Development Permit Area.
 - A wildfire hazard assessment and any recommendations must be incorporated into a restrictive covenant registered on the property title.

The RDNO has in force the Open Burning – Fire Regulation Bylaw 2514, 2011 (RDNO, 2011). Specifically, the bylaw:

- Classifies open burning as:

- Class A Open Burning
 - Class B Open Burning
 - Small confined fire
 - Special Open Burning
- Establishes the parameters within which the various classifications of open burning are permitted.
- Sets permit fees and describes offences and associated penalties.

2.5.4 Higher Level Plans and Relevant Legislation

The Okanagan Shuswap Land and Resource Management Plan (LRMP) was completed in 2001 and relates to Crown land throughout the Okanagan Shuswap Natural Resource District (Province of British Columbia, 2001). The LRMP makes several references to wildfire management and hazard reduction (Table 4), none of which impinge on the ability of local governments to undertake mitigation work. Flowing from the LRMP are orders pertaining to the establishment of resource management zones and old growth management objectives (Province of British Columbia, 2007) and none of these orders impede RDNO from pursuing strategic wildfire mitigation efforts.

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Table 4 Wildfire references in the Okanagan Shuswap Land and Resource Management Plan (Province of British Columbia, 2001).

Part 4 Community/Crown Interface (Page CCI 4-1)	
Sec 7	Protect populated areas from forest fire hazards in the wildland – urban interface, and protect the provincial forest from fires originating on contiguous private land.
Sec 7.1	The Ministry of Forests is to coordinate fire hazard reduction in the Interface zone through consultation with the public, licensed tenure holders, affected resource agencies, First Nations, and local government.
Sec 7.2	Where practical, coordinate and implement fire hazard reduction activities with priority areas for prescribed burning for ecosystem enhancement purposes.
Part 4 Ecosystem – Natural Disturbance Type 4 (page NDT4 4-9)	
Sec 10.1	Where practical, return fire to the NDT4a at historical fire cycle intervals by developing and implementing a burn plan that includes restoration and maintenance burning.
Sec 10.3	Develop and implement a plan to modify suppression on naturally occurring wildfires that meet impact prescriptions.
Sec 11.9	Develop a fire management plan for the NDT4a and b.
Sec 11.11	Develop and implement a plan to modify suppression on naturally occurring wildfires that meet impact prescriptions.
Part 4 Mountain Goat Habitat (page Wildlife_Goat 4-3)	
Sec 2.1	Where other resource values are not threatened, enhance early seral foraging opportunities by implementing a “let burn” policy for high elevation wild fires in inoperable areas that are on, or adjacent to, goat winter ranges.
Part 4 - Mule Deer Winter Range (page Wildlife_Mdeer 4-12/)	
Sec 3.4	Where practicable, utilize prescribed burns under specific conditions or mechanical treatments to enhance winter range forage values.

2.5.5 Ministry Plans

The Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) has prepared fire management plans for each Natural Resource District in the province, as required by ministry policy. Fire management plans are intended to address all wildfire-related issues within the natural resource district, particularly the desired interaction between resource management concerns and fire suppression requirements. It is important to note that district fire management plans are currently not public documents. For the purposes of this CWPP update, the authors were afforded the opportunity to view the plan.

The current fire management plan for the Okanagan Shuswap Natural Resource District dates from 2015 and carries forward the 2014 wording with updates to spatial data only. The district fire management plan is a brief 15-page document that also includes high-level district mapping according to four broad “priority themes”. The mapping themes are as follows:

- Theme 1 – Human Life and Safety
 - WUI areas (high, moderate and low structure density)
 - Evacuation routes and marshalling points
- Theme 2 – Critical Infrastructure and Property (that relates to maintaining Theme 1)
 - Energy generation and transmission, healthcare, first responder facilities, transportation, wildland structures etc.
- Theme 3 – High Environmental Cultural
 - Water resources, species at risk, cultural values
- Theme 4 – Resource Values
 - Ungulate winter range, old-growth management areas, timber, silviculture investments, range management, and visual quality areas

3. Values at Risk

Values at risk (VAR) include human health and safety, facilities, services, cultural and natural resources etc. that may be negatively impacted by wildfire. This includes human life, property, critical infrastructure, high environmental and cultural values, and resource values.

3.1 Human Life and Safety

The most recent data from the Government of Canada 2016 census indicates an enumerated population for the RDNO of 84,354– up 3.6% from the 2011 census. The 2016 census also indicates 35,875 occupied private dwellings in the RDNO, an increase of 5.9% from 2011. With a land area of 7,502 square kilometers, the population density of RDNO is 11.2 people per square kilometer (Government of Canada, 2016).

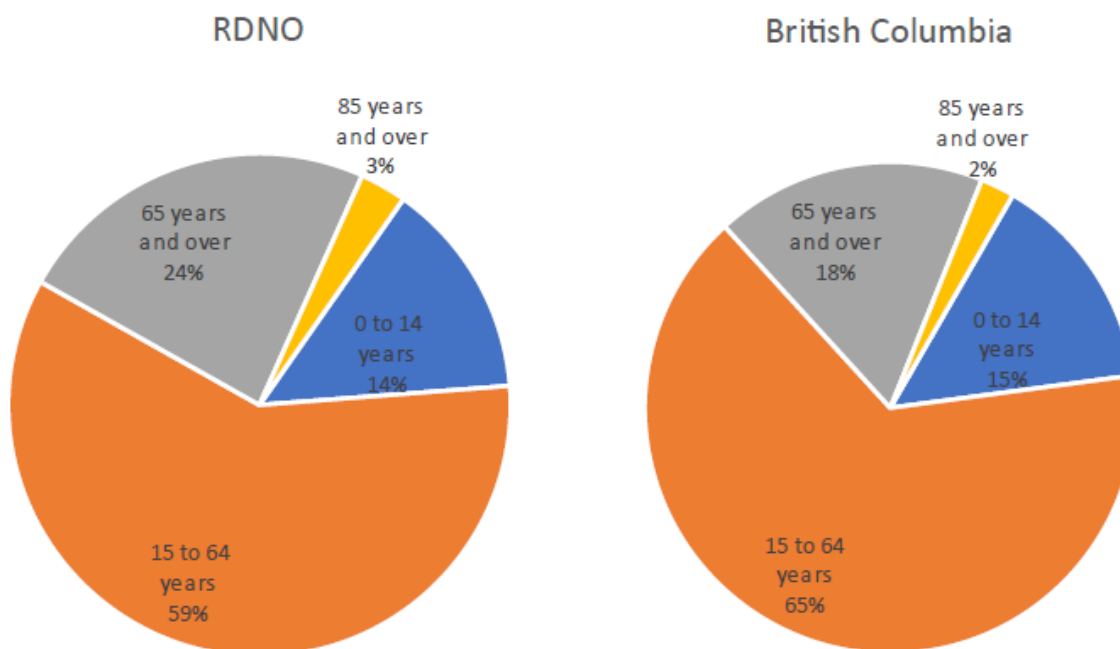


Figure 2 Age distribution in the RDNO and British Columbia, as determined by the 2016 census.

Compared to the provincial average, RDNO has a slightly higher proportions of people in both the 65 years and over and 85 and over age classes (Figure 2). With nearly one third of the population of the RDNO over the age of 65, extended periods of wildfire smoke will have a slightly higher impact on the Regional District compared to other communities.

Among a host of other constituents, wildfire smoke contains particulate matter (PM) which is primarily composed of organic carbon and black carbon components (Naeher, et al., 2007). The size of PM that biomass burning produces is usually fine particles less than 2.5 micrometers (μm), referred to as PM_{2.5} (Duran, 2014).

Although everyone responds to wildfire smoke exposure differently, the BC Centre for Disease Control (2018) identifies the following groups as being most at risk:

- people over 65;
- women who are pregnant;
- infants and small children;
- people with existing chronic respiratory conditions.

3.2 Critical Infrastructure

The RDNO is reliant on critical infrastructure detailed in the following sections.

3.2.1 Electrical Power

The RDNO lies entirely within the BC Hydro service area and hosts a 500kV substation at Ashton Creek in Area F. Fed by the Revelstoke Dam via the 5L77/5L75 500kV transmission lines, the

Ashton Creek substation continues transmission further west to the Nicola substation as well as the Selkirk substation to the south east. The Ashton Creek substation also supplies a 230kV transmission line south through the Trinity Valley to the Vernon terminal, and further south into the Okanagan Valley.

3.2.2 Communications, Pipelines and Municipal Buildings

The following infrastructure are noted:

- RDNO has two TELUS Mobility and one Rogers Communications cellular towers serving the area (Nikkel, 2018).
- Natural gas transmission pipeline runs through RDNO between the Spectra Energy line to the west and the south Okanagan (FortisBC, 2009). FortisBC has a corporate emergency response plan for pipeline and electrical emergencies (FortisBC, 2016).

Key public buildings in RDNO are summarized below.

Table 5 Key municipal buildings in RDNO.

Facility	Address
Pat Duke Memorial Arena	2270 Shields Street, Lumby
White Valley Community Centre	2250 Shields Street, Lumby
Mabel Lake Community Hall	111 Shuswap Falls Road, Lumby
Cherryville Community Hall	158 North Fork Road, Cherryville
RDNO Office	9848 Aberdeen Road, Coldstream
Silver Star Fire Department	9885 Silver Star Road
BX Swan Lake Fire Rescue	5764 Silver Star Road, Vernon
Lumby Fire Hall	1769 Shuswap Avenue, Lumby
Enderby Fire Hall	407 George Street, Enderby
RCMP – Lumby	2208 Shuswap Avenue
RCMP – Vernon	3402 30 th Street, Vernon
RCMP – Enderby	602 Granville Avenue, Enderby

3.2.3 Water and Sewage

The Greater Vernon Water (GVW) supplies water to the City of Vernon, District of Coldstream, Township of Spallumcheen and Electoral Areas B, C and D. GVW delivers in excess of 24 billion litres of water annually, with 55% of that being to agricultural users.

The goal of the GVW is, ‘...is to ensure the economical supply and distribution of a sufficient quantity and quality of water in the interests of both agricultural and non-agricultural users in the Greater Vernon Community. GVW is committed to protecting public, environmental, and economic health through a comprehensive “source-to-tap” approach.’ The GVW created a master plan that was adopted by the RDNO board in 2017. It is intended to provide guidance regarding utility and infrastructure improvements and renewal decisions and included an in-depth assessment of the current water system status.

Wastewater in RDNO is managed by on-site septic systems and a community wastewater treatment system. The Regional District of North Okanagan (RDNO) manages the Mabel Lake sewer system.

3.3 High Environmental and Cultural Values

Parks, recreation and cultural services are provided by the RDNO in a few areas through a partnership with its member communities. The partnership group, ‘Greater Vernon’, consists of the RDNO, Vernon, Coldstream and Electoral Areas B and C and they provide cultural services consisting of long-range planning, cultural sector capacity building, cultural project grants and facilities and operating grants for cultural programming. Environmental Services provided by the RDNO area focussed on invasive plants, starling control and noxious insects.

3.3.1 Drinking Water Supply Area and Community Watersheds

The Mission Hill Water Treatment Plant was commissioned in 2006. Plant capacity is 60ML, or 16 million gallons, per day. Phase 1 of the Plant utilizes ultraviolet and chlorine treatment. The North Kalamalka Lake intake pipe is 252 meters long and 20 meters deep. In conjunction with the completion of the Phase 1 Mission Hill Water Treatment Plant, the capacity of the Kalamalka pump station was upgraded to 60 ML/day. The Duteau Creek Water Treatment Plant was commissioned in 2010. Plant capacity is 160ML, or 42 million gallons, per day. Stage 1 of the Plant utilizes Dissolved Air Flotation (DAF) and chlorine treatment. As currently required by the Interior Health Authority, the addition of Stage 2 (Filtration) was scheduled to be completed in 2015.

There are several community watersheds within the RDNO AOI and the portions of community watersheds that fall within the AOI are summarized in Table 6.

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Table 6 Community Watersheds in the RDNO AOI. The Area D portion of the AOI contains no Community Watersheds.

Electoral Area	Community watershed name	Source	Area within AOI (ha)
Area B AOI	Irish	Irish Creek	863
	B.X.	B.X. Creek	18
	Klim	Klim Brook	4
Area C AOI	B.X.	B.X. Creek	6,751
	Coldstream	Coldstream Creek	5,401
	Fortune	Fortune Creek	4,252
	Maid	Maid Creek	356
	Meighan	Meighan Creek	293
	Glanzier	Glanzier Creek	237
	Duteau	Duteau Creek	134
	Kendry	Kendry Creek	122
Area F AOI	Brash	Brash Creek	1,349
	Glanzier	Glanzier Creek	364
	Kendry	Kendry Creek	22

3.3.2 Cultural Values

Due to an extensive and uninterrupted First Nation presence throughout the North Okanagan, wildfire and associated suppression operations have the potential to inadvertently seriously impact or destroy cultural heritage resources.

It can be challenging to navigate the requirements of the Heritage Conservation Act (HCA) during the critical initial attack phase of a wildfire response, but a basic awareness of what to look for can help to ensure that cultural heritage resources aren't impacted by suppression actions. For good reason, the exact locations of known resources are often privileged information, but through agreement and trust, general information regarding areas could be shared. From there, it is incumbent on personnel who are actively working in the field to be able to identify resources

so that suppression actions can be planned or altered in such a way as to not to contravene the HCA.

3.3.3 High Environmental Values

The BC Conservation Data Centre identifies Red, Blue, and Yellow listed vertebrate animals, plants and plant communities within the RDNO AOI, as summarized in Table 7 (BC Conservation Data Centre, 2018).

Table 7 Red and Blue listed species and plant communities within the RDNO AOI.

Common name	Scientific name	BC list status
Vertebrate animals		
American Badger	<i>Taxidea taxus</i>	Red
Western Grebe	<i>Aechmophorus occidentalis</i>	Red
Gopher Snake, Deserticola Subspecies	<i>Pituophis catenifer deserticola</i>	Blue
Great Basin Spadefoot	<i>Spea intermontana</i>	Blue
Painted Turtle - Intermountain - Rocky Mountain Population	<i>Chrysemys picta</i> pop. 2	Blue
Western Screech-owl, Macfarlanei Subspecies	<i>Megascops kennicottii macfarlanei</i>	Blue
Vascular plants		
Engelmann's Knotweed	<i>Polygonum engelmannii</i>	Red
Dark Lamb's-quarters	<i>Chenopodium atrovirens</i>	Blue
Mountain Moonwort	<i>Botrychium montanum</i>	Blue
Peach-leaf Willow	<i>Salix amygdaloides</i>	Blue
Red-rooted Cyperus	<i>Cyperus erythrorhizos</i>	Blue
Tweedy's Willow	<i>Salix tweedyi</i>	Blue
Tweedy's Willow	<i>Salix tweedyi</i>	Blue
Woolly Blue Violet	<i>Viola sororia</i>	Blue
Ecological community		
Baltic Rush - Common Silverweed	<i>Juncus balticus</i> - <i>Potentilla anserina</i>	Red
Black Cottonwood - Douglas-fir / Common Snowberry - Red-osier Dogwood	<i>Populus trichocarpa</i> - <i>Pseudotsuga menziesii</i> / <i>Symphoricarpos albus</i> - <i>Cornus stolonifera</i>	Red
Nuttall's alkaligrass - Foxtail Barley	<i>Puccinellia nuttalliana</i> - <i>Hordeum jubatum</i>	Red
Trembling Aspen / Common Snowberry / Kentucky Bluegrass	<i>Populus tremuloides</i> / <i>Symphoricarpos albus</i> / <i>Poa pratensis</i>	Red
Common Cattail Marsh	<i>Typha latifolia</i> Marsh	Blue
Hard-stemmed Bulrush Deep Marsh	<i>Schoenoplectus acutus</i> Deep Marsh	Blue
Invertebrate animal		
Immaculate Green Hairstreak	<i>Callophrys affinis</i>	Blue

3.4 Other Resource Values

Agriculture plays a significant role in the local economy in parts of the RDNO. Wildfire can have significant direct and indirect impacts on all agricultural sectors. For example, wildfires may displace or kill cattle while on their summer range and food crops may be directly impacted by prolonged smoke-filled skies, while evacuation orders or simply worker displacement may limit the ability of producers to harvest crops in a timely manner.

3.5 Hazardous Values and Solid Waste Management

The RDNO is not characterized by extensive heavy industry and the associated potentially hazardous materials. The RDNO operates eight Diversion and Disposal Facilities, three transfer stations, and six landfills (three open and three closed). The RDNO has the goal of maximizing the amount of material that is diverted from the landfill through recycling and alternate or secondary uses.

4. Wildfire Threat and Risk

The following is a summary of the factors that contribute to an understanding of the wildfire threat around a community. These factors include natural fire regime and ecology, Provincial Strategic Threat Analysis, and a local wildfire risk analysis. Risk assessment for wildfire and its impacts to communities considers both the likelihood of a wildfire and the potential consequence associated with that likelihood.

4.1 Fire Regime, Fire Danger Days and Climate Change

The RDNO is an active fire environment where conditions often exist during the summer months where there is potential for losses to the public. When assessing the wildfire situation of the region, past conditions offer an indication of potential future conditions in the near term, and climate change scenarios must be incorporated when considering increasing future community resilience.

4.1.1 Fire Regime

The ecology of the RDNO AOI has been shaped by a diverse fire regime. The AOI is represented by all natural disturbance type classifications (NDT1 to NDT5), which broadly describe ecosystems according to the degree to which they are affected by natural disturbance agents. The NDT classification (Table 9) of an area provides an illustration of the magnitude and frequency of natural disturbance (wildfires and windstorms, predominantly) across the land base.

Table 8 Natural disturbance type classification in British Columbia.

Natural Disturbance Type (NDT)	Description
NDT1	Ecosystems with rare stand-initiating events
NDT2	Ecosystems with infrequent stand-initiating events
NDT3	Ecosystems with frequent stand-initiating events
NDT4	Ecosystems with frequent stand-maintaining fire
NDT5	Alpine Tundra and Subalpine Parkland ecosystems

In terms of natural disturbance, a distinction is drawn between stand-initiating and stand-maintaining events. Stand-initiating events typically terminate the existing forest and induce secondary succession to produce a new forest. Stand-maintaining events serve to keep successional processes stable (Province of British Columbia, 1995). In wildfire terms, high intensity fire behaviour, such as intermittent or continuous crown fire, would be considered a stand-initiating event. Conversely, a low intensity fire surface fire consuming understory fuels while retaining a mature overstory is considered a stand-maintaining event.

These distinctions are important when assessing the wildfire history of an area. The absence of frequent stand-maintaining processes can result in a cascading series of ecological responses, including forest health, habitat and fuel loading issues. In the NDT4, low-intensity (i.e. surface fire) fire return intervals historically ranged from 4 to 50 years (Province of British Columbia, 1995). Forest protection policies centered around aggressive fire suppression have resulted in a drastically reduced frequency (or absence) of fire in ecosystems that are dependant (i.e. maintained) by frequent, low-intensity surface fires.

Stand-initiating fires (i.e. crown fires) in Ponderosa pine dominated stands were historically rare, with return intervals of at least 150 to 250+ years (Province of British Columbia, 1995). The longer a fire-maintained stand goes without fire maintenance, the greater the likelihood that a future fire occurrence will be a stand-initiating disturbance. From a firefighting standpoint this increasingly deteriorating condition can result in wildfires that require significantly more suppression effort and cost to control.

4.1.2 Fire Weather Rating

Five BCWS fire weather stations were reviewed for the RDNO CWPP. The Mabel Lake 2, Curwen Creek, Fintry, Salmon Arm and Kettle 2 fire weather stations, (Figure 3) were analyzed to provide a regional perspective of fire weather.

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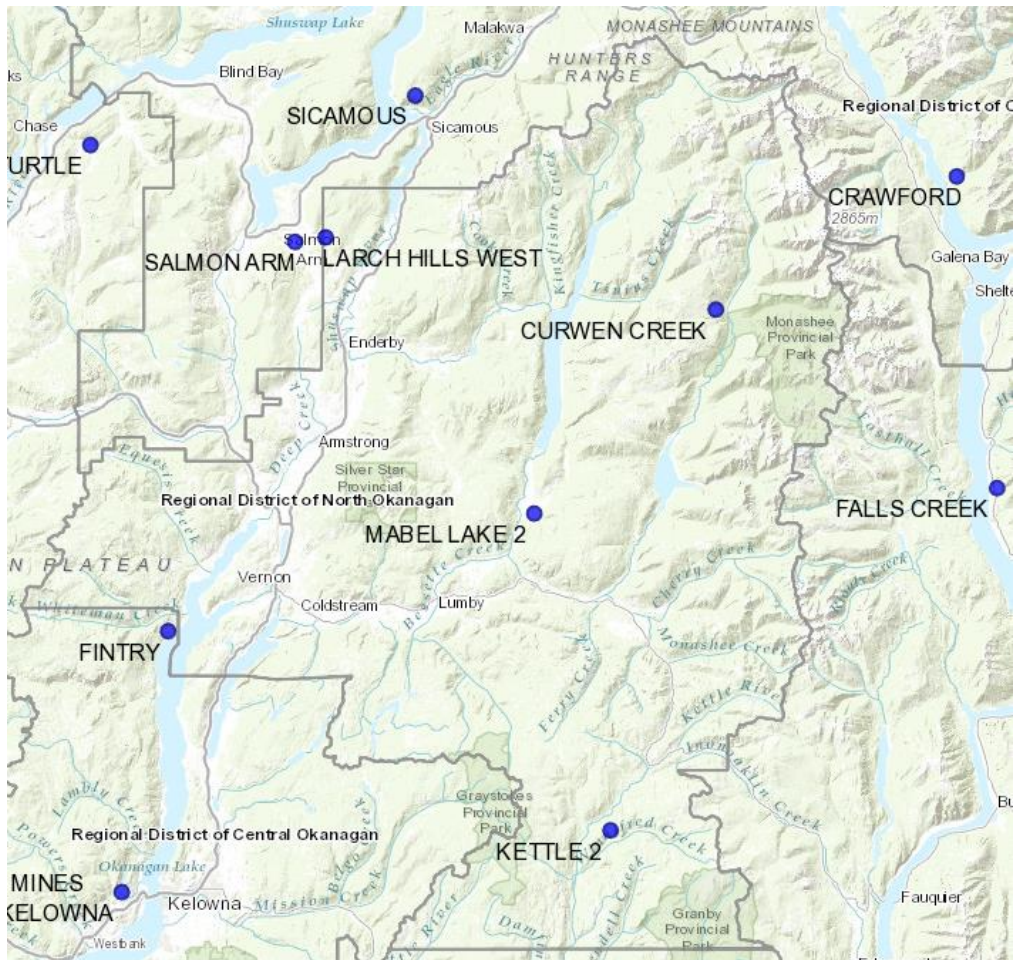


Figure 3 BC Wildfire Service fire weather stations in the RDNO region.

Table 9 BC Wildfire service active fire weather stations in relation to RDNO.

Station Name	Latitude	Longitude	Elevation	Install Date
Mabel Lake 2	50.352	-118.773	488m	January 1, 1987
Curwen Creek	50.602	-118.423	1286m	July 9, 1990
Fintry	50.207	-119.480	670m	July 13, 1990
Salmon Arm	50.685	-119.235	527m	October 5, 1989
Kettle 2	49.960	-118.626	1389m	August 9, 1987

For the purposes of CWPPs in BC, fire weather conditions are described in terms of the *Fire Danger Class*. Fire Danger Class is defined in the Wildfire Regulation and is a rating derived from outputs of the Canadian Forest Fire Weather Index (FWI) System. Although the sole intent of the Fire Danger Class rating scheme is to restrict high risk activities (primarily industrial) occurring on or about forest and grassland areas, the use of Fire Danger Class has been extended to the CWPP field as a straightforward means of characterizing fire weather conditions in an area represented by a weather station.

Fire Danger Class is determined by comparing the Buildup Index (BUI) to the Fire Weather Index (FWI) in one of three tables presented in the Wildfire Regulation. Each table is specific to one of three broad Danger Regions in BC; RDNO straddles Danger Region 3 and 1. The actual Fire Danger Classes are numerical ratings 1-5, in ascending order of severity. An illustration of the various inputs and components from which Fire Danger Class is derived is presented in Figure 4.

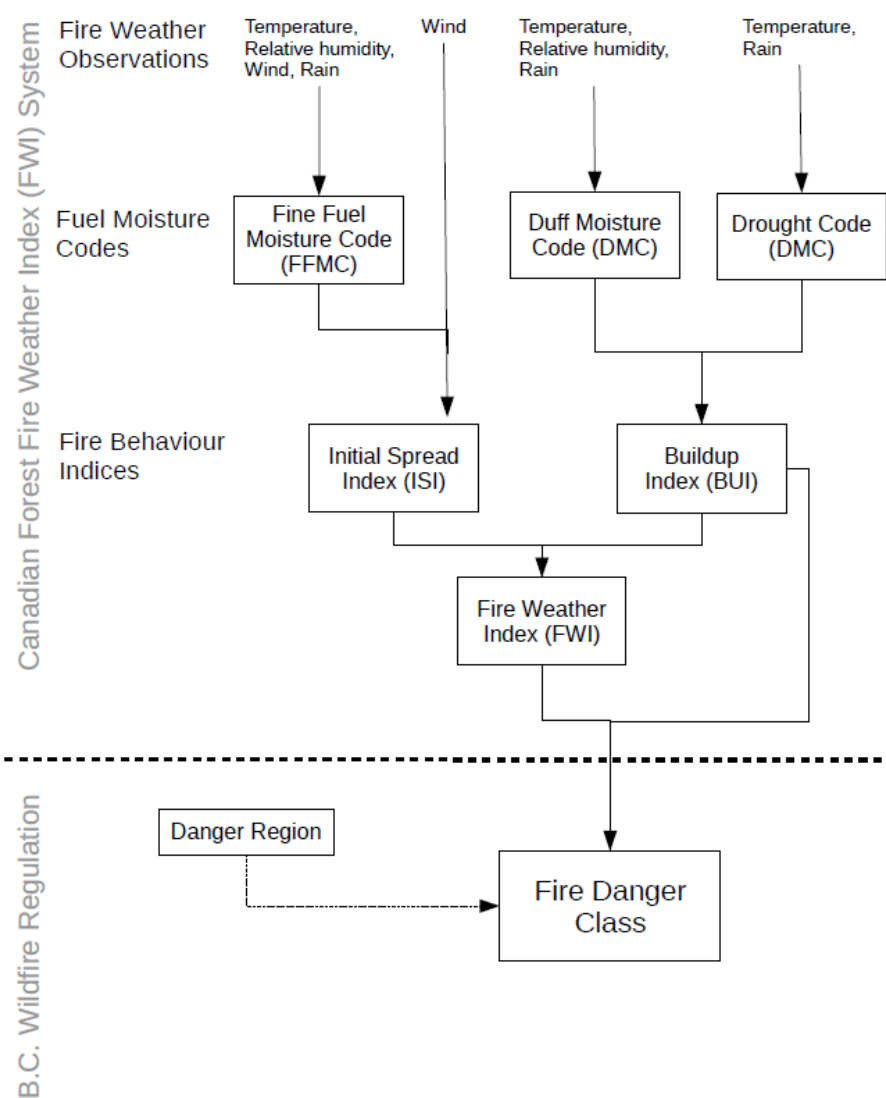


Figure 4 Fire Danger Class methodology.

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A Fire Danger Class report for each of the five fire weather stations analysed has been prepared (see Figures 5-9). The Fire Danger Class reports illustrate the number of days per year when the Fire Danger Class was rated 4 or 5. The RDNO straddles Danger Regions 1 and 3 which have the following BUI and FWI ranges for Fire Danger Class 4 and 5:

- Danger Region 1:
 - BUI: 43 – 119 +
 - FWI: 8 – 31 +
- Danger Region 3:
 - BUI: 51 – 201+
 - FWI: 17 – 47+

For each of the stations, the average number of Fire Danger Class 4 and 5 days in each dataset is presented (see Table 10), as well as the median, maximum and year of maximum. With the exception of the Curwen Creek and Mable Lake 2 Stations, 2017 had the maximum number of Fire Danger Class 4 and 5 days.

The datasets for the five fire weather stations of interest originate from 1987 to 1990 and have continued to the present (see Table 10). Of interest is the increasing trend for Fire Danger Class 4 and 5 days for each of the stations, with the exception of Mable Lake 2.

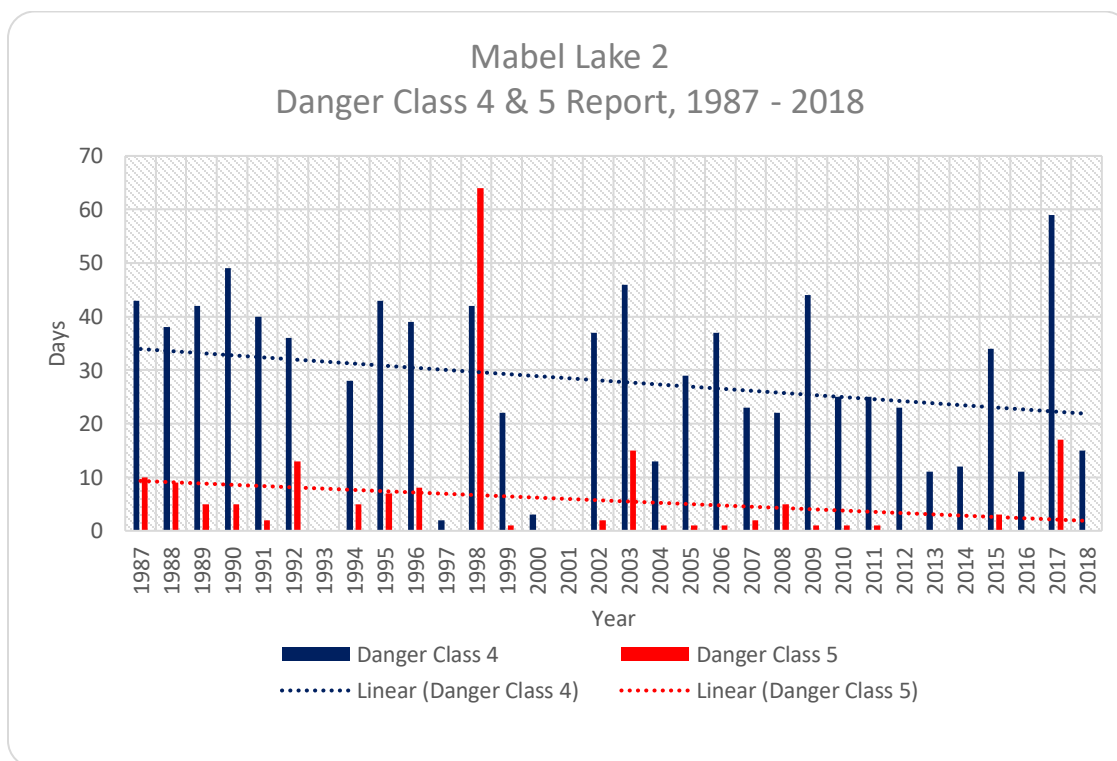


Figure 5 Mabel Lake 2 Danger Class 4 and 5 report.

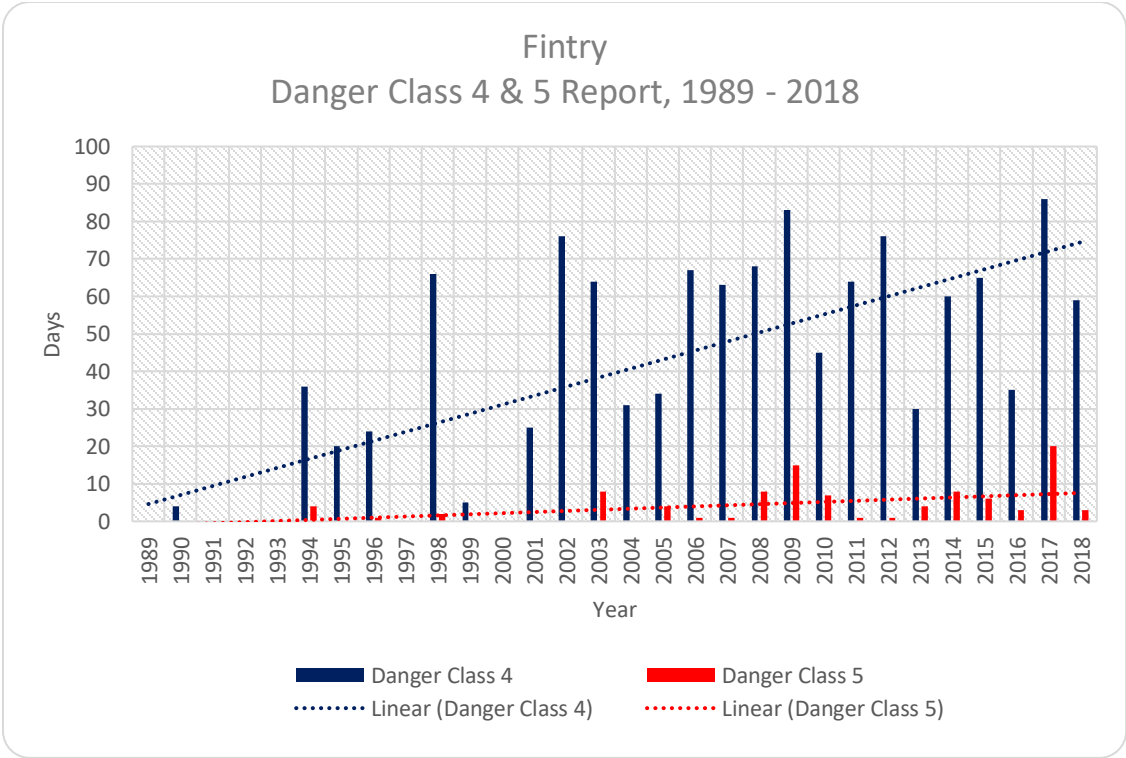


Figure 6 Fintry Danger Class 4 and 5 report.

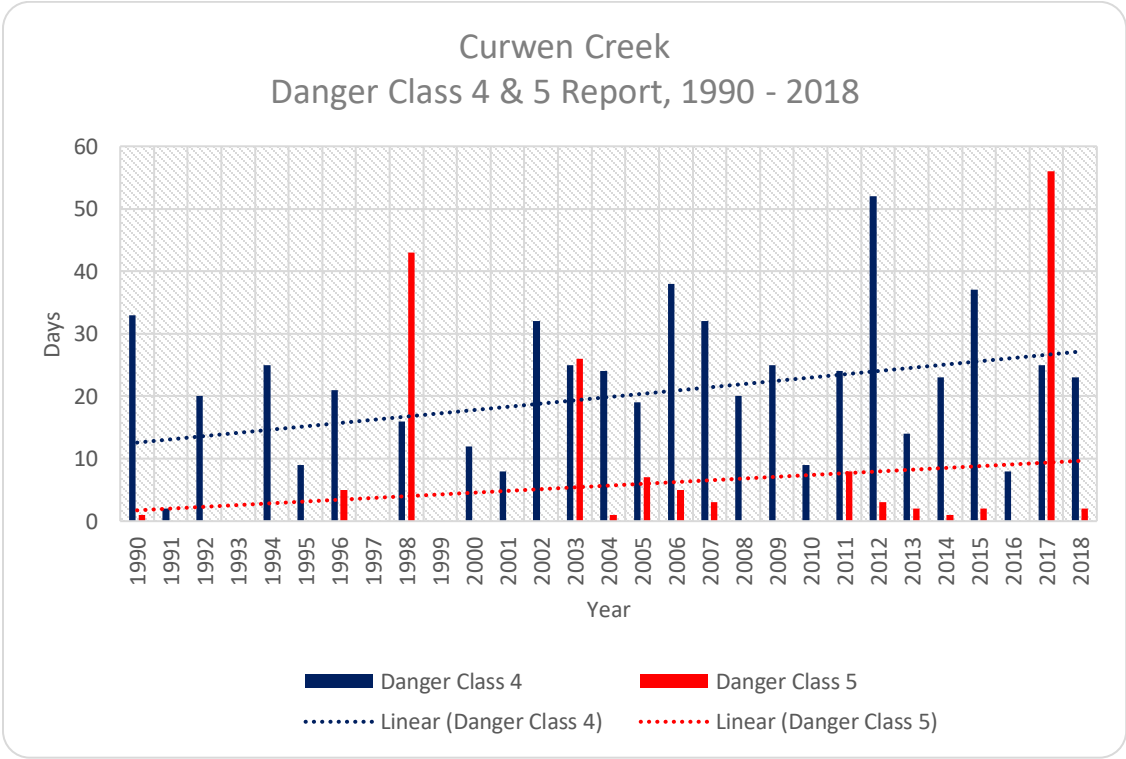


Figure 7 Curwen Creek Danger Class 4 and 5 report.

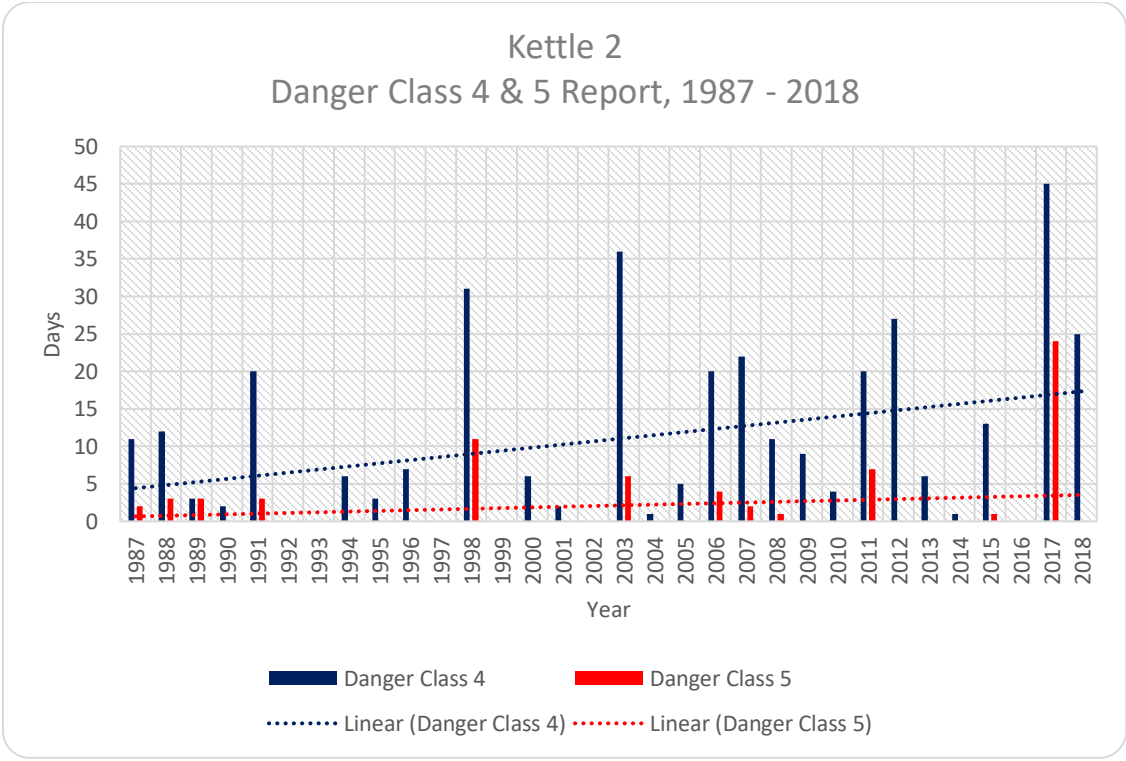


Figure 8 Kettle 2 Fire Danger Class 4 and 5 report.

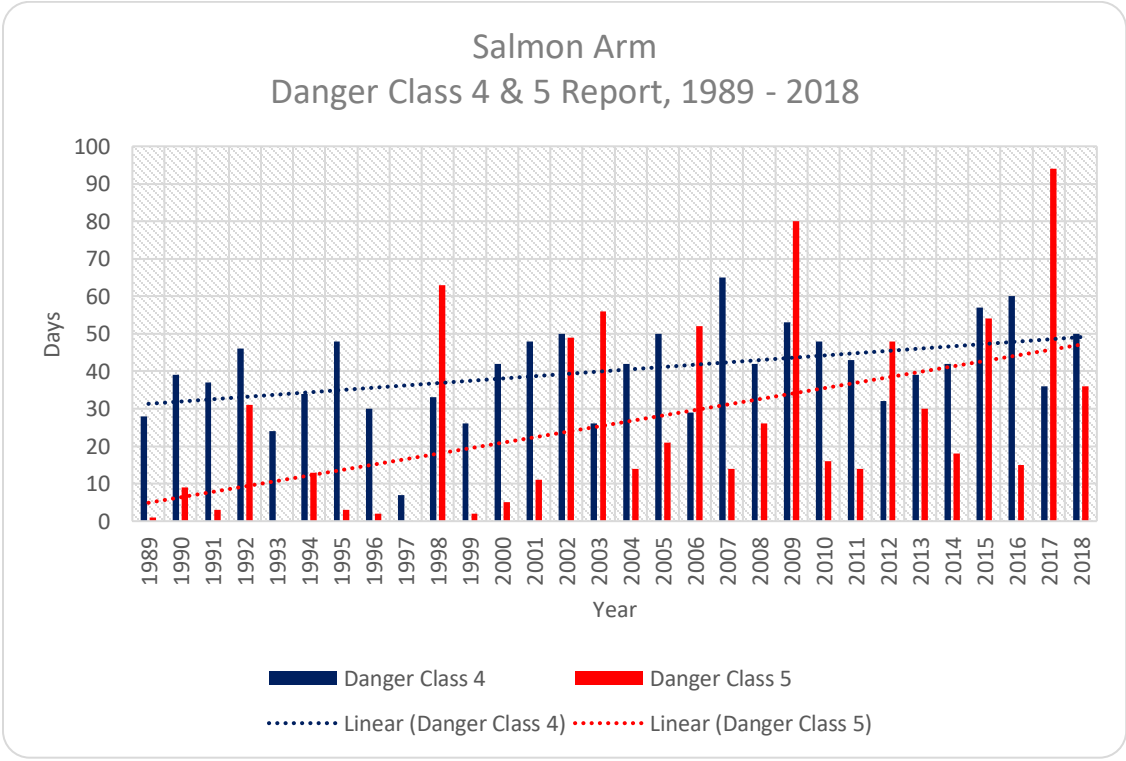


Figure 9 Salmon Arm Fire Danger Class 4 and 5 report.

Table 10 Summary of Fire Danger Class 4 and 5 days for regional fire weather stations.

Station Name	Danger Class	Days			Year of Maximum
		Average	Median	Maximum	
Mabel Lake 2	Danger Class 4	28	29	59	2017
	Danger Class 5	6	2	64	1998
	Combined	34	32	106	1998
Fintry	Danger Class 4	40	36	86	2017
	Danger Class 5	3	1	20	2017
	Combined	43	39	106	2017
Curwen Creek	Danger Class 4	20	21	52	2012
	Danger Class 5	6	1	56	2017
	Combined	26	25	81	2017
Salmon Arm	Danger Class 4	40	42	65	2007
	Danger Class 5	26	16	94	2017
	Combined	66	66	133	2009
Kettle 2	Danger Class 4	11	6	45	2017
	Danger Class 5	2	0	24	2017
	Combined	13	6	69	2017

4.1.3 Climate Change

The Pacific Climate Impacts Consortium (PCIC) is based at the University of Victoria and conducts quantitative studies on climate change and climate variability impacts for stakeholders in the Pacific and Yukon regions. Through analysis and interpretation of a variety of global climate models, PCIC serves to bridge the gap between climate research and practical application for a variety of end users. To do this, PCIC has several analysis tools available, including the Plan2Adapt toolkit, as well as the more detailed Regional Analysis Tool (Pacific Climate Impacts Consortium, 2013).

The future regional impacts of climate change are far from certain and projections are based on the best available models and information. For example, although the range of modelled future summer temperature increase is somewhat broad (Figure 10), the upward trend is conspicuous. Conversely, the range of modelled summer precipitation change (Figure 11) shows a more muddled range of projections. As with any set of models, as more data becomes available and emissions scenarios become more refined, future impacts will be brought into sharper focus.

The PCIC (2013) has drafted a set of potential climate impacts for the North Okanagan in the 2050s, including:

- Increase in hot and dry conditions
- Increase in temperature
- Longer dry season
- High intensity precipitation

- Decrease in snowpack
- Possible changes in vegetation productivity

From a wildland fuel perspective, these impacts could result in a variety of ecological changes. Long term changes in moisture regimes can affect forest health and species distribution. Ecological communities may begin to migrate northwards or to higher elevations as site suitability and disturbance patterns shift. Already dry ecological zones may become drier and more prevalent at higher elevations, making an already fire-prone landscape more extensive.

As some valley bottom areas and exposed slopes around RDNO are already characterized by relatively light grass fuels, climate change induced upslope migration of treed areas may have little effect on the overall wildfire threats posed to the WUI. In fact, such a shift could actually confine high-intensity fire to higher and higher elevations over the long term. However, in the wake of ecological migration, dead and downed fuel loading would most likely create a window of severe fuel hazard.

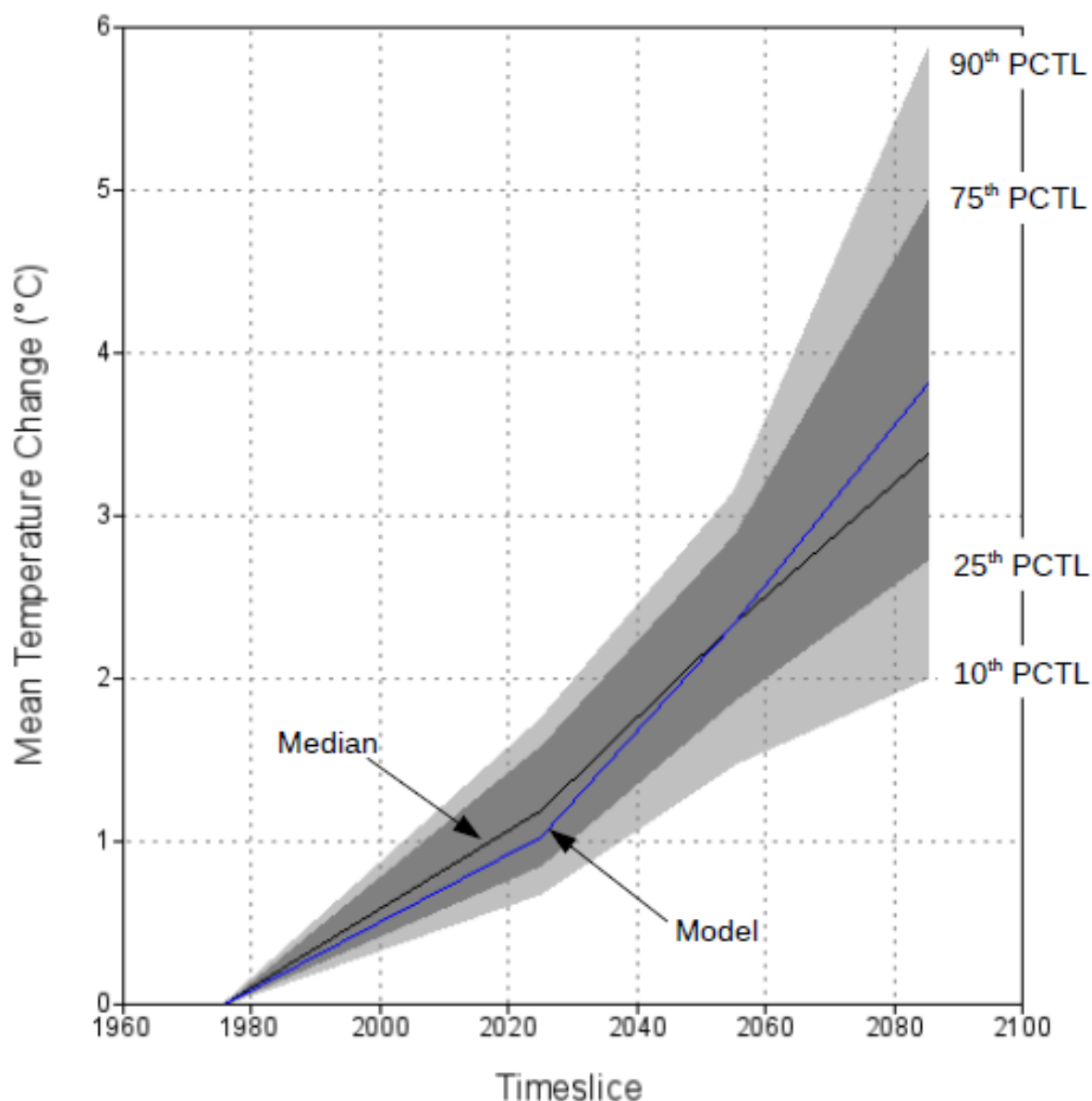


Figure 10 Range of projected summer (June, July, August) temperature change over three time periods (2020's, 2050's and 2080's) for the North Okanagan. This figure is produced from a set of Global Climate Model (GCM) projections and represents the range of modelled outputs. The dark grey shading represents 50% of the projections used in the set, while the light grey shading represents 80% of the projections used in the set. The black line labelled 'median' is the mid-point of projections in the set. The blue line labelled 'model' is the CGCM3 A2 run 4 model (Canadian Global Climate Model). A2 refers to one of several emissions scenarios developed by the Intergovernmental Panel on Climate Change (IPCC).

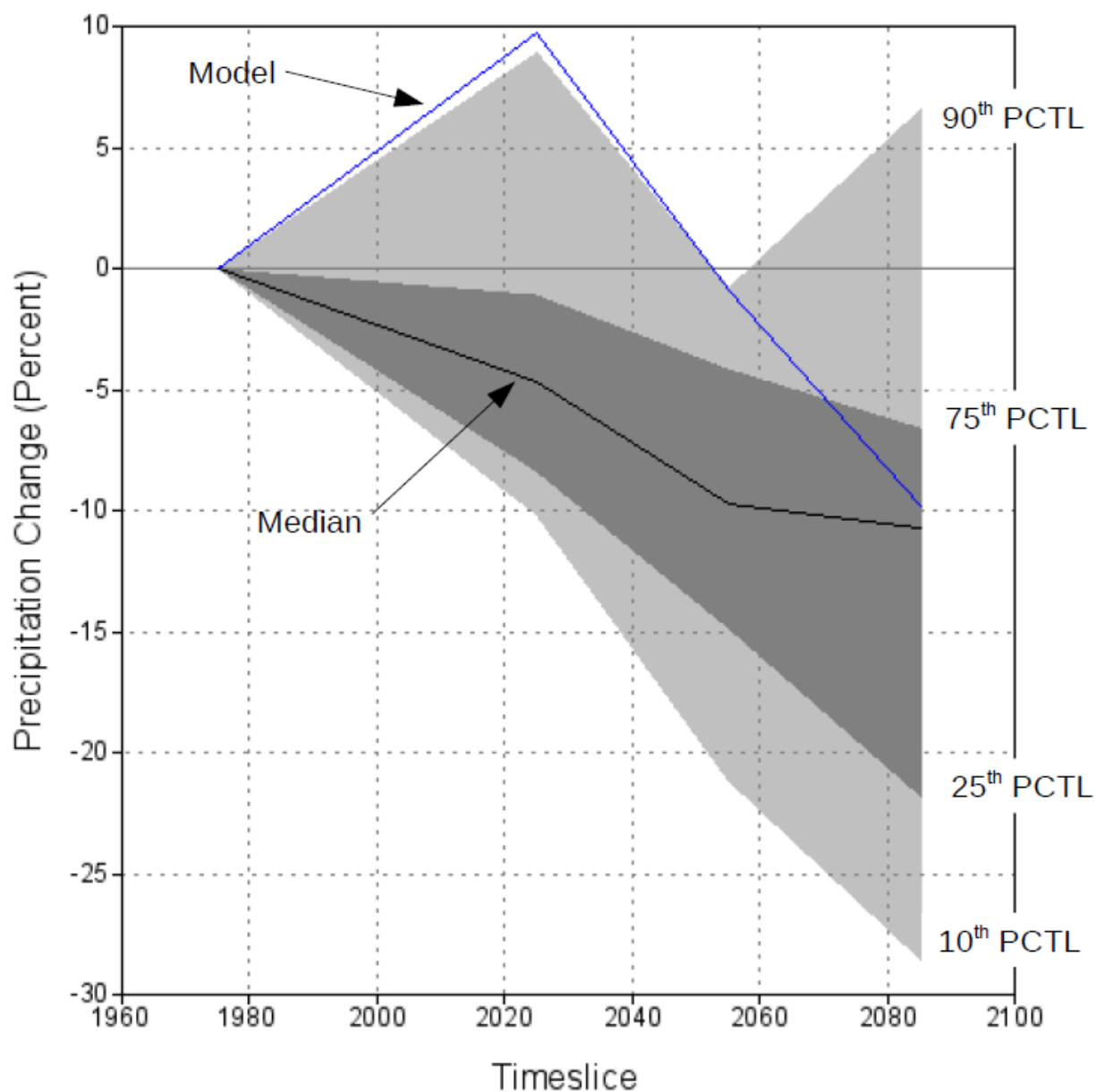


Figure 11 Range of projected summer (June, July, August) precipitation change (percent) over three time periods (2020's, 2050's and 2080's) for the North Okanagan. This figure is produced from a set of Global Climate Model (GCM) projections and represents the range of modelled outputs. The dark grey shading represents 50% of the projections used in the set, while the light grey shading represents 80% of the projections used in the set. The black line labelled 'median' is the mid-point of projections in the set. The blue line labelled 'model' is the CGCM3 A2 run 4 model (Canadian Global Climate Model). A2 refers to one of several emissions scenarios developed by the Intergovernmental Panel on Climate Change (IPCC).

4.2 Provincial Strategic Threat Analysis (PSTA)

The Provincial Strategic Threat Analysis (PSTA) is a provincial scale analysis that attempts to characterize wildfire threat across BC. The analysis combines historical fire density, potential spotting impacts and predicted head fire intensity to produce a wildfire threat score. These scores are grouped into ten threat classes, ranging from 1 to 10, or Nil to Extreme. The PSTA layer is intended to serve as a starting point from which to design and conduct more detailed sampling to further characterize wildfire threat to communities.

4.2.1 PSTA Final Wildfire Threat Rating

To determine the overall PSTA Threat Rating, historical wildfire density, head fire intensity (HFI) and spotting impact are combined using a weighted averaging process. Weights are assigned as 30% fire density, 60% HFI (90th percentile fire weather index (FWI) values) and 10% spotting impact. These weighted values were added together to produce a final fire threat rating and assigned to 10 classes to produce a detailed map of fire threat rating throughout British Columbia.

The 10 threat classes represent increasing levels of overall fire threat (i.e. the higher the number, the higher the threat). PSTA Threat Class 7 is considered to be a threshold and the most severe overall threat classes are Class 7 and higher. Areas of the province that fall into these higher classes are most in need of mitigation.

Areas rated as Class 7 or higher are locations where the fire intensity, frequency and spotting can be severe enough to potentially cause catastrophic losses in any given wildfire season, where those ratings overlap with significant values at risk.

4.2.2 Spotting Impact

A common misconception amongst the public is that when homes are destroyed during a wildfire, that they are consumed by something akin to a wave of fire slamming up against neighbourhoods. This is far from the case. Case studies from wildland urban interface fire disasters have shown that most homes aren't destroyed by direct flame impingement from extreme fire behaviour; they are more often ignited by smaller flames extending onto the house and by firebrands (embers) directly (Cohen, 2008). Fortunately, as detailed in 4.3.1, the RDNO AOI is primarily comprised of non-fuel or the O1 Grass fuel type, which has a low spotting potential (i.e. unlikely to generate and transport embers).

4.2.3 Head Fire Intensity

Head fire intensity (HFI) is a representation of the energy release from a flaming front at the head, or leading edge of a wildfire as it proceeds in a given direction at a certain rate by consuming available fuel. Head fire intensity is measured in kilowatts per meter (kW/m) of fire front and is a primary component of the Canadian Forest Fire Behaviour Prediction (FBP) System.

As a primary output of the FBP system, HFI is dependent on the type of fuel being burned under a given set of weather conditions and topographical characteristics. To calculate PSTA threat scores, 90th percentile weather data is used, adjusted to the existing topographical

characteristics, and the prevailing fuel type. This analysis carries several assumptions (BC Wildfire Service, 2015), including:

- Applicability of the provincial fuel type layer;
- Wind and slope are aligned, which is a worst-case scenario; and
- Broad average environmental lapse rates to account for varying elevations.

Calculated HFI values are then classified into ten PSTA-HFI Classes (such as Table 11, as an example) to facilitate further calculation and analysis. The descriptors used in Table 11 will vary among fuel types and is provided simply as a generalization of potential fire behaviour.

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Table 11 Head fire intensity classes and associated fire behaviour.

PSTA - HFI Class	Fire Intensity kW/m	Fire Intensity Class	Flame Length (meters)	Likely Fire Behaviour
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	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 history tells the story of the relationships between fire behaviour, landscape ecology, management policy (including fire suppression), human development and other land-use changes throughout the area. The RDNO AOI has a persistent history of wildfire on the landscape. The BCWS maintains a database of wildfires dating back to the early 1900s. Fire history data for fires that occurred prior to 1950 are limited to larger perimeters only and does not include fires that may only have been spot-sized. These perimeters have been digitized from a variety of

sources, some dating back to linen maps. From 1950 onwards, the wildfire dataset becomes more complete, capturing fires of all size classes and provides a more accurate picture of fire occurrence trends.



Figure 12 Burned-out Western Redcedar remnant south of the river mouth at Kingfisher. The fire history layer indicates that lightning ignited a fire in this area on August 18, 1919, eventually spreading to 1,600 ha.

The fire history dataset is by no means perfect. Occasionally historical wildfires plot within lakes and there are sporadic discrepancies in information between point layers and perimeter layers for a given fire, but generally the dataset provides an adequate basis from which to conduct a historical fire analysis.

In the AOI between 1950 and 2018 a total of 1,143 wildfires are recorded in the fire history dataset, with a nearly 50% split between lightning and person causes. When Areas B, C, D and F of the AOI are broken out, we see a that lightning fires make up a higher proportion of the fires in the Area F AOI, while person-caused fires account for the majority of fire starts in the Area B AOI. In the Area C and D AOIs fire cause is more or less evenly split between lightning and people. Of particular interest are the peak years of fire occurrence in the AOI: The 1960s through to the 1980s have so far been the periods of highest annual fire occurrence. See Table 12 for a breakdown of fire occurrence in the RDNO AOI.

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Table 12 Summary of wildfire occurrence information for Area B, C, D and F and the entirety of the AOI.

	Area of Interest - Regional District of North Okanagan, Fire History 1950 - 2018														
	Area B			Area C			Area D			Area F			Total AOI		
Cause	Lightning	Person	All	Lightning	Person	All	Lightning	Person	All	Lightning	Person	All	Lightning	Person	All
Total fires	127	291	418	76	90	166	69	90	159	298	102	400	570	573	1143
Annual avg.	2	5	6	2	2	3	2	2	3	5	2	6	9	8	17
% of cause	30%	70%	100%	46%	54%	100%	43%	57%	100%	75%	26%	100%	50%	50%	100%
Max.	8	20	23	6	6	8	7	6	10	22	6	23	36	27	58
Year of Max.	1961 1979 1994	1987	1987	1985	1970 2004	1970 1974 2004	1970	1974	1974	1960	1953	1960 1961	1970	1973	1970

When wildfire occurrence since 1950 are graphed for the AOI we see that the occurrence of both lightning and person-caused wildfires each display a negative linear trend (Figure 13). It's not readily apparent why lightning-caused fires have experienced a gradual decline in occurrence in the AOI since 1950. If the opposite trend were true, we could possibly hypothesize that improved fire detection may be at play. The decreasing rate of person-caused wildfires presents a few possible contributing factors, including improved spark-arresting technology on machinery and the possibility that fire prevention campaigns are having a positive impact. Occurrence graphs for each of the Areas within the AOI are provided in Appendix 1.

The fire history dataset reveals that wildfires have occurred in all months except December, January and February in the AOI (Figure 14). The occurrence of lightning-caused fires occupies a narrower window, spanning April to September, with July and August as the core period for most lightning fires to start.

When pre-1950 perimeter data is included in an annual area burned analysis of the AOI (Figure 15), we see that the period between 1919 and the early-1940s saw years with comparatively larger fire sizes followed by nearly seven decades of minimal annual area burned. In fact, since the 1940s, annual area burned in the AOI has never topped 200 ha in any one year, with most years seeing less than 50 ha burned. The more recent period of 1990 to 2018 is also presented (Figure 16) to bring the annual area burned in the AOI into sharper focus.

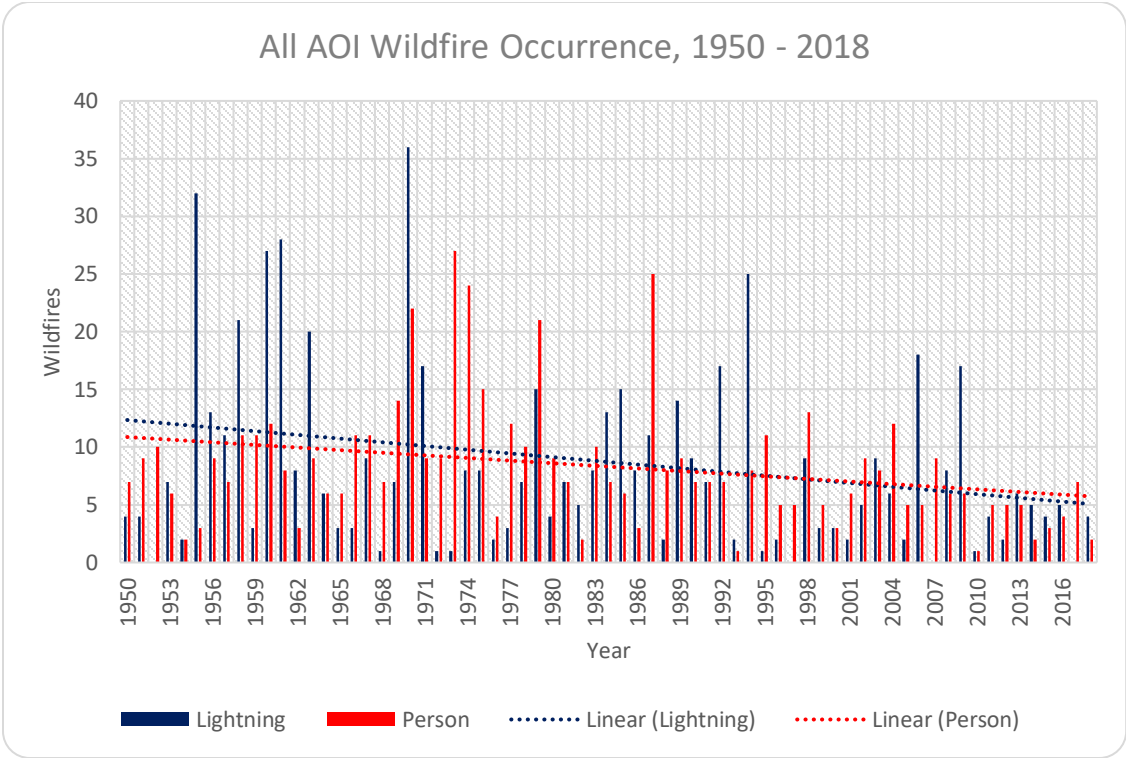


Figure 13 Wildfire occurrence in RDNO AOI, 1950 to 2018.

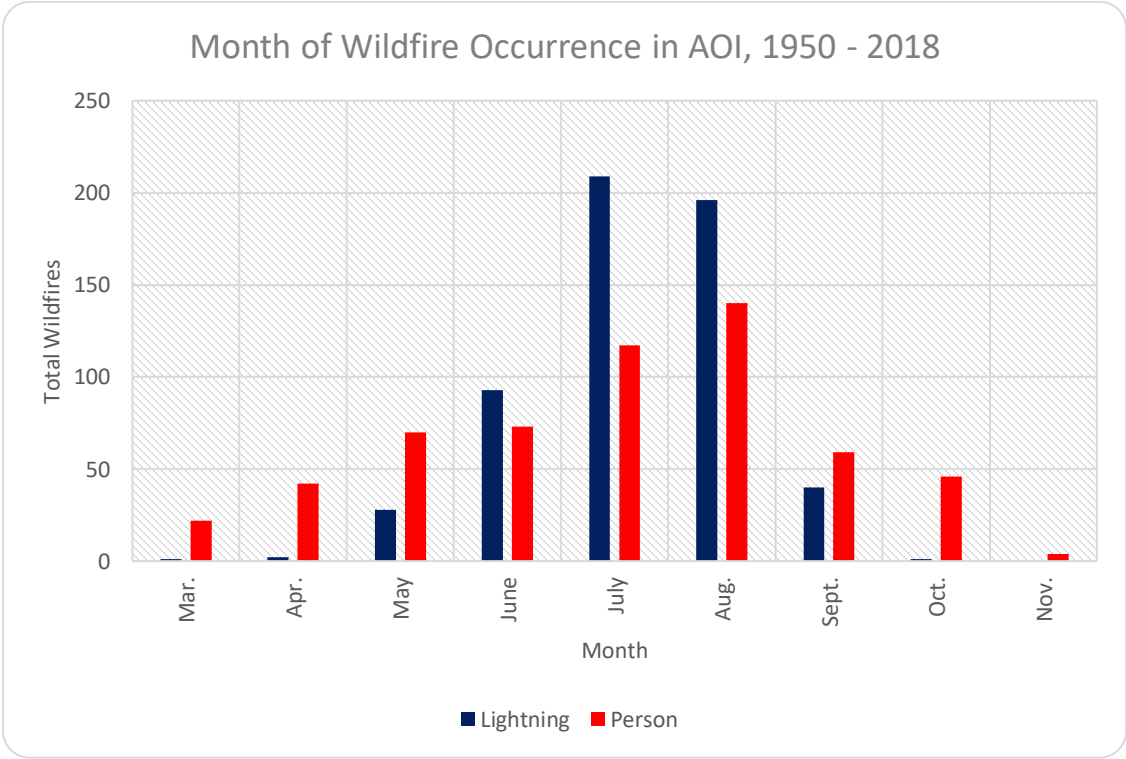


Figure 14 Month of wildfire occurrence in AOI (1950-2018)

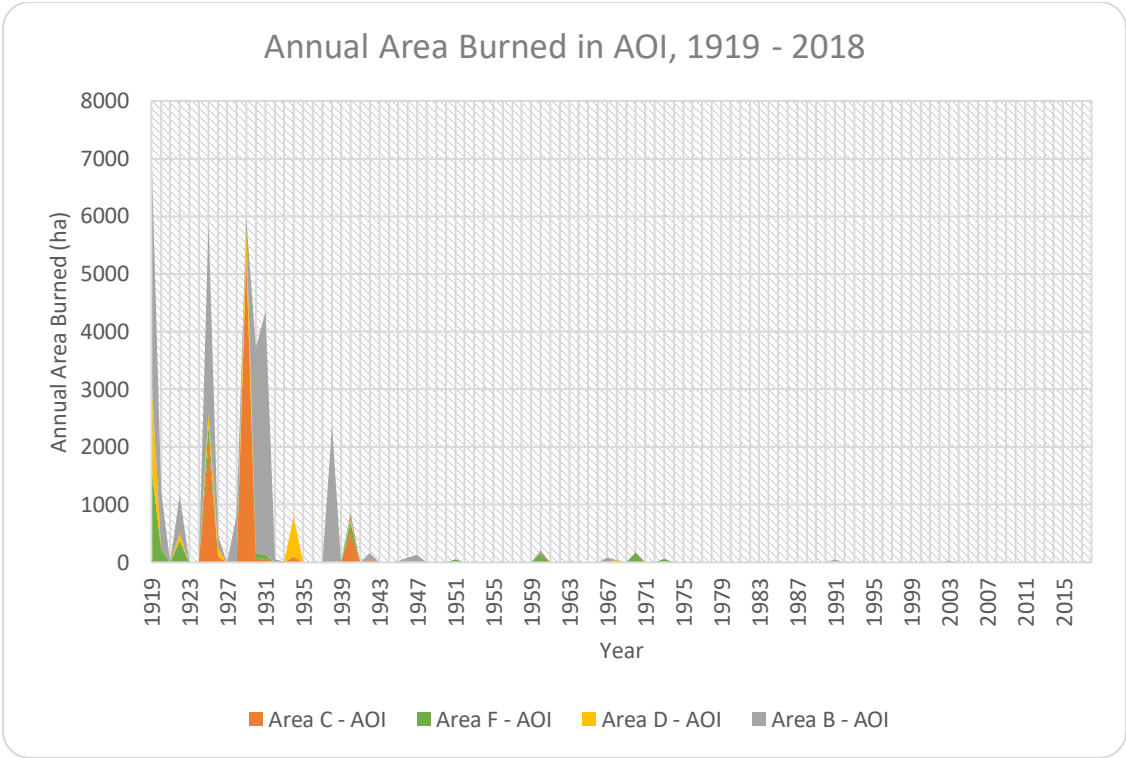


Figure 15 Annual area burned in the RDNO AOI since 1919.

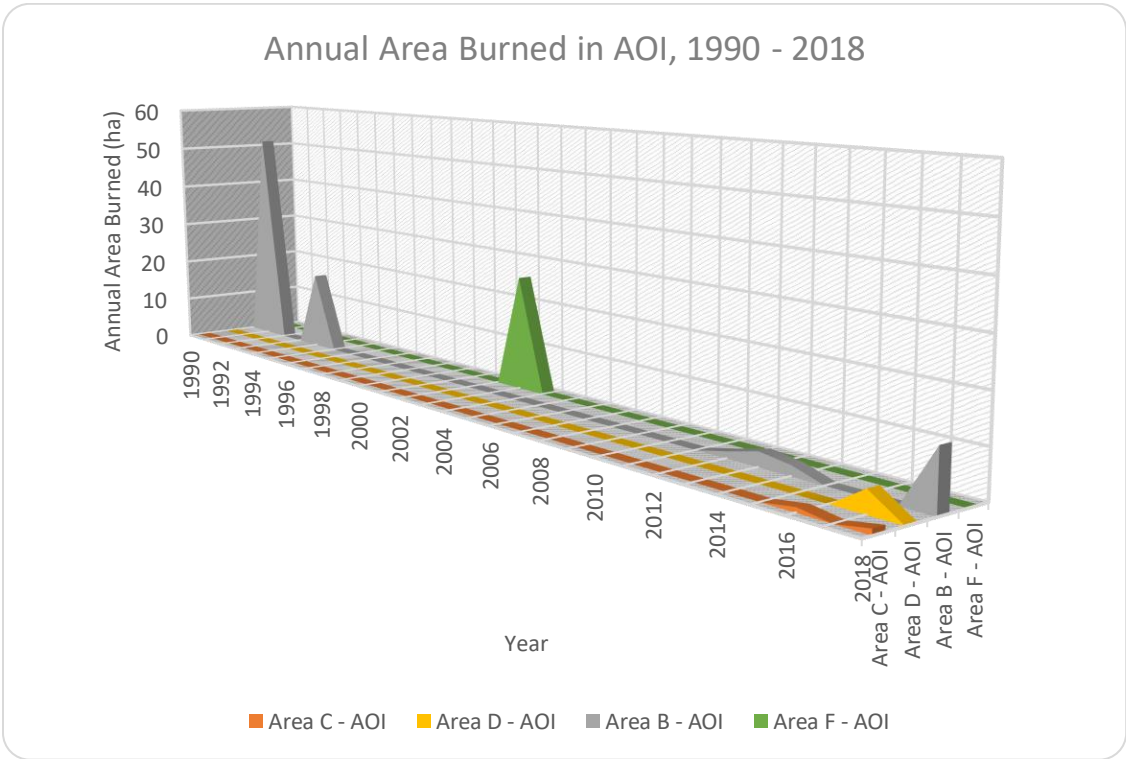


Figure 16 Annual area burned, 1990-2018

The fire history analysis was expanded beyond the AOI to encompass the entirety of the RDNO boundary (Figure 17). Over this larger area, we see that the linear trend for lightning-caused fires is relatively steady, owing to the inclusion of Area E which is typical wet-belt lightning country. However, we still observe a slight decrease in person-caused fires since 1950, though not as pronounced as the trend in the AOI. Again, we can point towards fire prevention efforts and technology as likely contributing factors.

When wildfire occurrence in each of the Electoral Areas is analyzed separately (see Appendix 2), similar occurrence trends are apparent. The exception is Area E, which displays a slight increasing trend of lightning-caused fires.

Across the greater RDNO area we observe a similar annual area burned pattern to that of the AOI (Figure 18). However, we also see small spikes in burned area since the 1940s, with 1967, 2003 and 2018 each totalling nearly 5,000 ha of burned area. As was done with the AOI, the period from 1990 to 2018 was analyzed for the entirety of the RDNO and is presented in Figure 19.

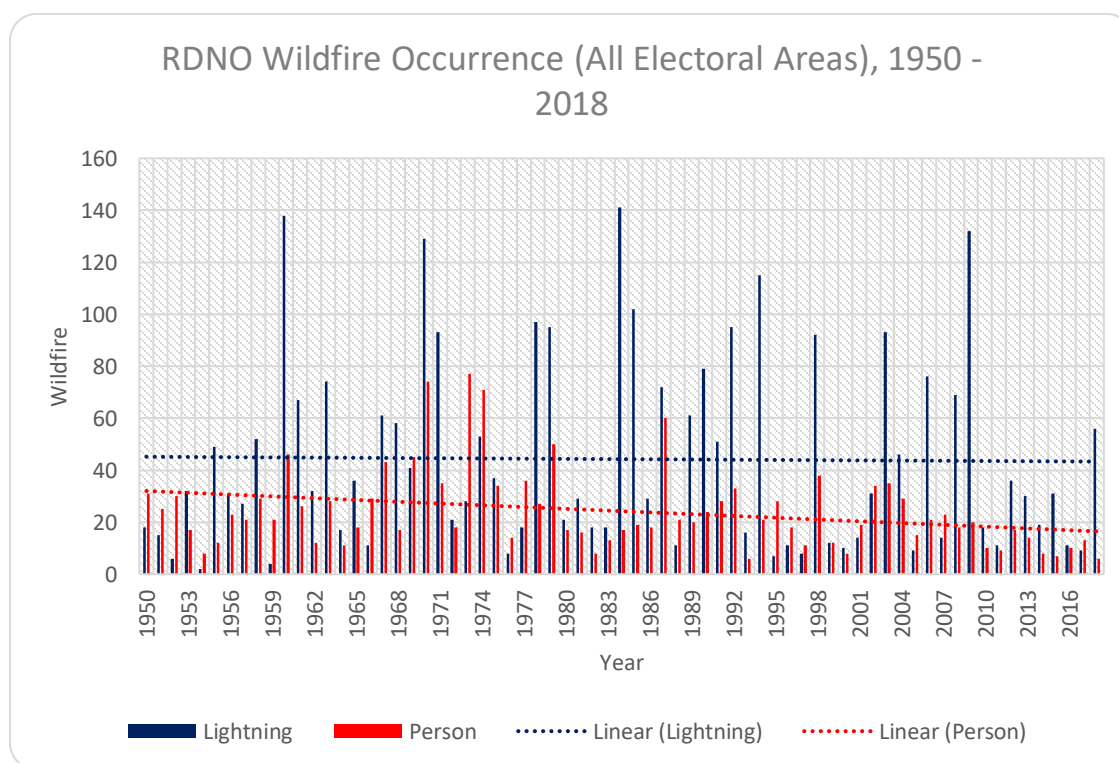


Figure 17 Wildfire occurrence, all Electoral Areas (1950-2018)

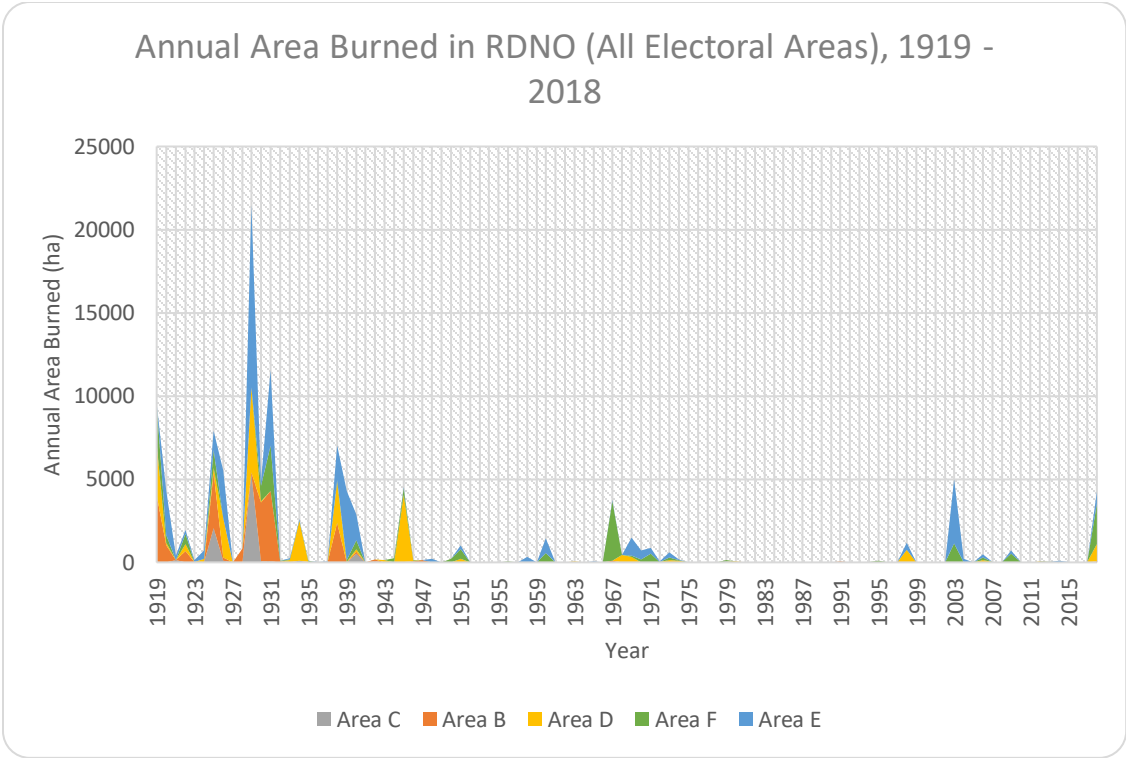


Figure 18 Annual area burned in RDNO, all Electoral Areas (1919-2018)

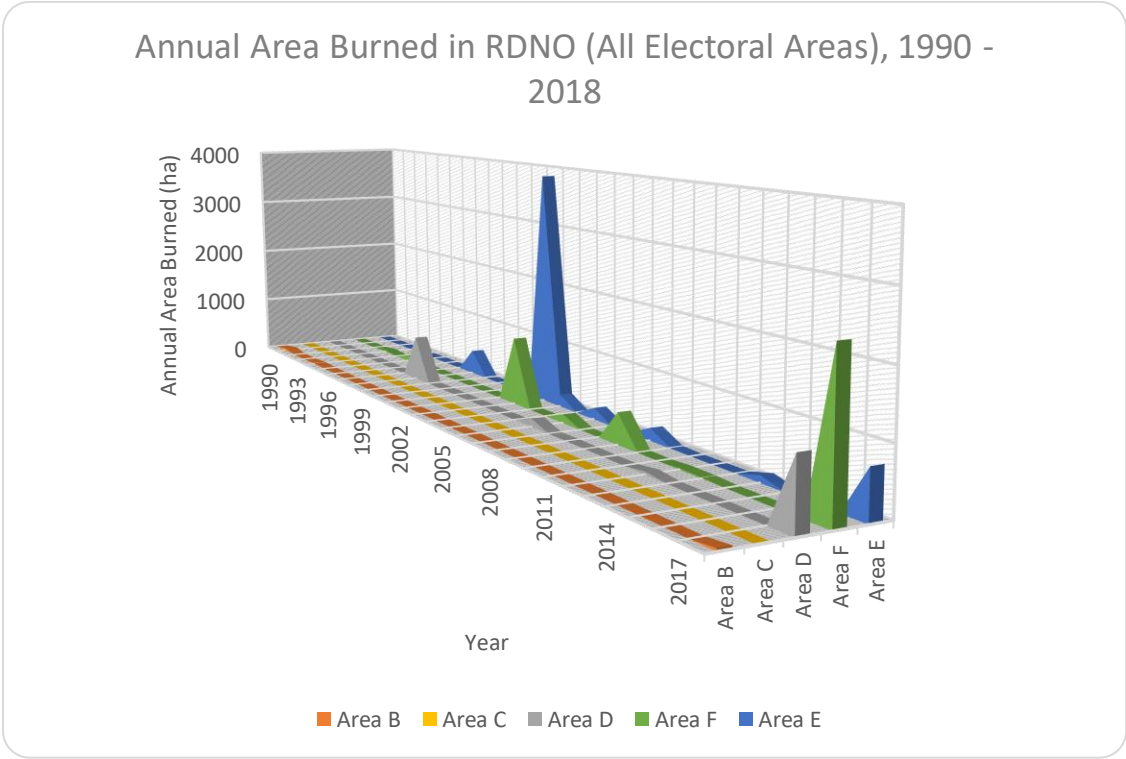


Figure 19 Annual area burned in RDNO, all Electoral Areas (1990-2018)

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For interest's sake, the entire fire history dataset for British Columbia was analyzed to help provide additional context to current wildfire issues. Similar to the trend displayed in RDNO (and elsewhere), the occurrence of person-caused wildfires is displaying a steady decline. Curiously though, lightning fires show a nearly opposite increasing trend. Provincially, this highlights both good and bad news: humans are starting fewer unwanted wildfires, but lightning fires seem to be increasing. The former can be encouraged through prevention campaigns and land use practices, while the latter is completely outside our control.

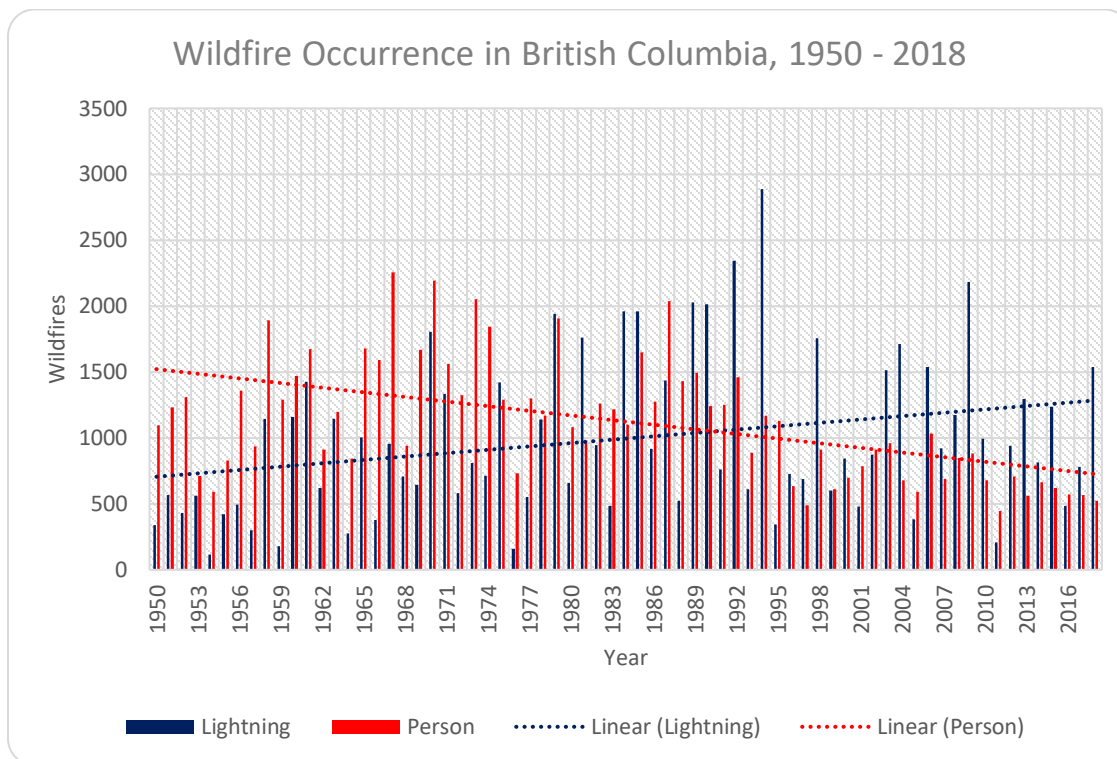


Figure 20 Wildfire occurrence in BC, 1950-2018

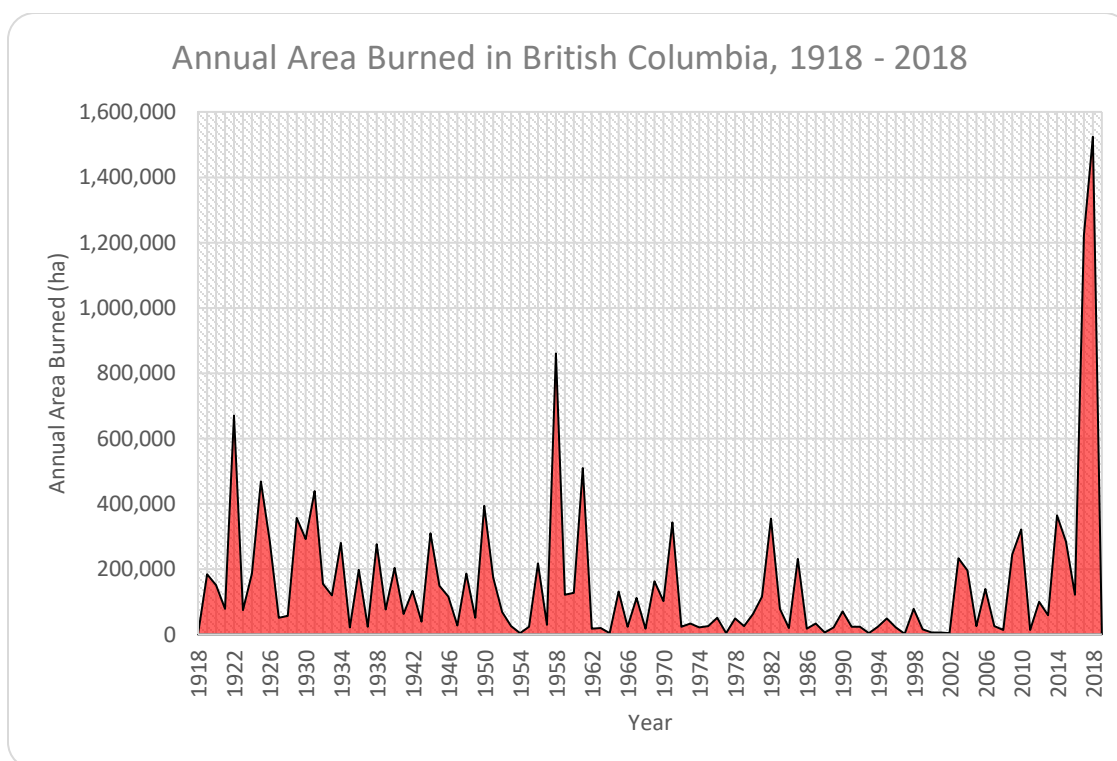


Figure 21 Annual area burned in BC, 1918-2018

4.3 Local Wildfire Threat Assessment

The process to assess wildfire threat for the RDNO CWPP followed the 2012 WUI Wildfire Threat Assessment guide methodology. Normally, plot locations are selected through GIS analysis and fire behaviour modeling of the provincial fuel type layer. Specifically, the methodology (as detailed in Appendix 5) seeks municipal or crown land polygons with a modelled fire behaviour rating of Moderate or higher that are within 100-m of a structure in the WUI. This methodology serves to identify the highest priority areas for field assessment.

4.3.1 Fuel Type Verification

The issue of fuel type is somewhat more complicated in BC compared to other parts of Canada, owing to the diversity and breadth of ecosystems in this province. Fuel types are a primary input to the Canadian Forest Fire Behaviour Prediction (FBP) System and form the basis for predicting rate of spread, type of fire and fire intensity class (i.e. the primary components of the FBP system). Although FBP fuel types are intended to be viewed qualitatively and not quantitatively, many forest types in BC simply don't represent good fits with the established national FBP fuel types.

The FBP system is an adequate tool for wildfire pre-suppression (i.e. preparedness) and suppression operations. Systems such as FBP are "intended to assist firefighters and officers in estimating potential fire behaviour in constant conditions..." (Taylor & Alexander, 2016). The utility of FBP in quantifying wildfire threat or risk or assessing forest types for the purposes of prescribing treatments is not well documented or reviewed. An ecological approach to describing

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wildland fuels provides greater opportunity to describe characteristics related to stand structure and biomass.

The ecology of the RDNO area is diverse, ranging from very dry and hot Interior Douglas-fir to wet cold Engelman Spruce – Subalpine Fir biogeoclimatic classifications. Within the greater RDNO boundary, 17 Biogeoclimatic subzones and variants are found to varying degrees and are summarized in Table 13.

Table 13 Proportions of biogeoclimatic subzones/variants across the RDNO AOI.

Biogeoclimatic subzones/variant/phase		Area in AOI (ha)	% of AOI
ICHdw4	Interior Cedar - Hemlock Shuswap Dry Warm	35,039	24%
IDFxh1	Interior Douglas-fir Okanagan Very Dry Hot	24,766	17%
IDFmw1	Interior Douglas-fir Shuswap Moist Warm	22,876	16%
ICHmw5	Interior Cedar - Hemlock Granby Moist Warm	14,032	10%
MSdm2	Montane Spruce South Thompson Dry Mild	10,936	7%
ICHmk1	Interior Cedar - Hemlock Kootenay Moist Cool	10,194	7%
ESSFdc2	Engelmann Spruce - Subalpine Fir South Thompson Dry Cold	7,633	5%
ICHmk2	Interior Cedar - Hemlock Thompson Moist Cool	5,908	4%
ESSFmh	Engelmann Spruce - Subalpine Fir Moist Hot	5,149	4%
IDFdk2	Interior Douglas-fir Cascade Dry Cool	4,469	3%
ESSFdc1	Engelmann Spruce - Subalpine Fir Monashee Dry Cold	1,992	1%
ICHmw2	Interior Cedar - Hemlock Shuswap Moist Warm	1,661	1%
ESSFwh1	Engelmann Spruce - Subalpine Fir Columbia Wet Hot	1,307	1%
ESSFwc4	Engelmann Spruce - Subalpine Fir Selkirk Wet Cold	555	0.4%
ESSFxcp	Engelmann Spruce - Subalpine Fir Very Dry Cold Parkland	148	0.1%
ESSFdcw	Engelmann Spruce - Subalpine Fir Dry Cold Woodland	96	0.07%
ESSFxc2	Engelmann Spruce - Subalpine Fir Thompson Very Dry Cold	13	0.009%
		146,775	100%

The natural disturbance patterns of the IDFxh1 have been characterized by historically frequent stand maintaining fires (i.e. fires in the NDT4, as discussed in 4.2) prior to the fire-return interval being interrupted by contemporary forest management and fire suppression policies. Stand maintaining fires are typically low intensity surface burns that consume understory fuels while retaining a healthy green overstory. These frequent fires kept ladder fuels to a minimum and typically resulted in an open, park-like stand structure.

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In the absence of periodic low intensity fire in the area, small trees that would have typically been fire-killed have become established, forming thickets and creating ladder fuels and resulting in relatively higher tree densities. Fine fuels, such as dead Ponderosa pine needles, often accumulate at the base of mature trees, resulting in higher fine fuel loading that could produce fire intensity great enough to result in lethal scorching of trees whose thick bark would have otherwise protected the vital phloem and cambial tissues.

The FBP fuel types for most interface areas in Areas B and C are predominantly classified as either Grass or Ponderosa Pine Douglas-fir; termed the O1 and C7 fuel types, respectively. The C7 fuel type lends itself well to manual fuel treatments that target the small diameter understory conifers and retains the larger diameter overstory layer. However, a C7 fuel type that undergoes this type of treatment (often referred to as “thinning from below”), ultimately remains a C7 fuel type since the FBP system has limited options for modifying C7 predictions.

At higher elevations, in the ESSF and MS zones and certain IDF subzones, C-3 and C-5 fuel types are more or less the best (but far from perfect) fit. These areas are more typical of a stand replacement fire regime, whereby high-severity fire results in a relatively higher proportion of tree mortality. Wet belt ecosystems, such as the ICH are notoriously challenging to classify according to fuel type. Often the best option is the M-2 or C-5 fuel types, though these are nowhere near a perfect match. The ICH zone is often typical of a mixed-severity fire regime, whereby examples of both relatively low-intensity and stand-replacing fires can be found on the landscape.

The FBP fuel type distribution for the AOI is presented in Table 15 and a generalized classification of all FBP fuel types, according to spotting potential, is provided in Table 14.

Table 14 Fuel type categories and crown fire spotting potential.

Fuel Type Categories	Fuel Type - Crown Fire/ Spot Potential
1: C1, C2, C4, M3-M4 (>50% C/DF)	High
2: C3, C7, M3-M4 (<50% C/DF) M1-M2 >50% Conifer	Moderate
3: C5, C6, O1a/b, S1- S3 ¹ M1-M2 (26-49% Conifer)	Low
4: D1, D2, M1-M2 (<26% Conifer)	Very Low

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Table 15 Distribution of CFFDRS fuel types in the RDNO AOI.

FBP Fuel Type	Area (ha)	%
C-7 Ponderosa Pine/Douglas-fir	28,799	20%
C-3 Mature Jack or Lodgepole Pine	26,925	18%
C-5 Red and White Pine	25,548	17%
M-1 Boreal Mixedwood - Leafless	20,631	14%
M-2 Boreal Mixedwood - Green		
Non-fuel (water, urban, cultivation etc.)	17,055	12%
O-1a Matted/Cut Grass	15,678	11%
O-1b Standing Grass		
D-1 Leafless Aspen	8,128	6%
D-2 Green Aspen		
S-1 Jack or Lodgepole Pine Slash	2,350	1.6%
C-2 Boreal Spruce	1,106	0.8%
S-3 Coastal Cedar/Hemlock/Douglas-fire Slash	342	0.2%
S-2 White Spruce/Balsam Slash	173	0.1%
C-4 Immature Jack or Lodgepole Pine Stands	40	0.03%
	146,775	100.0%

4.3.2 Proximity of Fuel to the Community

Wildland fuels closest to built-up areas usually represent the highest hazard to communities. The common recommended approach (i.e. SWPI, CRI, FireSmart and others) is to reduce fuel hazards from the value or structure outward, ensuring mitigation continuity. Untreated areas adjacent to the value or structure may allow a wildfire to build in intensity and rate of spread, which can increase the risk to the value. To capture the importance of fuel proximity in the local wildfire threat assessment, the WUI is weighted more heavily from the value or structure outwards. Fuels adjacent to the values and/or structures at risk receive the highest rating followed by progressively lower ratings moving out.

The local wildfire threat assessment process subdivides the WUI into three areas – the first 100 meters (WUI 100), 101 to 500 meters (the WUI 500), and 501 to 2000 meters (the WUI 2000). These zones provide guidance for classifying threat levels and subsequent priorities of treatments (Table 14).

Table 16 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.

Where fuel treatments are intended to reduce the risk to values in the built environment, the generally accepted practice is to begin treatments at the values and progress outwards. This strategy most often straddles the boundaries between private and public land and requires a coordinated effort to have any meaningful result. When gaps of untreated fuel are left, regardless of land status, the overall effectiveness of adjacent fuel treatments can become reduced or completely negated.

As mentioned in the introduction to 4.3, no public property polygons emerged with a Moderate or higher rating from the GIS and fire behaviour modeling.

4.3.3 Fire Spread Patterns

In complex mountainous terrain, wind patterns are highly variable across a landscape and the utility of basing an assessment of fire spread patterns off a distant fire weather station is limited at best. The BCWS has prepared *ISI roses* for each of its fire weather stations across the province, with the expectation that they be included in community wildfire protection planning. Similar to a wind rose, the ISI rose uses the direction and magnitude of ISI, which is a numeric rating of expected rate of fire spread that combines the effect of wind and the fine fuel moisture code (FFMC). The ISI Roses for Mabel Lake 2, Fintry, Curwen Creek, Salmon Arm, and Kettle 2 are provided in Figures 22-26, though extreme caution is needed when interpreting the plots for anywhere but the immediate station area.

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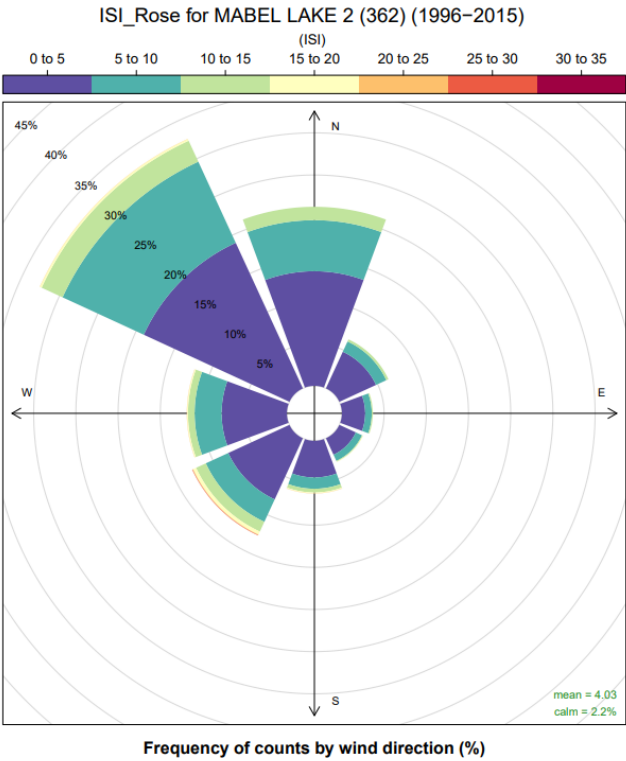


Figure 22 ISI rose for the Mabel Lake 2 fire weather station, 1996-2015. provided by the BCWS.

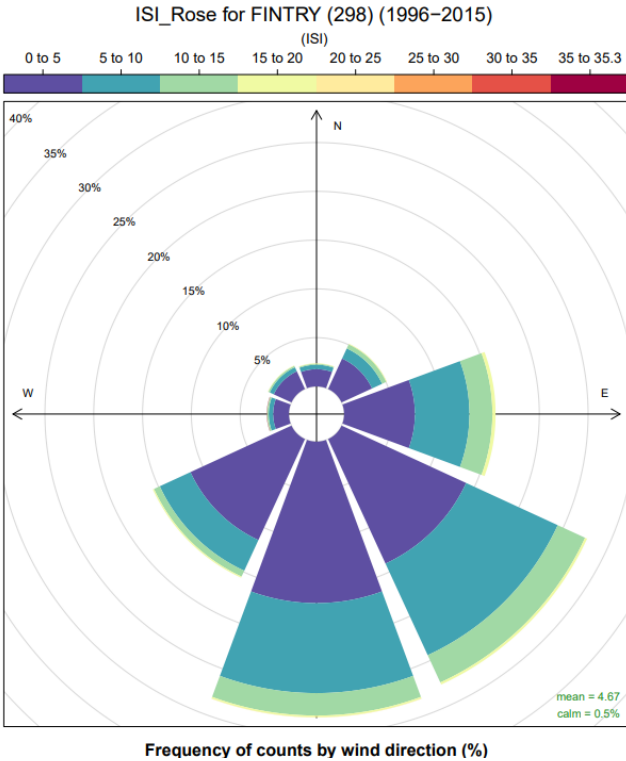


Figure 23 ISI rose for the Fintry fire weather station, 1996-2015. provided by the BCWS.

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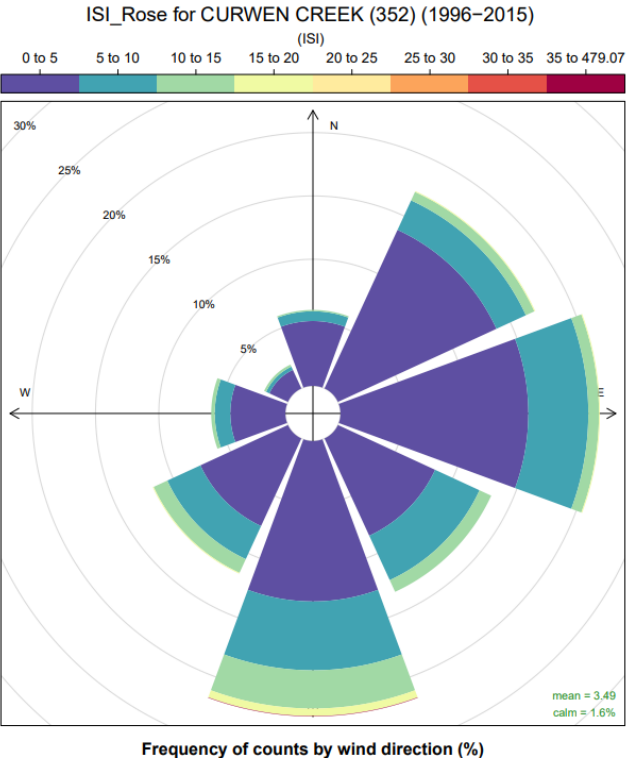


Figure 24 ISI rose for the Curwen Creek fire weather station, 1996-2015. provided by the BCWS.

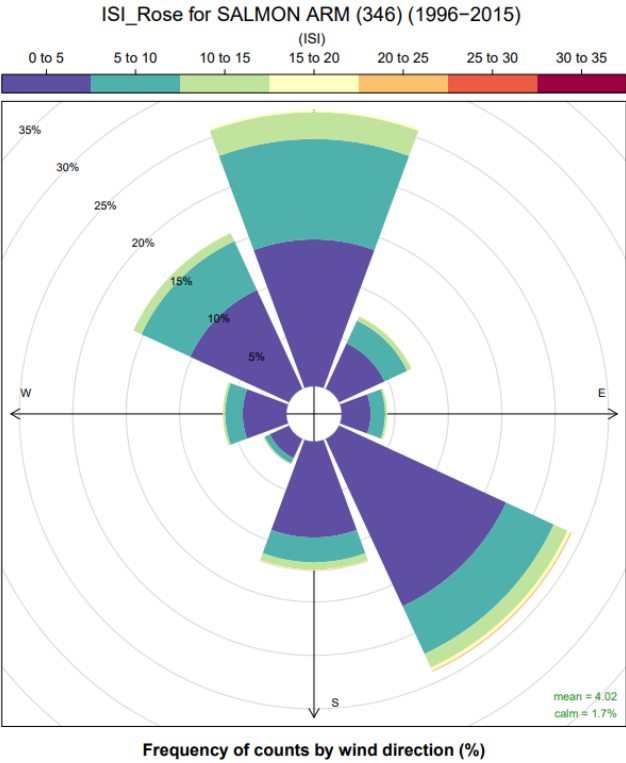


Figure 25 ISI rose for the Salmon Arm fire weather station, 1996-2015. provided by the BCWS.

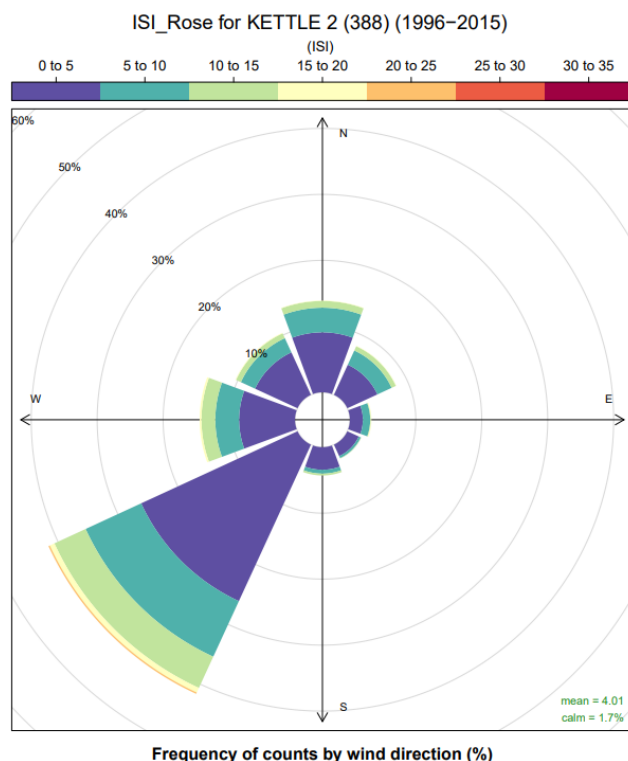


Figure 26 ISI rose for the Kettle 2 fire weather station, 1996-2015. provided by the BCWS.

4.3.4 Topography

In the context of the fire environment, topography refers to the shape and features of the landscape. Of primary importance for an understanding of fire behaviour is slope. When all other factors are equal, a fire will spread faster up a slope than it would across flat ground. When a fire burns on a slope, the upslope fuel particles are closer to the flame compared to the downslope fuels. As well, hot air rising along the slope tilts the flame uphill, further increasing the ease of ignition of upslope fuels. A pre-heating effect on upslope fuels also contributes to faster upslope fire spread.

Topography influences fire behavior principally by the steepness of the slope. However, the configuration of the terrain such as narrow draws, saddles and so forth can also influence fire spread and intensity. Slope aspect (i.e. the cardinal direction that a slope faces) determines the amount and quality of solar radiation that a slope will receive, which in turn influences plant growing conditions and drying rates.

The 2012 Wildfire Threat Assessment Guide (used for this CWPP) classifies slope slightly differently than the 2017 Wildfire Risk Classification process, but the intended outcome is similar – to characterize slope steepness in terms of how a wildfire will spread and behave on a given slope. The classifications ultimately attempt to reflect the role of slope as a primary input of the Canadian Forest Fire Behaviour Prediction System (FBP), which underpins much of the threat characterization and mitigation work in BC and elsewhere.

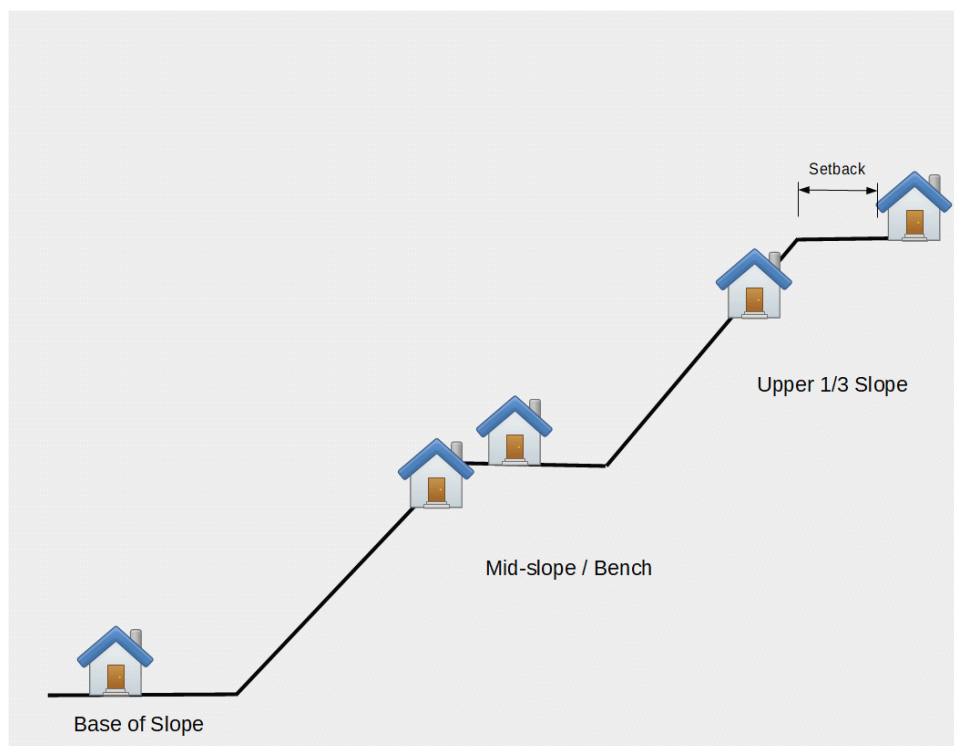


Figure 27 Relative slope position of values.

When structures (i.e. values) are situated on or near a slope, the position of the value in relation to the slope corresponds to the relative WUI threat rating. Where a slope is characterized by continuous and available fuel, values situated at the base of the slope are at less risk than values situated on the mid or upper slope (Figure 27). The risk to values that are situated on slope benches is dependant on the degree to which the value is “set back” from the crest of the slope. Adequate setback is where the value is far enough back from the crest of the slope, such that the value is not subjected to the full effects of upslope fire spread coming up from below. FireSmart Canada broadly defines adequate set back as 10 m for a single-story building, with set back increased proportionally for multi-story buildings (Partners in Protection, 2003).

4.4 Summary of Section 4 Recommendations

- **Recommendation 1 (Public Engagement):** When developing wildfire-related communications for the public, consider including the ecological and cultural role that fire has played on the regional landscape.
- **Recommendation 2 (Prevention and Preparedness):** Consider approaching the BC Wildfire to explore the possibility of re-establishing a fire weather station on the Aberdeen Plateau (outside the AOI for this CWPP update).
- **Recommendation 3 (Prevention and Public Engagement):** Maintain a link from the Regional District of North Okanagan website to the BC Wildfire Service Danger Class webpage to enable the public to check the RDNO fire weather station Danger Class.

- **Recommendation 4 (Preparedness and Governance):** On an annual basis, consider preparing a Danger Class report to help characterize past fire danger and assist decision makers in representing wildfire-related challenges faced by RDNO.

5. Risk Management and Mitigation Factors

When considering the risk of wildland urban interface fires the issue can be viewed in terms of the probable frequency of a fire occurring, and the probable magnitude of the resulting losses. Wildfire occurrence directly relates to fire cause and is the focus of fire prevention planning and education, which is a fundamental element of wildfire management. As discussed in 4.2.4 fire cause is nearly evenly split between lightning and people. This fact illustrates the importance of an all-encompassing approach to managing wildland urban interface fire threats: although prevention programs can reduce the occurrence of person-caused fires, we will never be able to completely eliminate the probability of a wildfire occurring, so we also need to attempt to reduce the magnitude of each occurrence and it's associated probable future losses.

5.1 Fuel Management

Managing wildland fuels is one aspect of reducing the risk to communities in the wildland urban interface. In the drier portions of the AOI, as previously discussed, the predominant fuel type in the interface is C7 Ponderosa Pine Douglas-fir. This fuel type, exemplified in the Interior Douglas-fir Biogeoclimatic zone, is particularly well-suited to certain fuel management treatments, owing to its typical fire-maintained structure of well-spaced and pruned fire adapted conifer overstory.

A variety of treatment methods are available for this particular fuel type, depending on treatment intensity, treatment timing, site sensitivity and public support, among other factors. Treatments in the C7 have traditionally been carried out by hand crews, whereby thinning and pruning have been undertaken with a variety of tools and techniques, including power saws, brush saws, pole-pruners etc. Debris disposal is typically carried out either through pile and burn, chipping or hauling off-site. These types of hand treatments can be labour intensive, depending on stand density, surface fuel loading and terrain limitations. Hand treatments are well suited to sites with thin and sensitive soils that would be otherwise degraded through ground-based equipment.

Fuel treatments can also be carried out with mechanized equipment, such as feller bunchers and various types of mulching heads. Conventional timber harvesting is also a viable form of fuel management in certain timber types, with the added benefit of at least partial recovery of costs through log utilization. The use of machinery enables the land manager to realize higher production rates compared to hand crew treatments alone. Site sensitivities are a significant factor when considering the use of mechanized methods – thin soils, common to lower elevation hot/dry sites can be significantly degraded if treatments aren't designed and carried out professionally.

Regardless of the method for reducing fuel loading on any particular forested site, surface fuels must be considered and attended to. During hand falling/bucking or mechanical harvesting, processing and yarding, surface fine fuel loading can increase with disturbance. In many cases, particularly in Ponderosa pine and interior Douglas-fir stands, the use of low-intensity prescribed

fire can be an effective means of both reducing surface fine fuel loads and realizing beneficial ecological fire effects.

Fuel management treatments, particularly on NDT4 sites, should not be viewed as one-time actions. Rather, fuel treatments require periodic maintenance entries to maintain the integrity and purpose of the treatment area. In the absence of maintenance, or periodic low-intensity fire, treated NDT4 sites will trend back towards pre-treatment structure and conditions.

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 a safe place from which to anchor crews and tactics, and improve suppression outcomes. The dimensions of interface fuel breaks are dependant on the forest/fuel type and associated fire behaviour, but generally this type of fuel break will occupy, at minimum, the WUI 100 zone. The design of an interface fuel break should incorporate existing natural features, where they exist, that offer a similar modification or impediment to fire behaviour. These can be areas of low fuel loading, no fuel loading or a fuel type with less potential fire behaviour.

Fuel breaks created through stand modification are not intended to be impenetrable barriers to fire spread; rather they are intended to modify and decrease fire behaviour. Similarly, the presence of an interface fuel break alone does not ensure the survivability of adjacent structures, especially if those properties are not FireSmart. The combination of a well designed and maintained interface fuel break *and* adjacent private property and structures that are FireSmart, is a proven method of achieving real risk reduction.

Fuel breaks located beyond interface fuel breaks (i.e. beyond the WUI 100 zone) are termed *primary fuel breaks*. The location of primary fuel breaks is contingent on land ownership (Crown vs. private), existing natural and man-made features, fuel types, and prevailing wind patterns. As with interface fuel breaks, primary fuel breaks are intended to modify fire behaviour and create fire suppression options that reduce the risk of high intensity wildfire reaching a community or other built-up areas.

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 need to have sufficient width and fuel modification to minimize horizontal and vertical fuel continuity to effectively reduce the head fire intensity as a wildfire enters into the fuel break.

As with interface fuel breaks, primary fuel breaks should not be viewed as impenetrable barriers to fire spread. The potential for ember transport and spot fires on the community side of any fuel break is a very real concern and may negate the effectiveness of any fuel break if not designed and treated in a manner that attempts to reduce this risk.

Seven broad potential primary fuel break areas have been identified and are summarized in Table 18, representing 1,275.8 ha in total. Within the WUI 17 possible interface fuel breaks have been identified through GIS analysis (detailed in Appendix 5) followed by site assessments using the 2012 WUI Wildfire Threat Assessment process (Morrow, et al., 2013). These proposed interface fuel breaks are summarized in Table 17 and total 154.8 ha.

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Table 17 Interface Fuel Breaks

Poly	Reference Plot	Wildfire Behav. Threat Class	WUI Threat Class	Geographic Area	Area (ha)	Feature Type	Priority Rank
1	RDNO_008	HIGH	EXTREME	Forsberg Road	22.1	Interface Fuel Break	Priority 1
2	RDNO_013	HIGH	EXTREME	Silver Star - Monashee Road	8.8	Interface Fuel Break	Priority 2
3	RDNO_014	HIGH	EXTREME	Kingsview Rd	3.2	Interface Fuel Break	Priority 3
4	RDNO_006	HIGH	EXTREME	Abbott Creek	52.0	Interface Fuel Break	Priority 4
5	RDNO_012	HIGH	EXTREME	Silver Star - Monashee Rd 2	1.9	Interface Fuel Break	Priority 5
6	RDNO_011	HIGH	EXTREME	Silver Star - Monashee Rd 3	13.0	Interface Fuel Break	Priority 6
9	RDNO_023	HIGH	HIGH	Mabel Lk Sub Rd 4	1.1	Interface Fuel Break	Priority 9
11	RDNO_022	HIGH	HIGH	Mabel Lk Sub Rd 3	1.9	Interface Fuel Break	Priority 11
12	RDNO_029	HIGH	HIGH	Cook Ck	10.4	Interface Fuel Break	Priority 12
15	RDNO_026	HIGH	MOD	Ashton Ck Preston Rd	28.1	Interface Fuel Break	Priority 15
16	RDNO_004	HIGH	HIGH	BX Falls Park Tillicum Rd	0.3	Interface Fuel Break	Priority 16
17	RDNO_020	HIGH	HIGH	Mabel Lk Sub Rd 1	0.4	Interface Fuel Break	Priority 17
18	RDNO_025	HIGH	HIGH	Mabel Lk Sub Rd 6	2.3	Interface Fuel Break	Priority 18
20	RDNO_031	MOD	HIGH	Lower Fall Ck	5.1	Interface Fuel Break	Priority 20
22	RDNO_030	MOD	MOD	Kingfisher Interp Centre	1.0	Interface Fuel Break	Priority 22
23	RDNO_021	MOD	MOD	Mabel Lk Sub Rd 2	1.6	Interface Fuel Break	Priority 23
24	RDNO_024	MOD	MOD	Mabel Lk Sub Rd 5	1.6	Interface Fuel Break	Priority 24
					154.8		

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Table 18 Primary Landscape Level Fuel Breaks

Poly	Reference Plot	Wildfire Behav. Threat Class	WUI Threat Class	Geographic Area	Area (ha)	Feature Type	Priority Rank
7	RDNO_002	HIGH	EXTREME	Six Mile Creek	426.1	Landscape Fuel Break	Priority 7
8	RDNO_005	HIGH	HIGH	Ladner Road	60.5	Landscape Fuel Break	Priority 8
10	RDNO_018	HIGH	HIGH	Trinity Valley Rd	110.5	Landscape Fuel Break	Priority 10
13	RDNO_015	HIGH	MOD	Kal Lk Park Cosens Bay Rd	15.2	Landscape Fuel Break	Priority 13
14	RDNO_007	HIGH	HIGH	Forsberg Road - North	70.3	Landscape Fuel Break	Priority 14
19	RDNO_027	HIGH	MOD	WL372	86.5	Landscape Fuel Break	Priority 19
21	RDNO_003	HIGH	LOW	Banks Rd - Landscape Break	506.7	Landscape Fuel Break	Priority 21
					1,275.8		

5.2 FireSmart Planning and Activities

The FireSmart Canada program is administered by Partners in Protection, a national non-profit association comprised of national, provincial, and local government agencies with fire protection mandates. Modelled after the FireWise Communities USA program in the United States, FireSmart Canada has developed a comprehensive planning and assessment process to mitigate wildfire hazards to existing communities, as well as guide new development. Although the FireSmart program is primarily focused towards residential homes, the principles have been adapted for application in mixed-use areas, industrial activities and elsewhere. For this reason, although home or house are the terms most often used when describing FireSmart principles, structure or building are equally appropriate and more broadly applicable.

5.2.1 FireSmart Goals and Objectives

The FireSmart program seeks to strike a reasonable balance between the aesthetic values of living in WUI areas with the need to make communities more resilient to the effects of wildfire. At the core of the FireSmart program is the relationship between a home and the surrounding natural areas and whether this relationship can result in the transfer of fire between the two. Hazards are assessed and mitigated by giving priority to the structure and immediate surroundings and then working progressively outwards. This is accomplished through the establishment of three zones around a structure:

- Priority Zone 1a: The area within 1.5m of a building

- Priority Zone 1: The area within 10 m of a building
- Priority Zone 2: The area 10-30 m from a building
- Priority Zone 3: The area 30-100 m from a building

On sites with relatively higher building densities, multiple sets of priority zones invariably overlap. One building's Zone 2 may be an adjacent building's Zone 1 and so forth. This characteristic is common in all but the most rural of WUI settings and speaks to the shared nature of wildfire hazard and collective resilience.

The general goal of FireSmart is to encourage private land holders to adopt and conduct FireSmart practices to reduce the fuel hazard and implement other measure to minimize damages to assets on their property from wildfire:

- Reduce the potential for an active crown fire to move through private land.
- Reduce the potential for ember transport through private land and structures.
- Create landscape conditions around properties where fire suppression efforts can be effective and safe for responders and resources.
- Treat fuels adjacent and nearby to structures to reduce the probability of ignition from radiant heat, direct flame contact, and/or ember transport.
- Implement measures to structures and assets that reduce the probability of ignition and loss.

Research and post-fire reviews have shown that when values have been constructed, retrofitted or treated in accordance with FireSmart principles, they stand a greater chance of survival compared to those that haven't (Westhaver, 2017; Partners in Protection, 2003). The spatial scale that determines home ignitions corresponds more to the specific site and characteristics of homes and property than to landscape scale wildfire management and fuel modification strategies (Cohen, 2000). In order to truly reduce the threat of homes and other values being destroyed in wildland urban interface fire disasters, homeowners and governments alike must take deliberate and concerted steps to properly assess and mitigate hazards.

5.2.2 Key Aspects of FireSmart for Local Governments

The FireSmart program is wholly dependent on interest and participation from residents who live in fire prone environments. Obviously local governments can't force residents to take an active interest in any particular cause or issue, they can conduct public education and awareness campaigns and support FireSmart projects, with the goal of building a critical mass of motivated residents who are committed to reducing the ignitability of their homes.

The challenge that local governments continue to face is how to deal with private landowners who are either unable or unwilling to mitigate fuel hazards on their property. Publicly funded programs such as FireSmart are not permitted to be used directly for work on private property, and there is little recourse for local governments to compel private landowners to undertake mitigation actions. Even if most homes in a residential area undertake meaningful FireSmart actions, when unmitigated private properties are interspersed among them, the overall threat to mitigated property remains, due to the threat of structure to structure ignition and propagation.

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Suggested FireSmart activities that have been successful with other local governments are presented in Table 16.

Table 19 FireSmart practices and activities.

FireSmart Theme	Suggested Activities
Communication, Education & Partnerships	<ul style="list-style-type: none">• Host a FireSmart day• Use local government and First Nation newsletters and social media• Undertake FireSmart Local Representative or Community Champion training• Continue to pursue CRI funding for FireSmart projects• Form a community wide FireSmart committee• Encourage homeowners and/or neighborhoods to undertake FireSmart site assessments and area assessments
Vegetation management	<ul style="list-style-type: none">• Develop FireSmart demonstration areas in public spaces, such as parks and municipal facilities• Strengthen landscaping requirements in zoning and development permits to require fire resistive landscaping and replacement of legacy high-flammability plants.• Facilitate treatment debris disposal for landowners
Planning & Development	<ul style="list-style-type: none">• Strengthen policies and practices for FireSmart construction and maintenance of public buildings• Maintain the Development Permit Areas for Wildfire Interface in order to require FireSmart exterior finishing, landscaping and professional assessments and recommendations

5.2.3 Priority Areas within the Area of Interest for FireSmart

The RDNO received three FireSmart grants in 2018 and chose to undertake this work at Silver Star Resort, in the Kingfisher community and Cosens Bay.

Unfortunately, the Cosens Bay AGM was held before the grant was received and thereafter, given the bulk of properties are recreational in nature and owned by absentee owners, it was not possible to gather those residents together for a community meeting. It is planned to do so in May of 2019.

Kingfisher and Silver Star both had successful community meetings and interest with residents of both communities was good. FireSmart Boards (the FireSmart Canada terminology used for a committee) were established in both communities, a Community FireSmart Plan completed and accepted by the board and volunteer work undertaken as part of the program.

The RDNO should continue to support these boards annually through time with resources (access to Local FireSmart Representative or by other means) to ensure they continue to progress as a FireSmart community

5.3 Community Communication and Education

The following community engagement strategies would be of benefit to RDNO and its residents in furthering wildland urban interface fire awareness and education:

- Establish a community wildfire safety page on the RDNO webpage, that includes:
 - the current CWPP;
 - completed FireSmart Community Assessment Reports;
 - information for residents on how to conduct their own FireSmart Structure and Site Hazard Assessment Forms, and steps they can take to lower their hazard scores;
- Host Wildfire or FireSmart Public Education Workshops or Information Sessions throughout the RD prior to and during fire season

5.4 Summary of Section 5 Recommendations

- **Recommendation 5 (Prevention):** The application of prescribed fire in areas surrounding RDNO should be supported as a proactive method of fuels management that can result in less smoke output than similar areas burning under wildfire conditions.
- **Recommendation 6 (Prevention and Public Engagement):** Wildland urban interface threat reduction should be promoted as a mutually beneficial strategy between private property owners and governments. Private property owners and governments alike need to take responsibility for the wildland fuel under their ownership.
- **Recommendation 7 (Prevention and Governance):** Consider lowering or removing the subdivision threshold of four or more lots with regards to the wildfire DPA requirements in Areas B and C.
- **Recommendation 8 (Prevention and Governance):** When drafting or updating wildfire DPA requirements and guidelines, incorporate FireSmart practices and disciplines, particularly with regards to landscaping.
- **Recommendation 9 (Prevention and Public Engagement):** RDNO should continue to pursue FireSmart projects, as it remains the best available option for generating public interest and action regarding hazard reduction on private property.
- **Recommendation 10 (Prevention and Public Engagement):** Establish a wildfire safety and hazard reduction page on the Regional District website to highlight the FireSmart program and simple actions that homeowners can take to reduce their homes' ignitability. Engage in public education information sessions throughout the RDNO associated with wildfire management and/or FireSmart.
- **Recommendation 11 (Prevention):** Consider the identified interface and landscape fuel breaks summarized in Tables 17 and 18, respectively, for treatment prescription and implementation.

6. Wildfire Response Resources

The BC Wildfire Service, as a component of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), has responsibility to respond to wildfires outside

local fire protection areas and to provide assistance to local fire departments on wildfires within their fire protection area, when requested. Fire departments are responsible for their own costs incurred while responding to wildfires within their jurisdiction. Costs incurred by the BCWS to undertake firefighting assistance within a fire department protection area are borne by the Province. In situations where the BCWS requests a fire department to respond to a wildfire outside their fire protection area, the fire department is compensated according to the Inter-Agency Operational Procedures and Reimbursement Rates agreement (The Office of the Fire Commissioner, The Fire Chiefs Association of BC, BC Wildfire Service, 2017).

6.1 Local Government Firefighting Resources

Within the AOI, the following fire protection areas are established:

- BX – Swan Lake;
- Silver Star;
- Rural Lumby/Area D, and
- Shuswap River.

6.1.1 Fire Department and Equipment

BX Swan Lake Fire-Rescue apparatus includes the following:

- Engine 61 – 1994 Spartan Gladiator / Hub (1050/1000)
- Utility 63 – 2014 Ford F-350
- Command 64 – Toyota Tundra
- Engine 65 – 2006 Freightliner M2 / Rosenbauer
- Tender 66 – 1999 International 4900, 1500 Gallons
- Rescue 67 – Ford Crew Cab bush rescue
- Rescue 68 – 2011 International 4400 Low-Profile / Express Custom
- Engine 69 – 1990 Ford F600 / 1997 Hub
- Structure Protection Unit (SPU) 18' Trailer

Lumby and District Volunteer Fire Department apparatus includes the following:

- Rescue 31 – 2012 Freightliner M2 / Hub
- Wildland 32 – Ford F350 brush truck
- Tender 36 – 1994 Freightliner FL80 / Anderson
- Tender 37 – 2004 Freightliner M2 / Hub/American Lafrance
- Engine 38 – 1997 Freightliner FL80 / Hub
- Ladder 39 – 2006 American Lafrance

Silver Star Fire Department apparatus includes the following:

- Unit 111 – 2002 Freightliner FL80RR / Superior pumper
- Unit 112 – 2008 F550 Crewcab 4x4



Figure 28 BX – Swan Lake Fire Rescue has long been a provider of wildland firefighting and structure protection assistance to other parts of the province during provincial emergencies (Photo from BX-Swan Lake Fire Rescue, 2018).

6.1.2 Water Availability for Wildfire Suppression

Where the coverage of these protection areas lies within municipal boundaries, fire hydrants are typically available as per municipal standards. In some cases, fire hydrants do exist in unincorporated settlements such as at Silver Star (where fire hydrant maintenance is the responsibility of the strata corporation). Outside of areas with fire hydrant coverage, water availability for fire suppression purposes will be natural or human containment structures (pools, ponds, etc.) as well as the water tenders belonging to the fire departments.

The RDNO should consider developing a Pre-Attack Plan Worksheet Map that outlines the locations of potential water sources and other relevant fire fighting details that could be used by outside resources in times of a large-scale wildfire that requires outside agency assistance (i.e. non-local fire departments or emergency crews).

6.1.3 Access and Evacuation

There is currently no formalized evacuation route plan for the Regional District of North Okanagan, but an application has been submitted to UBCM in order to fund the development of a comprehensive evacuation route plan for the Regional District. Should the funding be granted, this project will be completed in 2019.

Within the Pre-Attack plan recommended in the previous section, the RDNO should also highlight on that map areas with single or poor access. This can include development with only one access

point, access locations for natural water bodies and whether they are gated and what type of vehicle can be used for that water source.

6.1.4 Training

In addition to the S-100 basic wildfire training, a number of additional wildland firefighting courses exist within the BCWS training catalogue that have been difficult for non-BCWS fire personnel to access. Owing to the frequency of wildland and wildland urban interface firefighting that RDNO departments undertake, there should also be increased opportunities for local fire services personnel to undertake wildfire agency training normally reserved for BCWS employees. Possible training includes:

- Basic and Intermediate Wildland Fire Behaviour (S-290 and S-390, respectively);
- Wildfire Scene Preservation for First Responders (FI-110);
- Ignition operations and prescribed burn training;

6.2 Structure Protection

There are recent examples of wildland urban interface fires in the Okanagan (e.g. Glenrosa 2009, Seclusion Bay 2010 etc.) where the deployment of structure protection sprinkler systems was not possible or practical during the initial attack. While engaged in the critical initial attack phase of suppression, finite resources are often exclusively dedicated to life and safety (i.e. rescues and evacuation) and fire control. The ability to undertake structure assessments, plan and deploy structure protection sprinklers is often not possible during the emergent stages of a developing WUI fire. Structure protection units (SPUs) and SPU crews and specialists are most often deployed to fires that either already or have the potential to become longer duration project fires where extensive areas require SPU capability. In these cases, Type 1 SPU trailers are often deployed.

Homeowners should not rely on whether SPU capabilities can be installed on their home in time to save it. Rather, an active and concerted effort needs to be taken by residents to assess and mitigate hazards that affect the ignitability of their homes *before* a wildland urban interface fire disaster unfolds. It will never be possible to dedicate sprinklers and firefighters to protect every home in BC from wildfire – homeowners need to take action themselves ahead of time.

There are, however, scenarios when a local SPU that can be deployed in a timely manner can offer a tactical advantage to the local fire service. Some fire departments in BC have procured their own SPUs to complement their suppression capabilities. In many cases, it has proven to be a valuable tool for local suppression needs. Additionally, it can also prove to be a significant source of income during the fire season when provided to the BCWS. Such income can help subsidize the fire department and reduce the budgetary needs or burden on the Local Government.

BX-Swan Lake FD has had a SPU for several years and has used it extensively. This SPU has helped the members gain valuable interface fire experience and the department financially. Silver Star FD is working towards purchasing their own SPU. The RDNO should engage in discussions with other rural Fire Departments to determine their interest in SPU acquisition and support such interest within the means of the RDNO.

6.3 Summary of Section 6 Recommendations

- **Recommendation 12 (Operations and Preparedness):** Consider the development of pre-attack wildfire response plans that highlight natural water sources that can be used where hydrants are lacking. In addition, areas with limited access (single access roads, no turnarounds etc.) may also be beneficial to include in pre-attack plans.
- **Recommendation 13 (Operations):** As interagency partners in wildfire suppression operations, RDNO departments should consider pursuing seats in basic and intermediate wildfire training opportunities with the BC Wildfire Service, beyond S-100.
- **Recommendation 14 (Operations and Preparedness):** RDNO should consider acquiring Type 2 Structure Protection Units for Silver Star and Lumby that can be used locally or deployed under cost recovery elsewhere when conditions allow.

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APPENDIX 1: Additional Wildfire History Analysis

