The Corporation of the District of North Cowichan

Community Wildfire Protection Plan

Report by Diamond Head Consulting

January 2020

Community Wildfire Protection Plan for District of North Cowichan

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Executive Summary

The Corporation of the District of North Cowichan has a history of proactively managing wildfire risk through both policy and operations. In 2007, the District developed a Community Wildfire Protection Plan (CWPP). Since the original CWPP was developed, there has been substantial development growth in the urban wildland interface and changes in forest composition have increased wildfire fuel hazards in the surrounding forest. There is now also a better understanding of the expected impacts of climate change on wildfire including longer fire seasons and larger fires. This CWPP update includes the land within the jurisdictional boundaries of the District of North Cowichan, a majority of which is inside the District owned Municipal Forest Reserve (MFR). It responds to the current and anticipated changes to the study area's wildfire risk profile and makes recommendations to reduce vulnerability and increase the community's resilience to wildfire.

The District of North Cowichan is located within the traditional territory of several First Nations groups in southern Vancouver Island, including the Cowichan Tribes, the Halalt First Nation, the Lyackson First Nation, the Stz'uminus First Nation, and the Penelakut Tribe. It is home to 30,000 people and plays an important role in supporting economic activity in the southeastern portion of Vancouver Island. Key economic sectors include construction, forestry, professional services, healthcare, education and tourism.

The recognized values at risk identified in this plan include human safety and communities, critical infrastructure, cultural values, species at risk, recreation and timber resources. Critical infrastructure identified in and around the District plays an important role to move goods, power and fuel through Vancouver Island. Protecting the District from wildfire is important not only for the District itself but for the economy of the Island.

Wildfire threat and risk to these recognized values has been assessed within the District. The threat from wildfire was assessed using the Provincial Wildfire Threat Analysis, ground truthing of fuel conditions as well as a fire behavior modeling exercise. Wildfire threat reflects the potential fire behaviour considering fuel loading, slope, aspect and worst-case weather conditions. The highest wildfire threat in the District is posed by steep, coniferous forested slopes of the mountains inside the District boundaries, a majority of which are located inside the MFR.

Wildfire risk was calculated using the local threat score in addition to the proximity of fuel to the community, fire spread pattern and slope. Most of the public lands within the District boundary are rated as posing a moderate wildfire risk. The areas of high and extreme risk inside the District are dispersed throughout the area. There are no large continuous or concentrated areas of high risk.

This CWPP update makes recommendations to manage wildfire risk through fuel management, FireSmart planning, community education and wildfire response. Opportunities to treat interface fuels and create larger landscape level fuel breaks have been identified in locations with elevated wildfire risk. Most hazardous fuel areas within the urban interface are located on privately owned lands that are not eligible for treatment as part of the CWPP; therefore, building public awareness of wildfire risk and providing education to encourage homeowners to become FireSmart will be an important component of increasing the community's wildfire resilience. Policy opportunities are identified to improve the FireSmart performance of new developments. Best practices for the prevention of ignitions, early detection and improvements to suppression resources, training and interagency communication and cooperation are also discussed.

Many of the recommendations made within this CWPP update are meant to be implemented over time as funding and opportunities arise. Implementation of the recommendations requires a long planning horizon in order to accommodate both the rate at which forests grow and change, and the pace of community planning and development. For example, planning is needed to anticipate the altered ecological conditions that will result from climate change as well as forest stand dynamics to make interface forests more resilient and naturally resistant to wildfire. While complete implementation of the CWPP is a long-term prospect, it provides the framework to create communities that are designed for and prepared to defend against a wildfire event. This plan is also meant to be a living document that should be updated regularly.

Summary of CWPP Recommendations

This report includes information about the current wildfire threat and risk within the study area and provides many recommendations on what can be done by both local government and private individuals. Some of these recommendations are easily implemented with relatively low cost. Others, such as fuel treatments, require resources and support from the Provincial government and inter-agency cooperation. Recommendations have been prioritized based on how quickly they can be implemented and their relative impact on reducing wildfire risk.

There are funding sources available to help implement many of these recommendations. UBCM manages the Community Resilience Investment (CRI) Program which offers up to 100% funding for a range of wildfire mitigation initiatives. Many of the recommendations made in this report are eligible for CRI funding. Estimated costs for implementing these recommendations are in addition to the District's existing operating budgets.

Table 1 Summary of CWPP recommendations

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec 1	Continuously review the CWPP as a living document and complete an update every 5 years.	Low	5+	$5,000 per update
Rec 2	Develop fuel treatment prescriptions for interface fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).	High	3-5	$50,000
Rec 3	Integrate wildfire management considerations into the development of the Forest Management Plan for the Municipal Forest Reserve.	High	3	$10,000
Rec 4	Advocate to the Province for making threat and risk mapping publicly available for lands that are owned by public entities (i.e. BC Hydro).	Moderate	3-5	N/A
Rec 5	Consult and coordinate with BC Hydro to create defensible spaces and reduce risk around all substations.	Moderate	3-5	N/A
Rec 6	The District should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them.	Moderate	3-5	$50,000-$100,00
Rec 7	Develop neighbourhood level FireSmart plans for the priority neighbourhoods. This should include neighbourhood level FireSmart committees with the District, Fire Department, BCWS, and First Nations representative. This should also include a variety of strategies with the objective of increasing private land resilience to wildfire. Participating communities should	High	3-5	$50,000

Number	Action Item	Priority	Timeline years	Estimated Cost
	apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).			
Rec 8	Use recommended interface fuel treatment areas to promote similar projects on private lands. Showcase these treatments though a "FireSmart Day" with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Moderate	3-5	$15,000-$30,000
Rec 9	Develop and distribute FireSmart brochures to all houses within higher risk interface areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Moderate	3-5	$10,000-$20,000
Rec 10	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Low	5+	$5,000-$10,000
Rec 11	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Private Land).	Low	5+	$10,000-$20,000
Rec 12	Include Wildfire as a Development Permit Area. The specific requirements and GIS area for this DPA should be developed with a Wildfire specialist. This should aim to include areas that are within 100m of moderate, high, or extreme Wildfire Threat/Risk as a starting point. The specific language should include FireSmart construction materials and landscaping, and the removal of hazardous fuels. Specific objectives should be established, as well as recommended strategies to meet those objectives. This DPA should also include professional review and sign off. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI #3 Development Considerations).	High	1-2	$20,000-$40,000
Rec 13	Ensure that Wildfire DPA applications are reviewed by District or Fire Department staff to ensure the objectives of the DPA are achieved. This will require coordination between District staff and Fire Department staff.	High	1-2	N/A
Rec 14	When public events are planned to occur in, through, or near natural areas, a wildfire risk management checklist is created for vetting applications against. Vetting should include review and comments by the parks and fire departments prior to event approval. Have the	Moderate	3-5	N/A

Number	Action Item	Priority	Timeline years	Estimated Cost
	public information brochure prepared in conjunction with this CWPP update available for distribution at these events.			
Rec 15	Establish a school education program to engage youth in wildfire prevention and preparedness. Collaborate with the Recycling and Environmental Action Planning Society (REAPS) to support delivering wildfire education in their school programs.	Low	5+	$10,000-$20,000
Rec 16	Update the Districts digital media, including video and web content, to reflect this CWPP update. A separate webpage for wildfire awareness should be created with reference material for FireSmart Canada, BC Wildfire Service, and any other suitable wildfire resources.	Moderate	3-5	$20,000-$40,000
Rec 17	Ensure all road edges are mowed frequently during the summer months when the fire hazard rating permits.	Moderate	3-5	N/A
Rec 18	Post wildfire danger signage along major transportation corridors, at campsites, parks and recreation, and at high use trail heads areas. Signages should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires and properly dispose of cigarettes.	Moderate	3-5	$10,000-$20,000
Rec 19	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.	High	1-2	$10,000-$20,000
Rec 20	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated.	Moderate	3-5	N/A
Rec 21	Conduct interagency wildfire suppression training and annual mock wildfire response exercises in cooperation with the BC Wildfire Service. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).	Moderate	3-5	$20,000-$40,000
Rec 22	Establish a mutual aid agreement between the District and the Regional District Fire Protection Areas to enable sharing of suppression resources when responding to a wildfire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).	Moderate	3-5	$10,000-$20,000
Rec 23	Purchase and maintain two Structural Protection Units (SPU) with capacity to protect approximately 35 structures and train staff on their proper deployment.	Moderate	3-5	$100,000-$200,000
Rec 24	Complete an analysis of water availability in the AOI to identify strategic locations for water tanks and dry stand pipes in high risk neighbourhoods with poor water availability. Identify and map alternative water sources including reservoirs, lakes and perennial rivers.	Low	5+	$10,000-$20,000

Number	Action Item	Priority	Timeline years	Estimated Cost
Rec 25	Require that all new fire hydrants systems for new development areas are able to serve adjacent high risk interface areas.	Moderate	3-5	N/A
Rec 26	Continue to encourage residents to sign up for eALERT system.	High	1-2	N/A
Rec 27	Compile a spatial inventory of backroad, trails and gates for suppression access. Work with recreation groups and industrial operators to maintain roads through natural areas for wildfire suppression access and ensure local fire departments and BCWS have copies of gate keys and maps of gate locations.	High	3-5	N/A
Rec 28	Obtain keys, gate locations, and maps for private forest roads inside the AOI that may be required for evacuation and access. Develop a safety plan with industrial operator for use of these roads.	High	3-5	N/A
Rec 29	Develop on-line/social media that is coordinated with FLNRORD for distributing up to date info on wildfire threat and potential evacuation alerts.	Low	3-5	$10,000-$20,000
Rec 30	Identify neighbourhoods that have only one main road in and out for evacuation. Consider developing alternative access for these areas through future land use planning.	Low	5+	N/A
Rec 31	Cross-train structural fire fighters, as well as District staff that are frequently working in the interface areas, in S-100 Basic Fire Suppression and Safety and S-215 Fire Operation in the Wildland/Urban Interface. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).	Moderate	3-5	$20,000-$40,000
Rec 32	Train District staff who would potentially work in a liaison role with fire suppression agencies in Incident Command Training to streamline integration with the Incident Command System as it is established. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).	Moderate	3-5	$20,000-$40,000

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Section 1 Introduction

1.1 Purpose

The Corporation of the District Municipality of North Cowichan (the District) has recognized wildfire mitigation as a critical component of emergency preparedness and community planning. As the owner and operator of a large Municipal Forest Reserve (MFR), there are unique challenges as well as opportunities for managing wildfire risk in this municipality. In recognition of changes to the urban landscape in the District, the changing climate regime, and the progression of municipal policy and best practices, the District has commissioned this update to the 2007 District of North Cowichan Community Wildfire Protection Plan (CWPP).

The purpose of this CWPP is to define the threat from wildfire to human life, property and critical infrastructure, and to provide a framework to proactively reduce this threat. This document identifies necessary measures and actions that will result in:

1. Reduced likelihood of a wildfire entering the community.
2. Reduced impacts and losses to property and critical infrastructure.
3. Reduced negative economic and social impacts to the community.
4. Future development that is resilient to wildfires.

Photo 1. Quamichan Lake.

Wildfire Trends

Wildfires are impacting our communities more than ever before. Over the past decade there has been an average of 1,692 fires per year in British Columbia, burning an average of 151,000 ha (BC Wildlife Service, 2019). Approximately half of these fires were a result of human caused ignitions. The total cost to the province over this decade has been almost 2.4 billion dollars (BC Wildfire Service , 2017). The 2018 fire season surpassed 2017 as the worst on record with more than 1.25 million hectares burned. The costs for 2018 are currently estimated at $615 million dollars. In addition, the 2017 fire suppression costs came to $568 million with 65,000 people displaced due to evacuation orders (BC Wildlife Service, 2019). Both 2017 and 2018 fire seasons led to a Provincial State of Emergency being declared. In 2016, the most expensive natural disaster in Canadian History occurred in Fort McMurray, Alberta (Statistics Canada, 2017); this wildfire burned 590,000 ha of forest at a fire suppression cost of over 100 million and destroyed 2400 buildings resulting in 3.77 billion dollars in insurance claims (Natural Resources Canada, 2017).

The trend towards an increasing area burned and fire suppression costs has been recorded not only in BC but across North America (Marlon, et al., 2012). The trend is in large part attributed to climate change driving hot, dry summers and earlier springs that cause vegetation to start growing earlier, dry out earlier and for a longer period of time (Hope, McKenney, Pedlar, Stocks, & Gauthier, 2016). Since 1985, it is estimated that 50% of the increase in the area burned by wildfire in the western United States is due to human caused climate change (Abatzoglou JT, 2016). Research in British Columbia has estimated that the record-setting 2017 fire season was made 2-4 times more likely by climate change (Kirchmeier-Young, Gillett, Zwiers, Cannon, & Anslow, 2019). Worldwide, the length of the fire season increased by 19% from 1979 to 2013, with significantly longer seasons in the western United States (Jolly, et al., 2015).

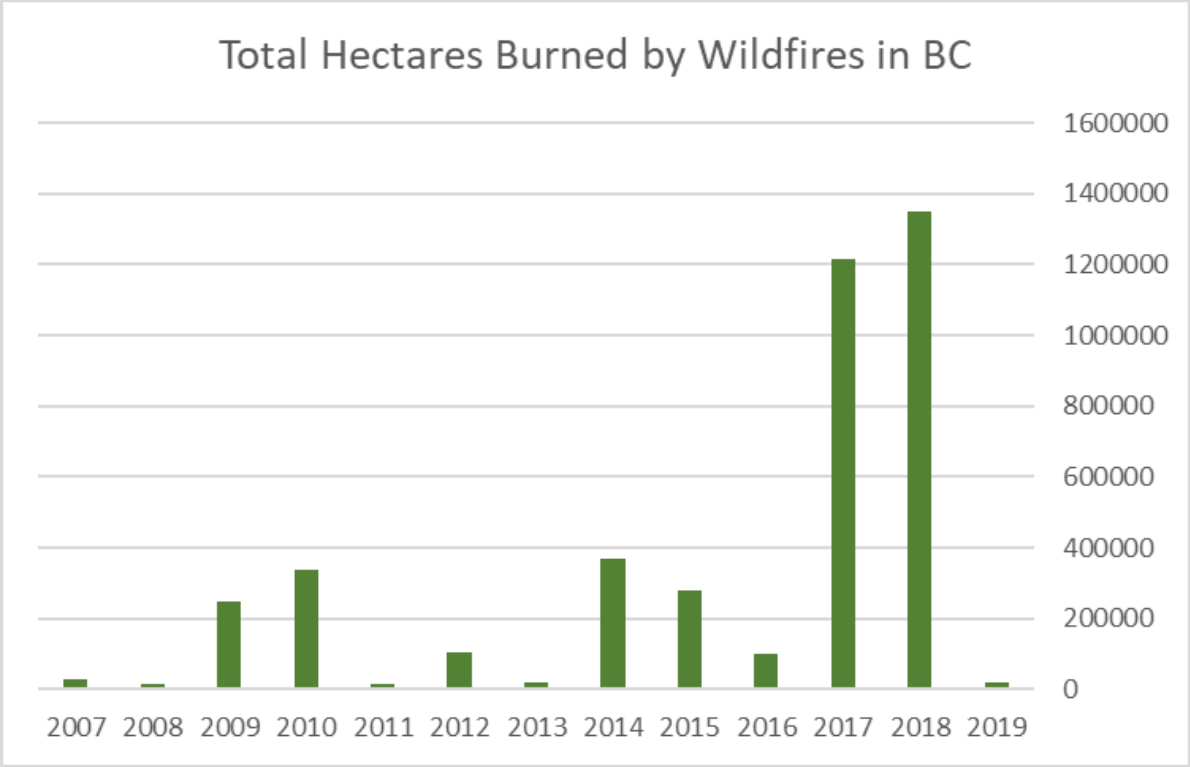


Figure 1 –Total area (ha) burned by wildfires in BC by year since 2007 (BC Wildlife Service, 2018)**.**

In addition to the changing climate, forest fuels in BC have built up over time due to a history of supressing wildfires and tree mortality from forest health factors such as the mountain pine beetle in the interior. Development and land use activities have increased the area of wildland urban interface and both the potential for human caused ignitions, and the values to protect. Climate change, fuel build up in our forests, and expanding wildland urban interface have created conditions that make fire suppression both challenging and expensive in BC.

On the coast of BC the climate is not as extreme and wildfires have typically been characterised by smaller wildfire events. However, the risk of largescale wildfires to coastal communities is predicated to increase with longer and more extreme wildfire seasons. Given the optimal growing conditions in the coastal ecosystems, fuel loading is much higher than in other ecosystems of BC. This means that when wildfire threat does become elevated, there is potential for extreme fire behavior based on the heavy fuel loading. Climate change models are predicting that the mean annual temperature will increase by 2.0°C in the 2050s with more very hot days (>30°C) and lower precipitation in the summer months (Pacific Climate Impacts Consortium, 2013). The warmer temperatures, earlier spring thaw, and possibly reduced summer rainfall may increase wildfire risk. While we cannot immediately influence climate, feasible strategies to protect our communities from wildfire need to focus on the factors that we can change now. This includes managing vegetation fuels in the wildland urban interface, building more resilient communities, improving suppression response and capability, reducing human-caused ignitions and increasing public awareness of wildfire risk through education.

1.2 CWPP Planning Process

CWPP Guiding Principles

The following guiding principles have been developed to help guide and support decision making and prioritize actions to manage wildfire risk in the District.

Guiding Principles	
Public Health and Safety	Public safety is the foremost priority for all wildfire management activities.
Protection of infrastructure	Community infrastructure, including private property, public structures and facilities, is protected from wildfire.
Sustainable Planning	Growth and development improve quality of life, maintain a healthy environment, and ensure a prosperous future.
Environmental Protection and Enhancement	Ecosystems that support biodiversity and environmentally sensitive features are protected and enhanced.
Interagency Co-operation and Policy	Wildfire management planning, preparedness, prevention, suppression, ecosystem rehabilitation, and education occurs in co-operation with all relevant agencies and neighbouring local governments.
Public Awareness, Education and Advocacy	Public understanding, support and awareness of wildfire risk management is increased through effective education, advocacy and communication.
Adaptive Management	The effectiveness of wildfire management initiatives is monitored and continuously improved by reviewing actions and decision-making processes.
Financial Responsibility	Wildfire management initiatives are prioritized and implemented adequately within reasonable, sustainable budgets and through innovative partnerships.

CWPP Implementation History and Planning Process

The District completed a Community Wildfire Protection Plan in 2007. This report identified large portions of the District's land base as "high" or "extreme" risk of wildfire. This report also made 18 recommendations that proposed strategies for reducing wildfire risk, from community involvement to firefighting equipment.

To reflect recent changes in fuel conditions, development and wildfire risk best practices, District staff applied for and received funding from the Community Resiliency Investment (CRI) Program to update the existing CWPP. Upon receipt of this grant, District staff retained an external consultant to update the CWPP to 2019 CRI standards.

The Province of BC provided spatial data from the Provincial Strategic Threat Analysis (PSTA) which includes fuel typing, risk analysis and values at risk. This analysis predicts the fire behaviour potential of the natural areas within the Area of Interest (AOI) and maps the potential wildfire threats to values across the landscape. The input sources for this provincial data were too coarse in the AOI to provide a suitable level of confidence in fire behavior potential. Recently complete vegetation resources inventory data (VRI) was analysed to determine accurate fuel typing. Fire behavior modeling was then completed using fire weather data from local weather stations.

The fire behavior modeling was used as the base from which to prioritize interface areas for further assessment. Critical values were refined through consultation with stakeholders. Ground truthing of fuel types and wildfire threat assessments was completed to update fuel typing, risk analysis, and values at risk. The result was a refined spatial product defining values at risk, wildfire behaviour potential, and overall wildfire risk to the community. This analysis was used to develop and prioritize the wildfire mitigation actions recommended in this CWPP. Recommendations are embedded throughout the following sections. These have been prioritised to help management focus on actions that will have the greatest benefit and reduce liability in the most efficient way.

A Living Document

Recommendations in this CWPP are designed to be implemented over both short and long timeframes while also acknowledging that wildfire risk will continue to change due to development, climate change and ecosystem processes. This plan is intended to be a living document that will be updated every five years.

Number	Action Item
Rec 1	Continuously review the CWPP as a living document and complete an update every 5 years.

CWPP Consultation Process

This CWPP update was developed in consultation with First Nations and local stakeholders, both public and private. These stakeholders include the District of North Cowichan, the Regional District of Cowichan, representatives from key industry groups, forest tenure holders. Stakeholders were engaged at the start of this project with referral letters and were asked to provide feedback. The level of involvement varied depending on the level of interest and availability to provide resources and input.

Information sharing occurred with local First Nations and was guided by the Consultative Areas Database and the District. Information sharing involved a letter describing proposed activities with enclosed maps.

The CWPP will be presented at a public council meeting and includes recommendations for ongoing engagement at community events. Public engagement recommendations have been made in this report with a focus on promoting risk mitigation on private land. Given that the District is limited in what it can do to treat fuels on private lands, community engagement is a priority for implementation of the CWPP.

Section 2 Local Area Description

2.1 CWPP Area of Interest

The AOI for this CWPP is the jurisdictional boundaries of the District of North Cowichan. The District is located in the southeast of Vancouver Island, between the cities of Nanaimo and Victoria. The District is part of the Cowichan Valley Regional District (CVRD), and encompasses the communities of Crofton, Chemainus, and Maple Bay, as well as suburban development adjacent to the City of Duncan. The District has an area of approximately 200 square kilometres, and a population of approximately 30 000 (as of 2016 census).

The District of North Cowichan is located within the traditional territory of Cowichan Tribes, Halalt First Nation, Lyackson First Nation, the Stz'uminus First Nation, and the Penelakut Tribe.). This territory encompasses approximately 500,000 hectares of land and sea in the vicinity of the Cowichan and Chemainus Rivers, Strait of Georgia, and Fraser River delta. There are four Indian Reserves (IR) within the District of North Cowichan. These total approximately 176 hectares and are located near the mouth of the Chemainus River and Bonsall Creek. Most of the District's southern border is shared with the Cowichan Indian Reserve IR #1. It also shares a small sea border with Halalt Island Indian Reserve IR # 1.

Photo 2. Looking towards Mount Tzouhalem and Saltspring Island from Maple Mountain.

Within the AOI there is a mix of land ownership. A total of 53% of the AOI is privately owned and 38% is Crown Land (Table 2, Figures 2 and 3). The Municipal Forest Reserve is classified as Crown Land in the provincial ownership database, and constitutes a majority of the Crown Land inside the AOI.

Table 2 Broad land ownership within the AOI

Jurisdiction	Area within the AOI (ha)	% of area within the AOI
Private land	11,963	60%
Provincial Crown Land	7,933	40%

***Note: All tables included in the report and accompanying maps have used UTM area calculations for the highest degree of accuracy. The geospatial data supplementing this report also include area calculations, however these are based on BC Albers. The minor differences between data contained in the tables in this report and the geospatial data is due to these different map projections.**

Table 3 Land ownership with Crown land breakdowns within the AOI. Note that the provincial forest ownership layer classified the MFR as Crown – Local/Regional Park.

Jurisdiction	Area within the AOI (ha)	% of area within the AOI
Crown - Community Watershed	112.3	0.6%
Crown - Conservancy Area, Ecological Reserve, Protected Area, Provincial Park	33.0	0.2%
Crown - Forest Management Unit	1296.8	6.5%
Crown - Local/Regional Park	5573.8	27.7%
Crown - Misc. Reserves	0.6	0.0%
Crown - Municipal Parcels	491.0	2.4%
Crown - UREP (Use, Recreation and Enjoyment of the Public Reserve)	0.2	0.0%
Crown - Watershed Reserve	45.5	0.2%
Crown - Wildlife Management Area	11.0	0.1%
Crown Lease - Misc. lease	4.7	0.0%
Crown Tenure - Woodlot Licence, Schedule B	364.3	1.8%
Federal - Dominion government Block/Federal Parcels	0.3	0.0%
Federal - Indian Reserve	1.4	0.0%
Private	11963.6	59.5%
Unknown Ownership/Exceptions	201.9	1.0%

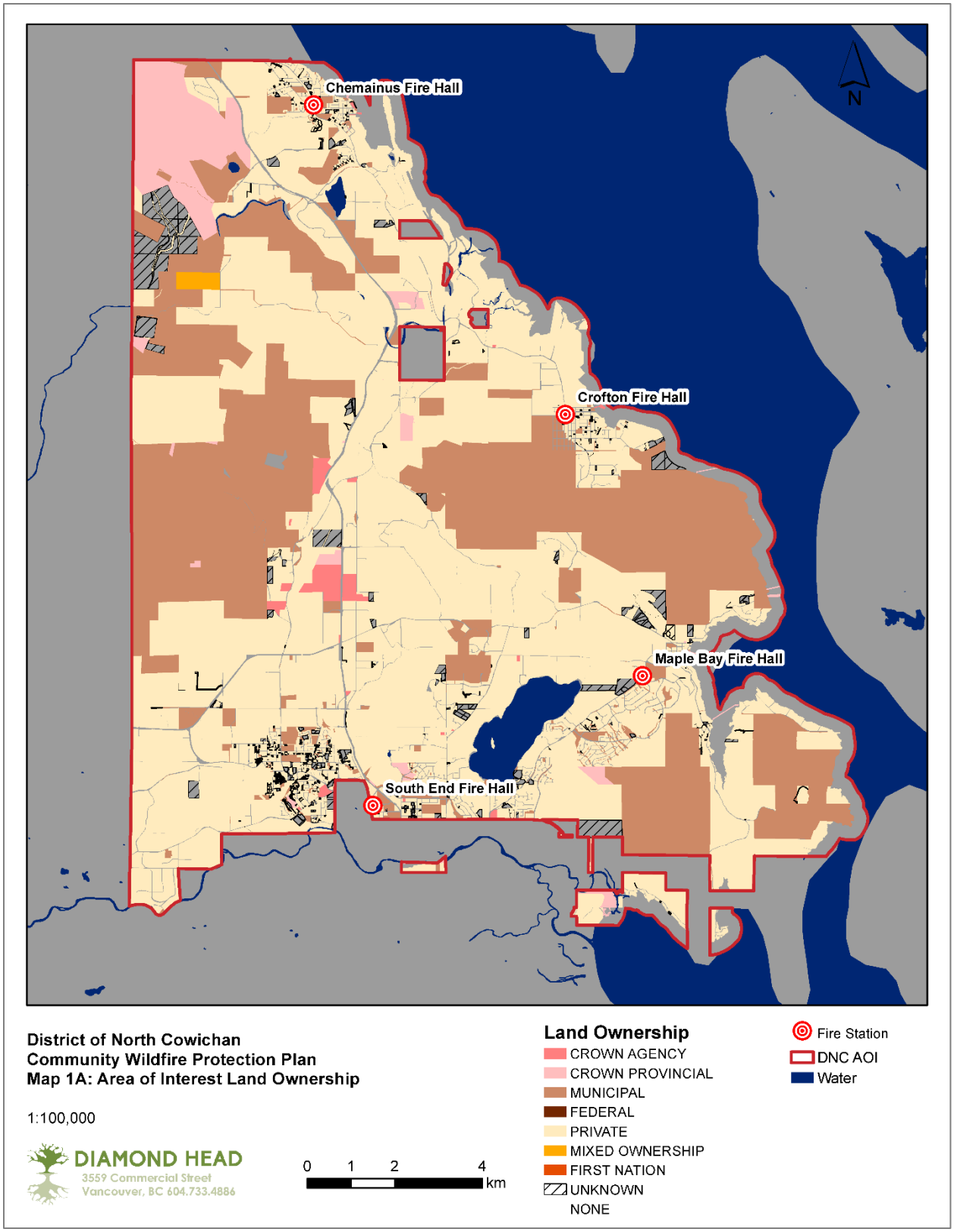


Figure 2 – Land Ownership with the AOI

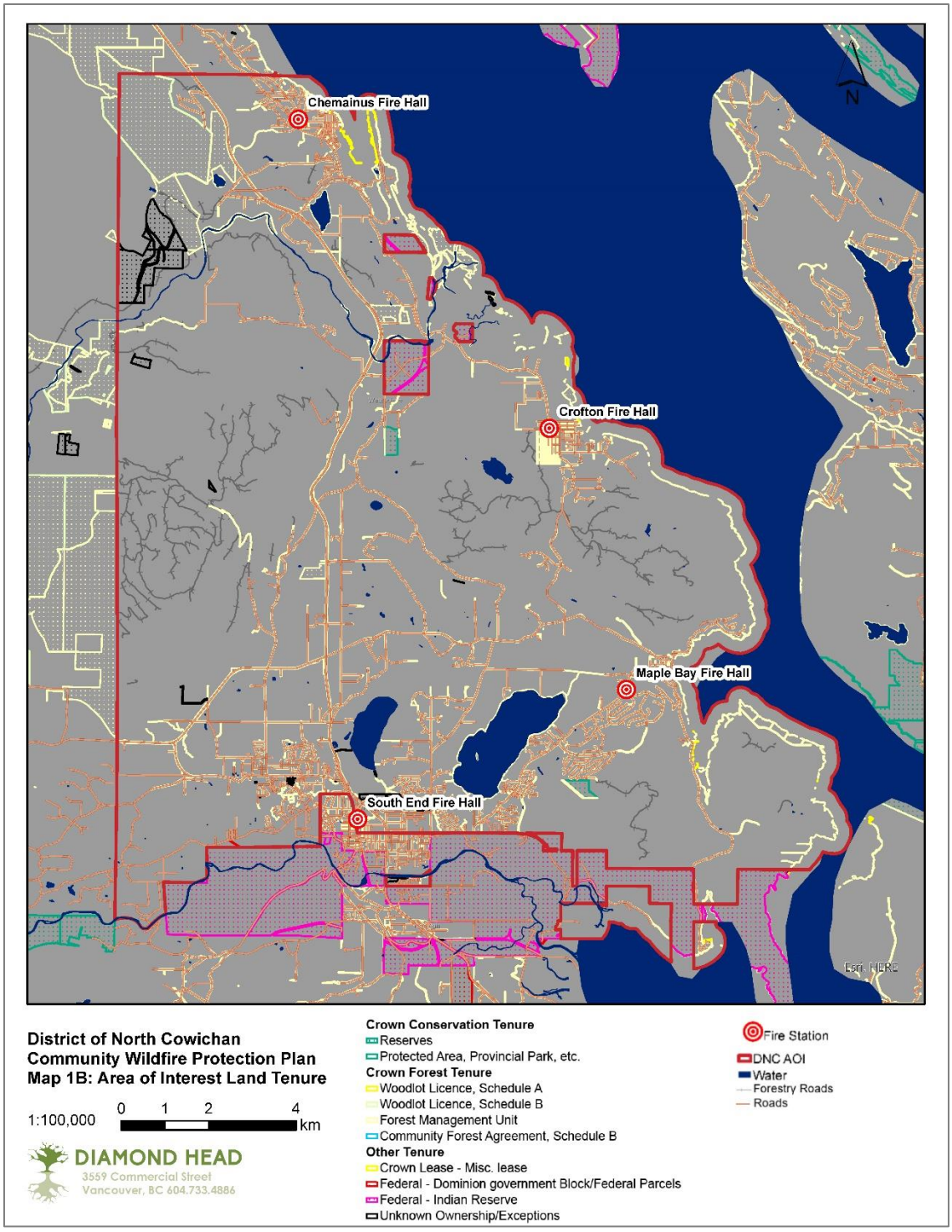


Figure 3 – Land tenures in the AOI.Note that there is a discrepancy in the Tenure Layers for roads (Crown Lease – Misc. Lease in the map legend). This layer depicts road right-of-ways rather than actual roads, and many of the roads shown are decommissioned and non-functional. The "Roads" and "Forestry Roads" layers are much more accurate and depict actual functional and maintained roads.

2.2 Community Description

While the forest industry has historically been central to the economy of the District and remains an economic driver, the community has diversified into tourism, food products, and technology. There are two large mills located in Crofton and Chemainus, and the District-owned MFR totals 5,000 hectares, or 25% of the District's total land area. Government services are also major part of the local economy, with the two largest employers being the Island Health Authority and provincial School District #79 (District of North Cowichan, 2018).

Table 4 Employees by key sectors in North Cowichan (Statistics Canada, 2017)

Sector	Employees
Agriculture, forestry, fishing, and hunting	670
Construction	1,205
Education	895
Healthcare and Social Assistance	1,970
Manufacturing (including milling)	1,240
Mining	135
Professional, Scientific and Technical Services	685
Public Administration	690
Retail, Tourism and Hospitality	3,070
Transportation and Warehousing	485

2.3 Past Wildfires, Evacuations, and Impacts

There have been 241 wildfires in the AOI since 1950, burning a total area of approximately 580 ha. (Figure 4 and Table 5). Note that one large fire (518 ha) in 1952 disproportionately increases the yearly average area burned. To better represent the typical size of wildfires, we have provided a modified average that is calculated by omitting this large fire. In the past 10 years there have been 64 fires that have burned approximately 10 hectares.

Table 5 Summary of wildfires in the AOI since 1950.

AOI Fires Summary	# of Fires	Area Burned (ha)
Total 1950 – 2018	241	580
Average #/year (including the 1952 fire)	3.5	8.5
Modified Average #/year (not including the 1952 fire)	3.5	0.9
Total 2009 – 2018	46	10
2009-2018 Average #/year	4.6	1.0

Over the past 10 years, the average # of fires in the AOI (4.6 per year) is 30% above the 68 year (1950-2018) average (3.5 per year). The 10-year average area burned (1 ha per year) is 11% above the 68 year (1950-2018) modified average, which omits the large 1952 fire. These statistics indicate that wildfire activity is increasing in the past decade.

The extremely dry and warm summer of 2018 saw one notable wildfire in the District, occurring on Maple Mountain. This fire displayed rapid rates of spread after ignition and burned within 500m of private residences, which were temporarily evacuated as a precaution. The BC Wildfire Service had all resources committed to active fires, and the local fire departments quickly actioned to limit and control spreads until Wildfire staff were made available. This wildfire demonstrates the potentially high fire behavior potential during summer drought periods, and the logistical and resource challenges that can be expected. These challenges are discussed further in Section 4.1

Photo 3. The 2018 Maple Mountain wildfire, post wildfire.

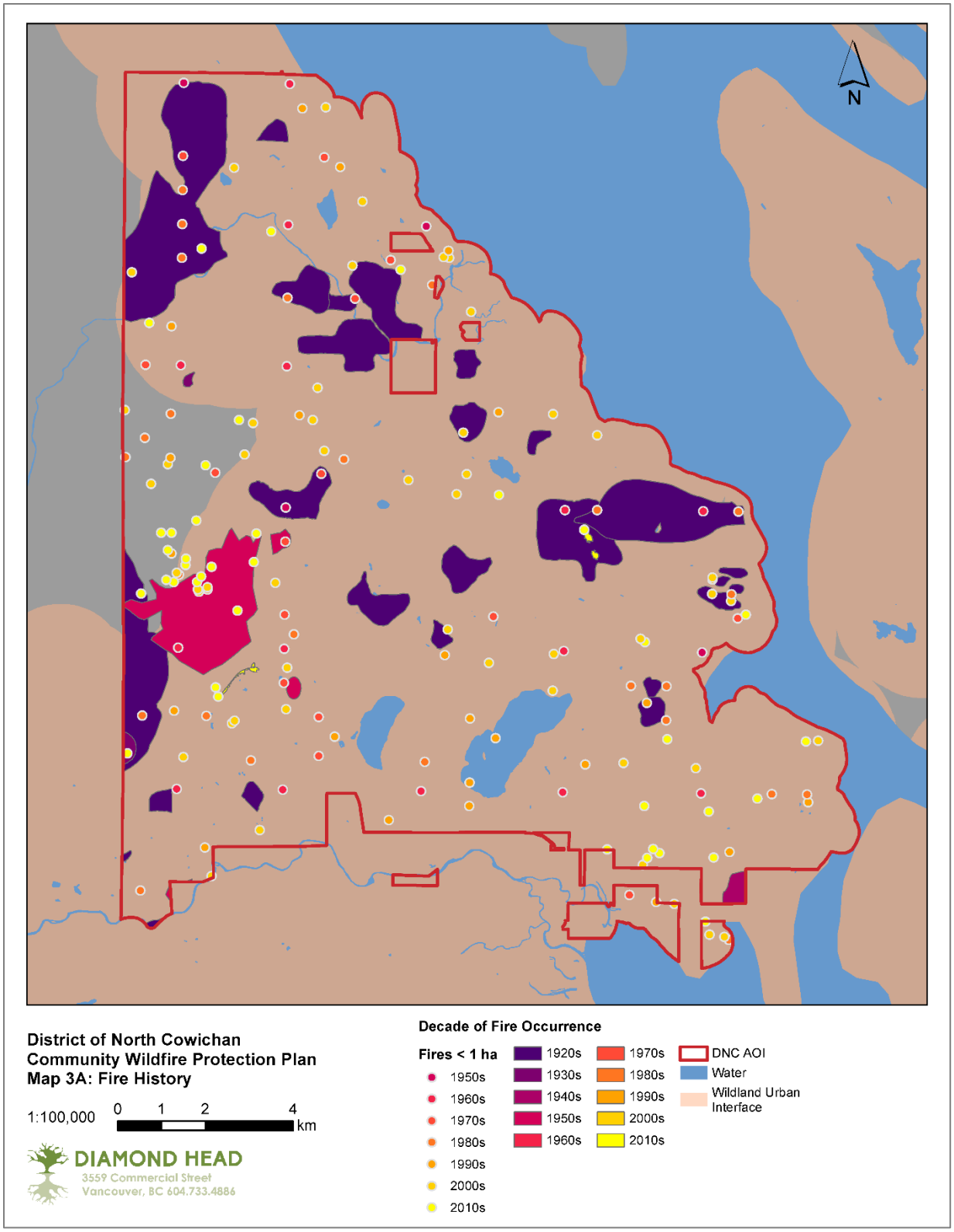


Figure 4 – Location of previous wildfire events in the AOI. Polygons represent larger wildfires and points represent smaller fires. Color codes represent fires within different decades.

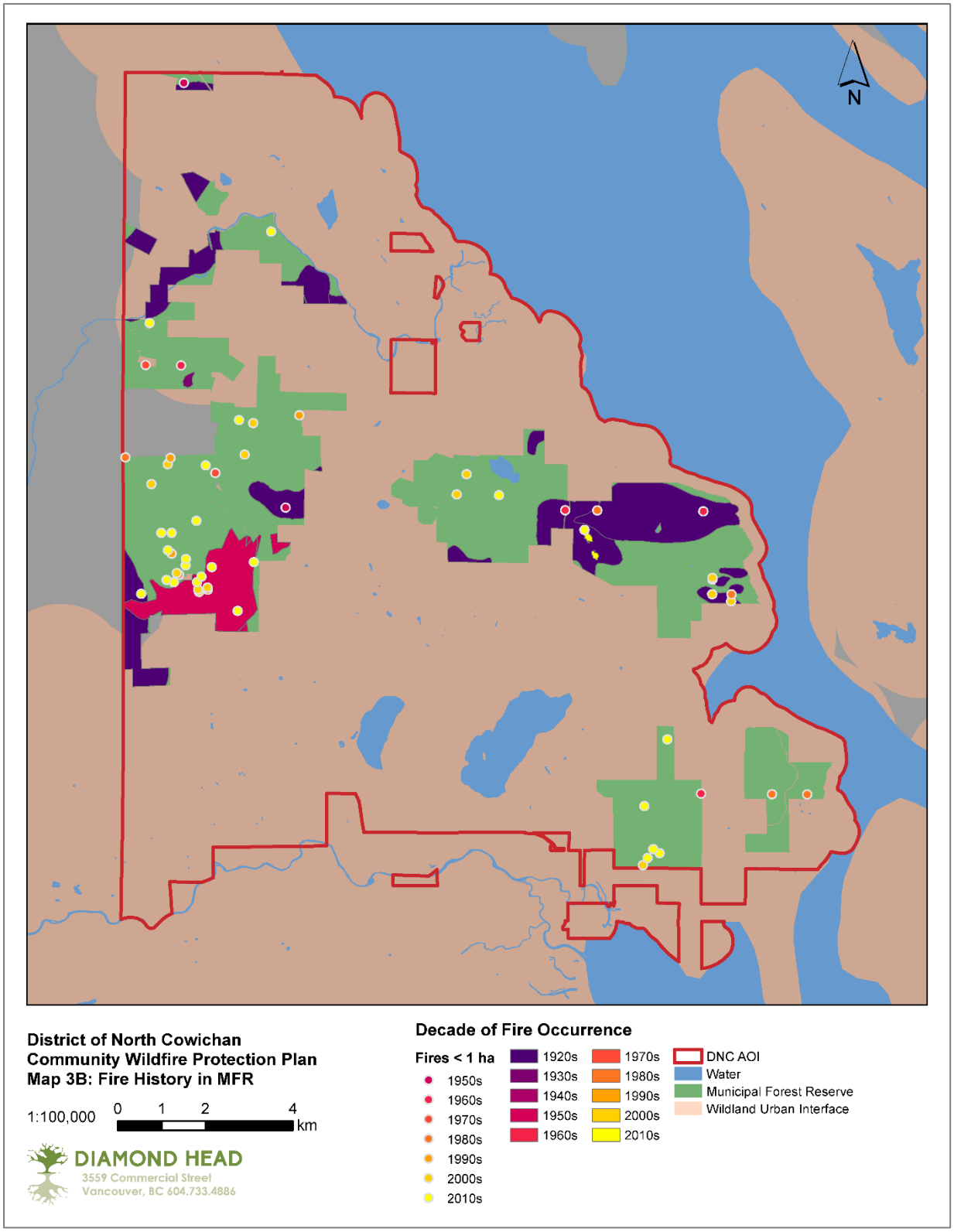


Figure 5 – Location of previous wildfire events in the AOI in relation to the Municipal Forest Reserve.

2.4 Current Community Engagement

The District engaged with residents of North Cowichan during the creation of its original Community Wildfire Protection Plan in 2007. Several recommendations in the 2007 CWPP were directed at affecting wildfire risk in the District through education and outreach, including creating a public education program, conducting neighbourhood information sessions in areas of the interface with relatively high fire risk, and sharing information with First Nations.

As a result of the original CWPP, three areas inside the District were treated for wildfire fuel mitigation work, with a total area treated of approximately 4 hectares. These areas were in a linear strip on Mount Tzouhalem, and formed a small fuel break between an adjacent communities and the larger forest. These treatments occurred in 2007. One other treatment has also occurred in the District land, a 2011 trailside treatment along the Cowichan Valley Trail in the community of Duncan. This was administered by the Cowichan Valley Regional District, as it occurred on property under their jurisdiction.

Recently, the District extended public engagement regarding operations in the Municipal Forest Reserve, which resulted in a temporary restriction on harvesting for 2019. At the same time, the municipality has decided to create additional positions on the Forest Advisory Committee, which review and provides recommendations on Municipal Forest Reserve operations. This ensures that community perspectives on forest management are considered.

The Cowichan Valley Regional District promotes and hosts FireSmart information on its website and offers FireSmart workshops for individuals and groups. As a result, the general public is aware and supportive of wildfire risk mitigation. The CVRD work provides a good model for the District to use in continuing its own educational and outreach programs for the general public. Recontextualizing the CVRD programs for the District presents an opportunity to use broader regional approaches in a more local setting.

2.5 Linkages to Other Plans and Polices

There are a number of plans and policies that relate in one way or another to wildfire planning. The most relevant are summarized below.

2.5.1 Local Authority Emergency Plan

The District of North Cowichan does not currently have its own emergency plan, however it is included in the CVRD Local Authority Emergency Plan. This outlines contingency plans for large incidents which may include evacuation and the activation of an Emergency Operations Centre (EOC). This can be used to coordinate emergency response at a regional scale, with provisions for smaller scale incidents and management. The District has internal emergency planning procedures which have been developed to tie in with the CVRD Local Emergency Plan. Wildland fire scenarios specific to the District of North Cowichan are not described, however broad wildland fire scenarios, effects, and equipment and personnel deployment are discussed. The District operates an eAlert system to alert residents and

businesses of critical incidents. This automatic alert service is voluntary, and sends alerts via text, phone, or email.

2.5.2 Affiliated CWPPs

This report is an update to a pre-existing CWPP from 2007 for North Cowichan. A parallel community wildfire protection planning process is currently ongoing for other communities in the Cowichan Valley Regional District, led by the Regional District. Drafts have been provided for review and to aid in the development of this CWPP Update. These included recommendations for treatment areas which are in the jurisdictional boundaries of the District of North Cowichan. These treatment areas were visited in the field for a follow up assessment, and have been included in this report.

2.5.3 Local Government and First Nation Plans and Policies

None of the four Indian Reserves within the boundaries of the District, or the adjacent Cowichan IR # 1 and Halalt Island IR # 1, have developed wildfire protection plans. No emergency response plans have been developed for the Indian Reserves contained within the District. In April 2018, Cowichan Tribes staged an emergency response drill for a fictional interface wildfire.

Official Community Plan

The Official Community Plan for North Cowichan was adopted in 2011 and provides a framework for land use in the District. Council initiated an updating process for the plan in 2019 and anticipates rewriting the plan to form the basis for local area plans throughout the community. The OCP provides direction on development in the wildland-urban interface as well as municipal forest management. It adopts areas of high and extreme wildfire-risk (identified in the 2007 CWPP) as areas of natural hazard subject to additional development approval requirements under Development Permit Area 4. These requirements include provisions for egress, installation of fuel-free landscaping and the use of fire-retardant exterior building materials. Key language from the relevant sections follows:

Section 2.1.2 “Forestry”

> *“Maintaining thriving, healthy forests – whether used for timber or non-timber harvesting, recreation or wildlife habitat – is essential if the Municipality is to achieve its goals of preserving the rural setting while providing for economic activity. […] Policies for forest management must account for these values and also deal with practical issues such as fire prevention.”*

Policy 2.1.2.7(b) “The Municipality will encourage responsible recreational uses of municipal forest lands”

> *“The Municipality will control recreational and other access in the Municipal Forests […] during high fire risk periods”.*

Policy 2.2.3.1 “The Municipality will discourage development in areas with natural hazards.”

> *"Floodplains, interface fire areas, coastlines and steep slopes over 20% are deemed to be hazardous for development, and are designated as Development Permit Areas under the* Local Government Act *(Section 919.1(1)). All hazard lands are subject to the Development Permit Area Guidelines (DPA-4).*

Policy 2.2.3.4 "The Municipality will reduce risks to life and property in fire-prone areas."

> *"Subdivision development proposals will be reviewed in accordance with the* Fire Protection Guidelines for Subdivision Development in the Wildland Urban Interface at the Municipality of North Cowichan*. For new subdivisions, it will be important that road grades meet DNC standards for public roads, even when the proposed road will be private. Single access development will be discouraged. For new lots, buffers that create fuel-free zones around structures for fire protection are required. Fire resistant building construction (e.g., use of fire retardant materials and sprinkling systems) is also required."*

Development Permit Area 4 – Hazard Lands (DPA-4)

> *"To protect development on area with natural hazards, a development permit is required before land or vegetation in the designated areas is altered. […] Based on criteria adopted from the provincial risk assessment methodology, the properties shown on Map 8 have been identified as being at high or extreme risk for interface wildfires."*

Additionally, the OCP commits the municipality to conduct municipal operations, including from forestry, in such a way as to reduce or eliminate discharges to the atmosphere. Forest management, including wildfire fuel management, is therefore subject to the requirements and directions included within the OCP.

Sensitive Ecosystems

The OCP adapted sensitive ecosystem inventory mapping maintained by the Province within its Development Permit Areas. Many sensitive ecosystems are found within the District, including some of the most significant remaining Garry oak woodlands (considered plant communities at risk) in Canada. The current municipal forestry operations are careful to consider these mapped unique ecosystems, including those that are rare or endangered. This may be subject to change in the updated MFR Forest Management Plan to allow for forest operations in unique ecosystems for the purpose of enhancement. Additionally, the District commits in its OCP to preserve sensitive ecosystems in a natural condition, keeping them free of development and human activity to the maximum extent possible.

Photo 4. Garry Oaks in the Garry Oak Preserve.

Fire Protection Bylaw No. 3340

The District of North Cowichan Fire Protection Bylaw No. 3340 regulates the use of open burning, recreational fires, and wood burning appliances. Open burning is permitted between March 15 through April 15 and September 15 through November 30, only when the ventilation index is rated as 'good' by Environment Canada and only outside the Urban Containment Boundary. Open burning may take place inside the Urban Containment Boundary only on properties of at least two acres in size or if a permit has been obtained from a bylaw officer. The Open Burning Bylaw does not generally apply to burning associated with forestry activities under the *Forest and Range Practices Act* or *Private Managed Forest Land Act*, and does not apply to forest practices carried out in the Municipal Forest Reserve or on other Municipal land used for forestry purposes.

Climate Action & Energy Plan

Climate change policy is embedded in the OCP and outlined in a number of District reports and plans. The Municipality produced the Climate Action & Energy Plan in 2013, following direction set in the OCP to meet obligations under the 2007 *BC Climate Action Charter*, monitor and report on community greenhouse gas emissions, and promote sustainable development. Land use planning supporting

community densification and expanding the area of North Cowichan under tree cover are major recommendations of the Climate Action & Energy Plan. The plan incorporated future climate projections produced by the Pacific Climate Impacts Consortium at the University of Victoria (PCIC), anticipating the following changes from the 1961-1990 baseline by 2050:

- an increase in average annual temperature of 1.6 °C;
- a decrease in summer precipitation of 19%;
- an increase in winter precipitation of 5%;
- an additional 15 frost-free days per year.

The plan anticipates that periods of extremely dry conditions will become more common, resulting in more frequent and severe forest fires.

2.5.4 Higher Level Plans and Relevant Legislation

Vancouver Island Summary Land Use Plan (2000)

The plan provides high-level direction to crown land management on Vancouver Island. None of the special management zones or orders continued under the plan's legal authority apply to areas within the limits of the District of North Cowichan.

2.5.5 Ministry or Industry Plans

There are no additional relevant ministry or industry plans for the AOI.

Section 3 Values at Risk

Wildfires can cause impacts to a community in a number of ways. They can cause direct impacts to structures, facilities and infrastructure. They can disrupt economic activity through evacuations of residents, who must often take leave from their employment. The movement of goods and services, and transmission lines, are critical to the economies of the surrounding communities. Less direct impacts can include smoke from nearby wildfires, which can reduce tourism activity and impact agriculture production. These many direct and indirect impacts are difficult to quantify but have the potential to cause significant cumulate impacts on the local economy. This section of the report provides an overview of the types of values that are at risk from wildfire within this AOI.

3.1 Human Life and Safety

Protection of human life is the top priority in the event of wildfire in the urban interface. Structure locations have been used to provide a measure of the density of population. All areas with an average density of more than 6 structures per kilometre was defined as the Wildland Urban Interface (WUI) in this report (Figure 6).

Table 6 provides a summary of the total area within the AOI by structure density class. The District has a very evenly dispersed population with concentrations of higher density in the communities of Chemainus, Crofton, and Duncan. There are widely dispersed areas of moderate density throughout the District. These types of developments present the most difficulty for suppression response and evacuation access as they tend to be spread out with trees embedded closely in and around the structures. The only areas without development are the Municipal Forest Reserve throughout the District, and small portions of forested land in the northwest of the District

Table 6 Summary of density

Density Structures/ km^2	Area (ha)	% of total area
1-6	3473.6	16.3%
6-24	4285.9	20.2%
25-100	6080.8	28.6%
100-250	1989.1	9.4%
250+	1595.9	7.5%
No buildings	3845.1	18.1%

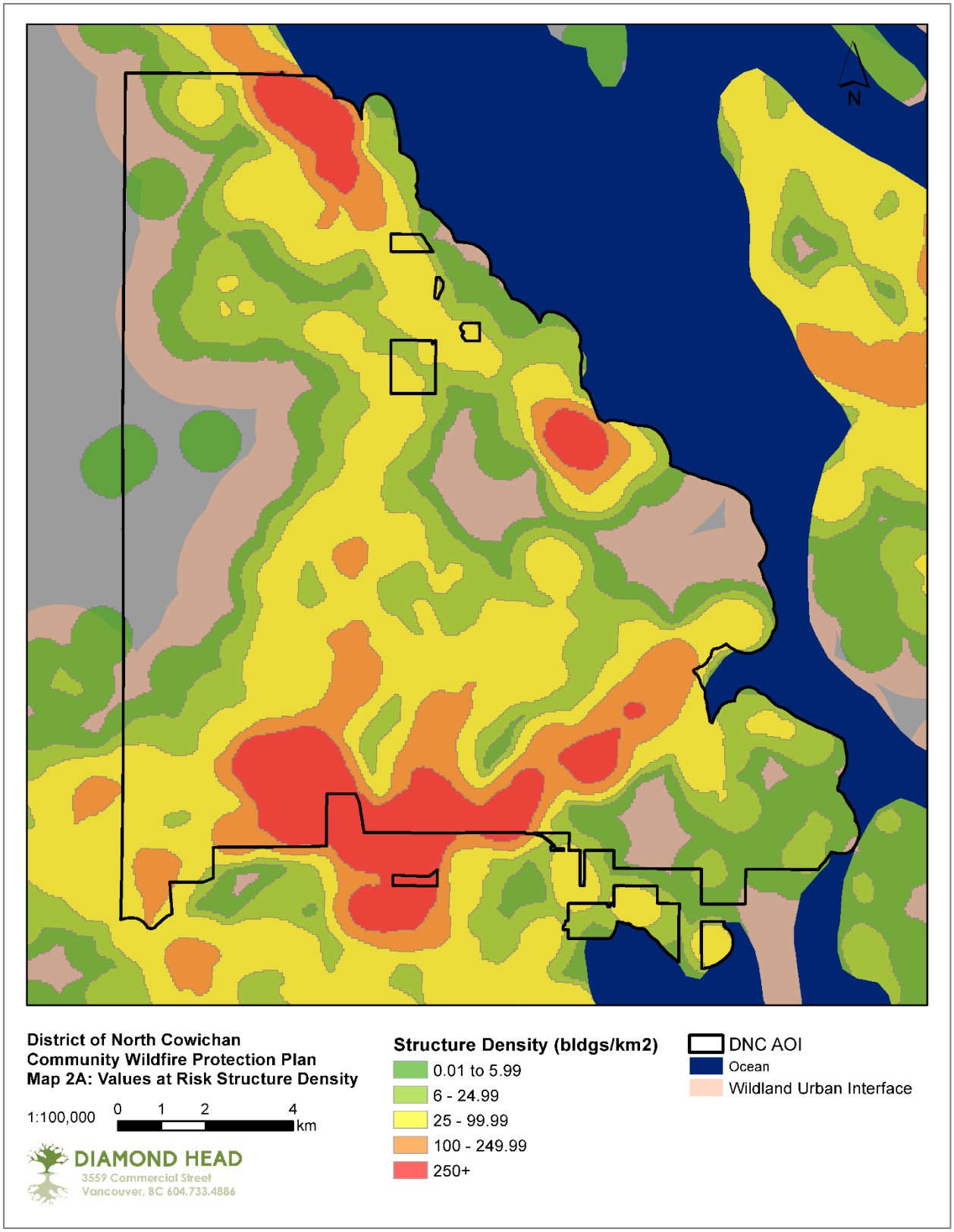


Figure 6 – Density of structures

3.2 Critical Infrastructure

The features and utilities that are considered critical infrastructure were identified through consultation with stakeholders. These are features that, if disrupted or destroyed, would cause serious impacts on the functioning of the government and important facilities that the public relies on. These include BC Hydro transmission lines and substations, railways, municipal water supply, waste treatment, hospitals, schools, airports, municipal buildings, police and fire stations (Figure 7).

3.2.1 Electrical Power

BC Hydro services North Cowichan through an electrical grid of above ground transmission lines, with 600 kms of transmission and distribution lines in the AOI. Many transmission lines that service adjacent communities run through the AOI. One of the main transmission lines that connects Vancouver Island to the mainland runs through the centre of the District. As such, the District forms a critical hub for the power supply on Vancouver Island. BC Hydro has policies and mitigation activities in place for vegetation management and wildfire preparedness and mitigation. These include fuel management in the interface area surrounding their infrastructure, requirements for wildfire assessments prior to work in the interface, and risk evaluations during periods of high or elevated wildfire danger. These lines and their substations are also a source of ignition, particularly if trees fall on the lines. BC Hydro is responsible for managing the risk from trees falling onto their power lines.

3.2.2 Communications, Pipelines, and Publicly Owned Buildings

There are many community facilities that could be identified for protection in the case of a wildfire. The definition of what is considered critical infrastructure are those facilities that are important to protect to ensure the District can continue functioning in the case of a catastrophic wildfire event. For the purposes of this CWPP the following municipal and public buildings were identified by District staff as critical infrastructure:

- North Cowichan Municipal Hall
- The Cowichan District Hospital
- Elementary Schools: Chemainus, Crofton, Maple Bay, Alexander, Drinkwater and Ecole Mount Prevost
- Secondary Schools: Chemainus, Queen of Angel's, Duncan Christian, Quamichan and Queen Margaret's
- Post Secondary: Vancouver Island University, Cowichan Campus
- North Cowichan Fire Department: 4 Halls
- RCMP: Duncan and Chemainus detachments
- South Island Highway Patrol
- Water infrastructure
- Key communications infrastructure

Photo 5. District of North Cowichan Fire Department Station in Maple Bay

3.2.3 Transportation

The District is well served by multiple highways. Highway 1 runs north to south, with good capacity to support evacuation. Highway 18 runs west of the District towards Lake Cowichan. There is a network of privately owned forest roads that are reserved for use by private forest operators in the area. These roads are regulated with locked gates restricting access. These roads can be used for wildfire suppression access, however this requires coordination to ensure roads are accessible. Rail lines run north to south through the District connecting Courtney to Victoria.

3.2.4 Water and Sewage

The District of North Cowichan water system is serviced by a network of watermains, wells, reservoirs, and pump stations. There are 20 pump stations and 16 reservoirs, many of which are located in interface areas between communities and natural forest areas. The Cowichan Valley area typically experiences summer droughts and is subject to water restrictions to conserve water.

Industry

The major industrial facilities inside the District boundaries include three mills, located in Chemainus,Crofton and Cowichan Bay. These mills are located on the waterfront, without significant interface with adjacent forest areas. In the event of a wildfire and required evacuation, shutting down these mills would be a labor and time-intensive process.

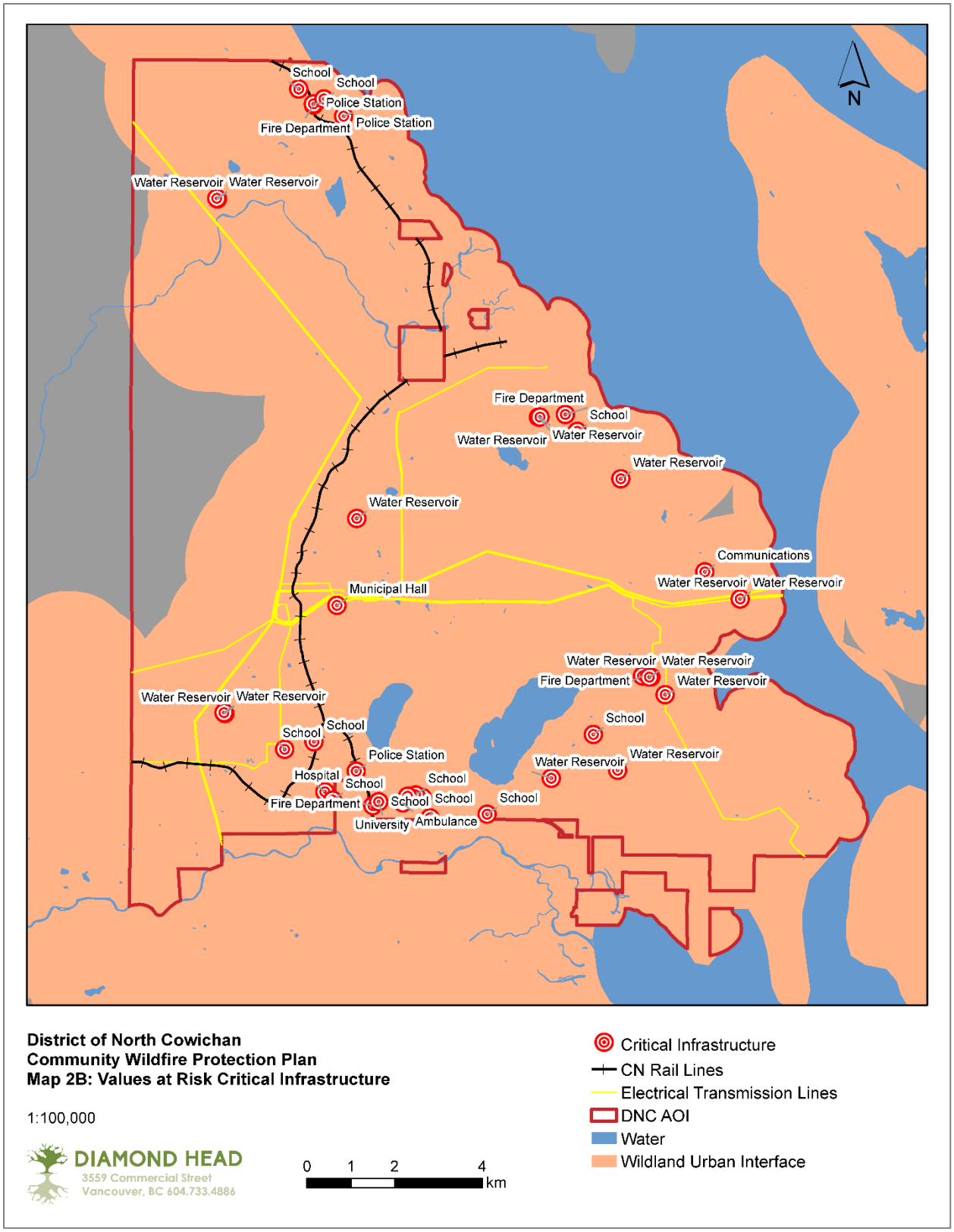


Figure 7 – Critical infrastructure Map

3.3 High Environmental and Cultural Values

3.3.1 Drinking Water Supply Area and Community Watersheds

Portions of the Banon Community Watershed overlap with areas in the northwest corner of the District of North Cowichan. Approximately 200 hectares of the watershed is inside the District municipal boundary, with a majority of the area outside the District in the CVRD boundaries. This watershed supplies drinking water for the towns of Chemainus and Ladysmith (British Columbia Ministry of Environment, 2014). Wildfires can cause shifts in landscape processes that can decrease water quality by increasing sedimentation and nutrients downstream, and increasing erosion adjacent to watersheds (Emelko & Sham, 2018). This can be particularly damaging in periods of summer drought when water supply is the lowest. These periods of summer drought are experienced when large, intense wildfires are most likely to occur.

3.3.2 Cultural Values

The Archaeology Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development maintains a spatial database of archeological and historical sites. These include locations where there is evidence of past human activity. Within the AOI there are 137 recorded sites and 12 of these are archeological sites related to aboriginal life during the 14,000 years prior to European contact. These sites are concentrated mainly to the waterfront. They include cache pits, house pits, trails, fishing sites, cooking features, lithics, grave sites and human remains. Due to the sensitive nature of these sites their exact locations cannot be published.

There are eight locations which include sites of historic importance from the past 200 years. Four of these are non-protected heritage sites and include log cabins, trails, and historic buildings. Four historic sites are protected under some federal, provincial or local act including recognized heritage buildings as well as some heritage trees.

3.3.3 High Environmental Values

The BC Conservation Data Centre (CDC) records BC's most vulnerable vertebrate animals and vascular plants, each of which is assigned to a provincial Red or Blue list according to their provincial conservation status rank. Species or populations at high risk of extinction are placed on the Red list and are candidates for formal endangered species status. Blue-listed species are considered vulnerable to human activity and natural events.

There are 27 occurrences of Red-listed species, 18 Blue-listed species, 24 Red-listed ecological communities, and 5 Blue-listed ecological communities. There is also one overlap with a masked sensitive occurrence. The impacts of fuel treatments to these plants, animals and ecosystems should be taken into consideration when prescribing fuel treatments across the AOI. Details regarding the management requirements of these entities can be found on the Conservation Data Center Website (https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre). Maps

of known occurrences of these species are also available at the CDC website. Red and blue listed wildlife species at risk that are known to inhabit the AOI or the adjacent natural areas are listed in Table 7. Red and Blue listed ecological communities are listed in Table 8.

Table 7 Recorded known occurrences of Red and Blue listed species that inhabit the AOI (Conservation Data Centre).

Scientific Name	Common Name	Category	B.C. Status
Sericocarpus rigidus	*White-top Aster*	Vascular Plant	Blue
Lomatium dissectum	*Fern-leaved Desert-parsley*	Vascular Plant	Red
Meconella oregana	*White Meconella*	Vascular Plant	Red
Sidalcea hendersonii	*Henderson's Checker-mallow*	Vascular Plant	Blue
Psilocarphus elatior	*Tall Woolly-heads*	Vascular Plant	Red
Fraxinus latifolia	*Oregon Ash*	Vascular Plant	Red
Balsamorhiza deltoidea	*Deltoid Balsamroot*	Vascular Plant	Red
Viola praemorsa var. praemorsa	*Yellow Montane Violet*	Vascular Plant	Red
Sericocarpus rigidus	*White-top Aster*	Vascular Plant	Blue
Phalacrocorax auritus	*Double-crested Cormorant*	Vertebrate Animal	Blue
Bidens amplissima	*Vancouver Island Beggarticks*	Vascular Plant	Blue
Sericocarpus rigidus	*White-top Aster*	Vascular Plant	Blue
Fraxinus latifolia	*Oregon Ash*	Vascular Plant	Red
Megascops kennicottii kennicottii	*Western Screech-owl, Kennicottii Subspecies*	Vertebrate Animal	Blue
Coenonympha tullia insulana	*Common Ringlet, Insulana Subspecies*	Invertebrate Animal	Red
Allogona townsendiana	*Oregon Forestsnail*	Invertebrate Animal	Red
Balsamorhiza deltoidea	*Deltoid Balsamroot*	Vascular Plant	Red
Erynnis propertius	*Propertius Duskywing*	Invertebrate Animal	Red
Ardea herodias fannini	*Great Blue Heron, Fannini Subspecies*	Vertebrate Animal	Blue
Coenonympha tullia insulana	*Common Ringlet, Insulana Subspecies*	Invertebrate Animal	Red
Viola praemorsa var. praemorsa	*Yellow Montane Violet*	Vascular Plant	Red
Lomatium dissectum	*Fern-leaved Desert-parsley*	Vascular Plant	Red
Callophrys mossii mossii	*Moss' Elfin, Mossii Subspecies*	Invertebrate Animal	Blue
Butorides virescens	*Green Heron*	Vertebrate Animal	Blue
Triteleia howellii	*Howell's Triteleia*	Vascular Plant	Red
Ardea herodias fannini	*Great Blue Heron, Fannini Subspecies*	Vertebrate Animal	Blue
Viola praemorsa var. praemorsa	*Yellow Montane Violet*	Vascular Plant	Red
Triteleia howellii	*Howell's Triteleia*	Vascular Plant	Red

Scientific Name	Common Name	Category	B.C. Status
Euphyes vestris	*Dun Skipper*	Invertebrate Animal	Red
Prophysaon coeruleum	*Blue-grey Taildropper*	Invertebrate Animal	Blue
Clarkia purpurea ssp. quadrivulnera	*Wine-cup Clarkia*	Vascular Plant	Red
Tonella tenella	*Small-flowered Tonella*	Vascular Plant	Blue
Balsamorhiza deltoidea	*Deltoid Balsamroot*	Vascular Plant	Red
Butorides virescens	*Green Heron*	Vertebrate Animal	Blue
Viola praemorsa var. praemorsa	*Yellow Montane Violet*	Vascular Plant	Red
Rana aurora	*Northern Red-legged Frog*	Vertebrate Animal	Blue
Syntrichia laevipila	*Twisted Oak Moss*	Nonvascular Plant	Blue
Nearctula sp. 1	*Threaded Vertigo*	Invertebrate Animal	Blue
Euphyes vestris	*Dun Skipper*	Invertebrate Animal	Red
Sanicula bipinnatifida	*Purple Sanicle*	Vascular Plant	Red
Ardea herodias fannini	*Great Blue Heron, Fannini Subspecies*	Vertebrate Animal	Blue
Triteleia howellii	*Howell's Triteleia*	Vascular Plant	Red
Erynnis propertius	*Propertius Duskywing*	Invertebrate Animal	Red
Lomatium dissectum	*Fern-leaved Desert-parsley*	Vascular Plant	Red
Silene scouleri ssp. scouleri	*Coastal Scouler's Catchfly*	Vascular Plant	Red

Table 8 Recorded known occurrences of Red and Blue listed ecological communities found in the AOI (Conservation Data Centre).

Scientific Name	Common Name	B.C. Status
Alnus rubra / Rubus spectabilis / Equisetum arvense	*Red Alder / Salmonberry / Common Horsetail*	Blue
Pseudotsuga menziesii / Berberis nervosa	*Douglas-fir / Dull Oregon-grape*	Red
Thuja plicata / Rubus spectabilis	*Western Redcedar / Salmonberry*	Red
Thuja plicata / Rubus spectabilis	*Western Redcedar / Salmonberry*	Red
Pseudotsuga menziesii / Berberis nervosa	*Douglas-fir / Dull Oregon-grape*	Red
Pseudotsuga menziesii / Berberis nervosa	*Douglas-fir / Dull Oregon-grape*	Red
Quercus garryana / Bromus carinatus	*Garry oak / California brome*	Red
Thuja plicata / Rubus spectabilis	*Western Redcedar / Salmonberry*	Red
Alnus rubra / Carex obnupta [Populus trichocarpa]	*Red Alder / Slough Sedge [Black Cottonwood]*	Red
Pseudotsuga menziesii - Arbutus menziesii	*Douglas-fir - Arbutus*	Red
Alnus rubra / Rubus spectabilis / Equisetum arvense	*Red Alder / Salmonberry / Common Horsetail*	Blue
Alnus rubra / Carex obnupta [Populus trichocarpa]	*Red Alder / Slough Sedge [Black Cottonwood]*	Red
Abies grandis / Berberis nervosa	*Grand Fir / Dull Oregon-grape*	Red
Pseudotsuga menziesii / Melica subulata	*Douglas-fir / Alaska Oniongrass*	Red
Thuja plicata / Symphoricarpos albus	*Western Redcedar / Common Snowberry*	Red
Thuja plicata / Symphoricarpos albus	*Western Redcedar / Common Snowberry*	Red

Scientific Name	Common Name	B.C. Status
Thuja plicata / Symphoricarpos albus	*Western Redcedar / Common Snowberry*	Red
Alnus rubra / Rubus spectabilis / Equisetum arvense	*Red Alder / Salmonberry / Common Horsetail*	Blue
Pseudotsuga menziesii / Berberis nervosa	*Douglas-fir / Dull Oregon-grape*	Red
Abies grandis / Berberis nervosa	*Grand Fir / Dull Oregon-grape*	Red
Thuja plicata / Rubus spectabilis	*Western Redcedar / Salmonberry*	Red
Populus trichocarpa - Alnus rubra / Rubus spectabilis	*Black Cottonwood - Red Alder / Salmonberry*	Blue
Quercus garryana / Bromus carinatus	*Garry oak / California brome*	Red
Alnus rubra / Carex obnupta [Populus trichocarpa]	*Red Alder / Slough Sedge [Black Cottonwood]*	Red
Abies grandis / Berberis nervosa	*Grand Fir / Dull Oregon-grape*	Red
Abies grandis / Berberis nervosa	*Grand Fir / Dull Oregon-grape*	Red
Alnus rubra / Carex obnupta [Populus trichocarpa]	*Red Alder / Slough Sedge [Black Cottonwood]*	Red
Populus trichocarpa - Alnus rubra / Rubus spectabilis	*Black Cottonwood - Red Alder / Salmonberry*	Blue
Quercus garryana / Holodiscus discolor	*Garry Oak / Oceanspray*	Red

3.4 Other Resource Values

The primary landscape level natural resource in the North Cowichan area is timber, both in the 5,000 hectare MFR and the small portions of forested land. There is also a long coastline within the District providing access for industrial and recreational boats. Two Port Terminals associated with Catalyst paper and at Chemainus Bay provide access for larger commercial vessels.

Recreation Features

North Cowichan is well known for its highly developed trail network. The District of North Cowichan and the Cowichan Trail Stewardship Society maintains a large network of hiking and mountain bike trails, many of which overlap or are contained within the MFR. The BC Bike Race frequently hosts a day of bike racing in the District, attracting thousands of visitors from all over the world. The District is also a destination for camping, hiking, kayaking. Most recreation is concentrated in the late spring to fall insofar as the MFR is considered, with a substantial amount during the wildfire season, resulting in an elevated risk in forested areas. No camping is permitted inside the MFR.

3.5 Hazardous Values

The intent of this sub-section is to identify hazardous values that pose a safety hazard to emergency responders. The major industrial operators in the AOI are mills located in Crofton and Chemainus. These mills are located on the waterfront, and have limited interface with the broader landscape forest. These mills have heavy concentrations of fuels in the form of log decks, chips, and sawdust, as well as storage tanks with hazardous materials.

A waste management facility is located in the western portion of the AOI, at 3900 Drinkwater Road. This facility has small concentrations of hazardous materials, typically household chemical waste and

materials. This facility is lightly vegetated, however it does partially interface the landscape forest to the west.

Section 4 Wildfire Threat and Risk

The following sections provide a summary of the factors that contribute to wildfire threat and risk. Wildfire threat is a term that reflects the potential fire behaviour that a natural area could support. This considers fuel loading, slope, aspect, weather conditions, fire regime and the impacts from pests and diseases. The term wildfire risk accounts for the likelihood of a wildfire occurring, its potential behavior and the consequences of it impacting human lives, structures, and infrastructure.

4.1 Fire Regime, Fire Danger Days and Climate Change

4.1.1 Fire Regime and Fire Weather

All ecosystems are influenced by periodic disturbances that vary in size, severity, and occurrence. Examples of common disturbances include: wildfire, windthrow, ice and freeze damage, water, landslides, insect and disease outbreaks as well as human caused events such as logging. Historically, agents of disturbance were viewed as unhealthy and a threat to the integrity of the forest as a timber resource. Hence, it was standard policy to suppress all wildfires. The resultant effect is that fire dependant ecosystems are expressing biological and physical instabilities such as hazardous fuel accumulations and pest outbreaks. Only recently have we gained an understanding of the integral role that disturbance agents play in maintaining spatial and temporal diversity in our ecosystems.

Wildfire is often the most severe disturbance type and can significantly alter the physical and biological characteristics of an ecosystem. It can change the structure and species composition of a forest, remove some or the entire forest floor organic layer, and alter the chemical properties of the soil. In ecosystems where natural wildfires are frequent, wildfires help to prepare seed beds, recycle nutrients, alter plant succession, maintain a diversity of age classes (seral stages) across the landscape, control insect and disease outbreaks as well as reduce fuel accumulations. Many of the native plant species in fire dominated ecosystems depend on it for their existence.

All biogeoclimatic subzones have been separated into natural disturbance types (NDT) according to the Forest Practices Code Biodiversity Guidebook. These NDTs are classified based on the size and frequency of natural disturbances that occur in those ecosystems as per the following:

- NDT 1 Ecosystems with rare stand-initiating events
- NDT 2 Ecosystems with infrequent stand-initiating events
- NDT 3 Ecosystems with frequent stand-initiating events
- NDT 4 Ecosystems with frequent stand-maintaining fires
- NDT 5 Alpine Tundra and Sub-alpine Parkland ecosystems

The subzones on the east coast of Vancouver Island are classified as NDT 2 - Ecosystems with infrequent stand-initiating events. These forests generally experienced infrequent wildfires (the mean fire return interval is 200 years) of moderate size (20 to 1000 hectares). Occasional large fires would occur during periods of extreme drought, however fires in general were patchy with unburnt islands throughout. This

would result in forests of even age and size trees, with patches of mature trees that had survived previous fires. Veteran survivors of large fires are typically found scattered throughout the forest.

Human intervention through forest management has altered the fire regime in this area. Forest harvesting is the dominant factor determining forest composition on the south coast of BC. This area has historically been a centre for logging and forestry since colonization by European settlers. Previous historic logging removed most of the trees that were accessible to fallers and equipment, and most of the remaining forest near communities is second-growth. This has shifted the natural fuel characteristics: forests near communities are much more homogenous in composition. The patches of veterans and unburnt mature trees are no longer present, having been removed through forest harvesting. Wildfire suppression has also influenced forest composition and is discussed in the Fire Density section below.

Photo 6. Typical mature second growth conditions found in the local area.

Fire Weather Rating

The District is in the Coastal Douglas-Fir (CDF) zone that covers the southeast coast of Vancouver Island. There are some small patches of CWH (Coastal Western Hemlock) zones in higher elevations, but overall a majority of the District is in the CDF zone. The CDF zone has one subzone, the CDFmm (moist maritime subzone), which covers a majority of the District of North Cowichan. The CDFmm represents the mildest climate in Canada, and is characterized by mild, wet winters, and dry, warm summers. The growing season is very long, which creates good climatic conditions for forest growth.

Table 9 Climatic characteristics of the biogeoclimatic zone within the District of North Cowichan (Green & Klinka, 1994)

Biogeoclimatic Zone	Range	Annual Precipitation (mm)	Summer Precipitation (mm)	Annual Snowfall (cm)	Annual Temperature (C)
Coastal Douglas-fir	Max	1263	272	92	10.5
	Min	636	105	17	8.8

Table 10 summarizes temperature and rainfall statistics from the nearest Ministry of Environment weather station. The daily high temperatures were higher in 2018 compared with the 30 year average. Rainfall was also lower in 2018 with very little rainfall in July and August.

Table 10 Weather statistics for the months of May to Sept

Weather Attribute	May	Jun	Jul	Aug	Sep
30 year Daily Average High (°C)	17	19.5	22.1	22.2	18.8
2018 Max Daily High (°C)	28	30.5	31	30.5	28
30 year Average Rainfall (mm)	50.5	39.1	24.2	26.2	31.4
Rainfall in 2018 (mm)	4.2	33.7	1.8	3.2	76.1

Table 11 provides a summary of the average number of moderate, high and extreme rated fire danger days in the fire season (May to Sept). This has been calculated from data over the past ten years. The closest station “Saltspring 2” was used, as this had the most complete data for the past several decades and was used for the wildfire behavior modelling in **Error! Reference source not found.**. The average number of high and extreme rated days from this station is about 73.8, about 48% of fire season. (May to September).

Table 11 Fire Danger Average - Average number of moderate, high, and extreme rated fire danger days over the past ten years (May to Sept)

Weather Station	Average # of Days as Moderate	Average # of Days as High	Average # of days as Extreme
Cedar – 13km NW	39.3	35.9	39.1
Mesachie 2 – 25km W	36.2	34.5	29.8
Saltspring 2 – 5km E	38.2	44.6	29.2
Victoria Airport– 15km SE	37.3	47.0	29.6

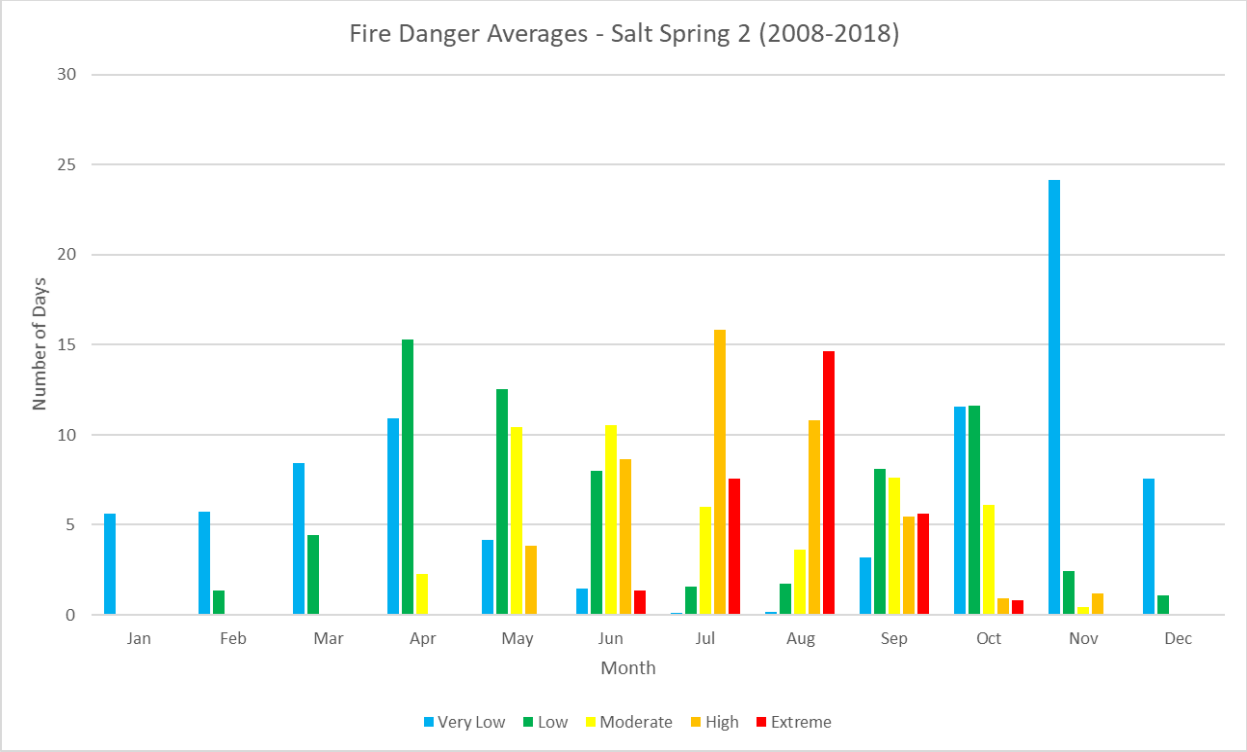


Figure 8 - Average number of danger days in each fire danger class over the past ten years (May to Sept from Saltspring 2 weather station)

It is important to note that while there is relatively good coverage from weather stations for the AOI, there is significant variability within the District. This is due to the varying topography throughout the area, as well as the influence of the coast and islands to the east. The actual fire weather can vary widely in the District, and projected wildfire weather from weather stations may not be representative of the actual fire hazard in the District.

4.1.2 Climate Change

The Cowichan Valley Regional District, adjacent to the District of North Cowichan, produced a Climate Projection Report for the area in 2017 (Cowichan Valley Regional District, 2017). This report provides detailed projections of how climate change will affect the Cowichan Valley by the 2050s. These models predict an annual average temperature increase of 3°C by the 2050s. Precipitation is expected to increase by 5%, however this will come mostly in the form heavier rainstorms. Summers are expected to be hotter, with longer dry spells.

Changes to climate are affecting the risk from wildfires. In North Cowichan, average annual temperatures will be warmer, with longer summer dry spells. A majority of historical wildfire in the region is associated with summer droughts, and as such longer summer droughts can be expected to increase the amount of high and extreme wildfire danger days in the summer. While precipitation may increase with climate change, this is expected to be in the form of heavier winter rainstorms which will not decrease summer wildfire risk.

4.2 Provincial Strategic Threat Analysis (PSTA)

The PSTA is a high-level analysis conducted at the Provincial level and is intended to be used as a starting point for an assessment of local wildfire threat. The recommended method for updating the Provincial Wildfire Threat Analysis as part of a CWPP involves air photo interpretation and ground truthing to update fuel typing. For any changes to fuel types the fire intensity is manually updated to reflect the closest polygon with the same fuel characteristics. In the AOI the provincial outputs of fuel types and fire intensity were poor due to coarse and inaccurate inventory mapping. For this reason its was not possible to update the PSTA following the recommended methodology. Instead new fuel typing was completed using recently completed Vegetation Resources Inventories (VRI) mapping. This fuel type layer was verified through ground truthing and used to recalculate fire behavior for the AOI. The findings from this analysis are provided in section 4.2.

The original PSTA spatial data is provided below. This is an interpretation of fuel type mapping, historical fire data and weather, and topography. The PSTA includes information and maps that describe fuel types, historical fire density, and the potential for embers to land in an area (spotting impact), head fire intensity, and a final calculated wildfire threat score (Figure 9).

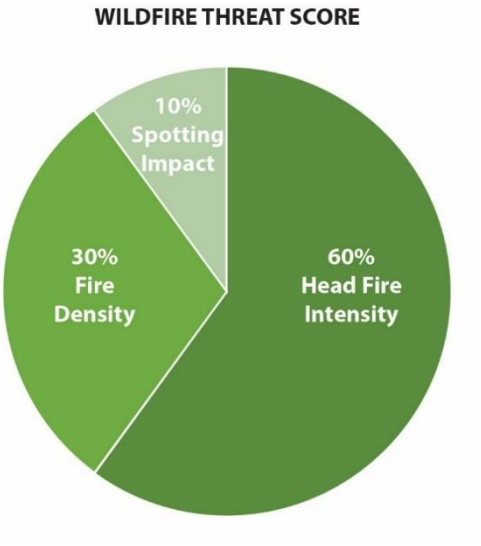


Figure 9 – Input factors and contributing weights to the final PSTA score.

The 10 Fire 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. Areas rated as Class 6 are also considered to be particularly prone to wildfires ,are susceptible to crown fires (head fire intensity greater than 10,000 kW/m), and are most likely to be affected by spotting impacts.

The PSTA mapping for the AOI (Figure 10) appears fragmented because the analysis cannot be published for private land. This analysis was completed at a coarse scale with poor input data. The PSTA identified the majority of the public land area assessed as a Moderate threat (Table 12).

Table 12 Summary of wildfire threat on public owned lands

PSTA Threat Rating (class)	Area (ha)	% of area
Extreme (9-10)	104.0	0%
High (7-8)	490.4	2%
Moderate (4-6)	6391.6	30%
Low (1-3)	811.3	4%
No Data (Private Land)	11724.0	55%
Water	1749.0	8%

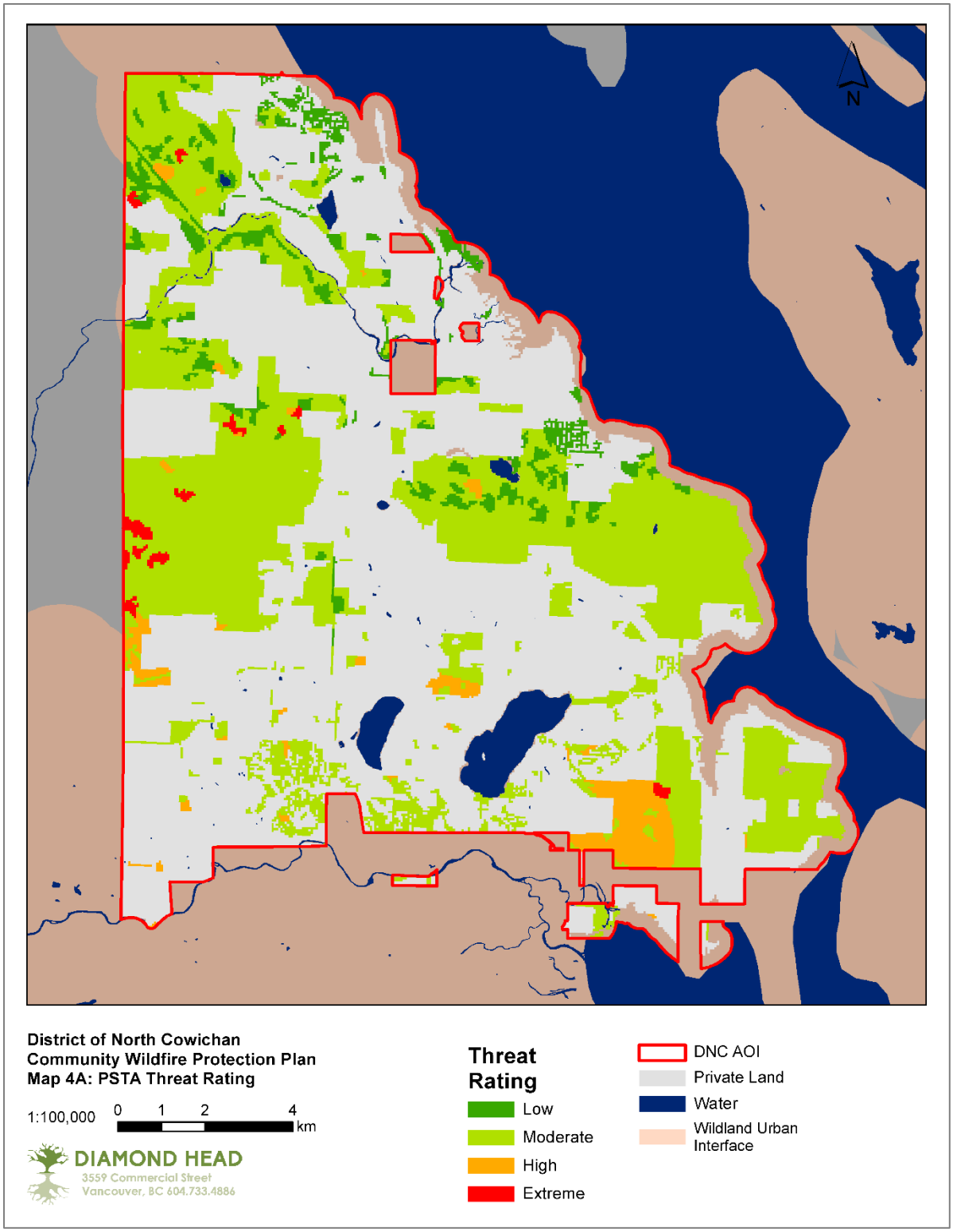


Figure 10 – Provincial Strategic Threat Analysis threat rating for public owned lands

Provincial Wildfire Threat Analysis - Limitations

The PSTA is a generalized and coarse analysis completed at a province wide layer with a 50m pixel size. This tool is useful for higher level wildfire analysis, however lacks detail that is required for a localized analysis of wildfire risk. In the case of District of North Cowichan, recently completed VRI data was used to create a more detailed fuel typing layer and to recalculate the fire behavior modeling. This process and methodology is detailed in section **Error! Reference source not found.**.

4.2.1 Fire History

The AOI has a fire regime that is characterized by mostly moderate-sized fires that are between 10 and 2000 hectares, which is typical of the disturbance regime in this ecosystem. These moderate-sized fires were significantly more frequent and larger prior to 1950. This is likely due to a combination of factors. After 1950, the wildfire service effectively suppressed a majority of wildfires due to technological advances in the wildland firefighting techniques. Furthermore, broadcast burning was a frequent technique in the forest harvesting industry to dispose of post harvest debris, which led to more frequent human caused large fires. Section 2.3 above includes some additional discussion of wildfire history.

One of the implications of reduced wildfire activity in the AOI is an increase in fuel loading. The most common predicted type of wildfire in the AOI is lower intensity surface fires. These wildfires tend to consume ground and surface fuels, while sparing the trees. This reduces fuel loads in the forest without causing major mortality in the overstory trees, as would be expected during a higher intensity crown fire. Modern fire suppression quickly suppresses these surface fires, minimizing their influence on the ecosystem, leading to heavier fuel loading in these forests than would be typically expected in a natural disturbance regime. This process, known as “fire exclusion,” increases the likelihood of very large wildfires that strain and sometimes exceed wildfire suppression capabilities.

Table 13 Summary of wildfires in the AOI

AOI Fires Summary	# of Fires	Area Burned (ha)
Total: 1920-1950	N/A*	6806.5
Average/year	N/A*	227
Total 1950 – 2018	241	580
Average #/year	3.5	8.5
Total 2009 – 2018	46	10
10 Year Average	4.6	1

***Fire number data prior to 1950 is generally unreliable, as only large fires are included in dataset.**

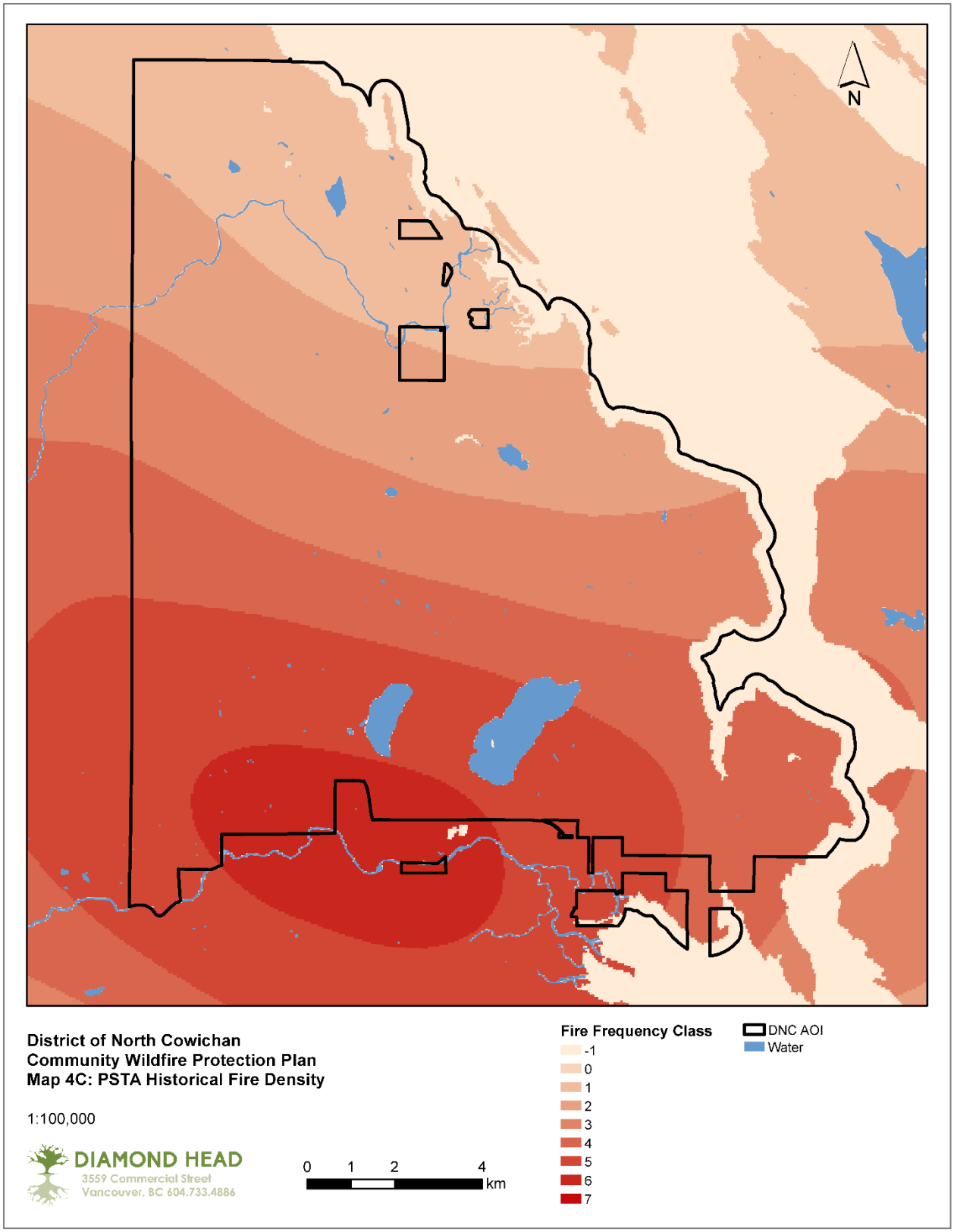


Figure 11 – Provincial Strategic Threat Analysis historical wildfire density

4.3 Local Wildfire Threat Assessment

The PSTA is a generalized and coarse analysis completed at a province wide layer with a 50m pixel size. This tool is useful for higher level wildfire analysis, however lacks detail that is required for a localized analysis of wildfire risk. In the case of District of North Cowichan, a more detailed fuel typing layer was developed and used to recalculate the fire behavior modeling using local weather data. The following is a summary of this analysis.

Fuel Typing

A recent vegetation resource inventory (VRI) was completed for the District. To produce the most accurate assessment of fire behavior potential for this area, new fuel typing was developed from this VRI inventory. This was done using a series of queries of forest attributes to best match the coastal forest conditions associated with each Fuel type. This updated typing was confirmed through air photo interpretation and ground truthing, and is further discussed in Appendix 1.

Fuel typing falls into sixteen national benchmark fuel types that are used by the Canadian Fire Behaviour Prediction System (Canada, Canadian Wildland Fire Information System, 2018). This system divides fuels into 5 major groups and 16 more specific fuel types. These groups are used to describe fuels according to stand structure, species composition, surface and ladder fuels and the organic (duff) layer. The current Canadian Forest Fire Behavior Prediction (FBP) System does not include coastal forests in their fuel type descriptions (Perrakis & Eade, 2015), therefore the fuel type that most closely represents forest stand structure was identified. Fuel types by area in the AOI are summarised in Table 14.

Table 14 The fuel types and representative areas found within the North Cowichan AOI.

Fuel Type Classification	Total Area (ha)	% of area
C2	5.9	0.03
C3	2010.6	9.5
C4	772.5	3.6
C5	4659.4	21.9
C7	547.9	2.6
D1	1091.5	5.1
M2	2761.4	13.0
01b	76.1	0.4
S3	1020	4.8
Non-Fuel Areas	8309.5	39.1

Fuel type C-5 –Mature Conifer

The most common fuel type in the AOI is C-5 (~22%), which is characterized by mature second-growth stands dominated by Douglas-fir (*Pseudotsuga menziesii*). This fuel type is moderately dense (500-1000 stems per ha) and has a high crown base height of 10 to 15m. Most of these stands in the AOI have very low understory density. The ground fuel component consists of moderately dense fine fuel layer (>7cm) and a low percent cover of large woody debris (>7cm). It takes a large amount of energy to create a crown fire in stands of this type in comparison with the denser conifer fuel types (C-2, C-3, and C-4).

Photo 7: Example of a stand classified as C5 fuel type

Fuel type C-3 – Semi Mature Conifer

This fuel type is characterized by pure, fully stocked conifer dominated stands that have achieved complete crown closure. These stands tend to be dominated by Douglas-fir. The stands tend to be between 20-60 years old and over 90% coniferous, with a density of 1000-2000 stems per hectare in the overstory. Dead surface fuels are generally light and scattered, and crown base heights are between 4-8m.

Photo 8: Example of a stand classified as C3 fuel type

Fuel type M-2 – Mixed stands

This fuel type is found scattered throughout the study area. These fuel types are characterized by stands comprised of a mix of coniferous and deciduous species. The conifer component is mostly Douglas-fir, with a component of Alder (*Alnus rubra*), Bigleaf Maple (*Acer macrophyllum*), Black Cottonwood (*Populus balsamifera ssp. Trichocarpa*), and Arbutus (*Arbutus menziesii*). In addition to the diverse species composition, stand mixtures exhibit wide variability in stand structure and development. Fire behaviour potential in these stands is highly dependant on the coniferous component, with higher coniferous component having a higher wildfire behaviour potential.

Photo 9: Example of a stand classified as M2 fuel type

*Fuel type D**-1/2 - Deciduous***

This fuel type consists of stands that are generally moderately stocked and dominated by deciduous trees. These are comprised of a mixture of Cottonwood, Alder, Bigleaf Maple, and Arbutus. These stands may include a small to very small component of conifers, usually in patches or as single trees. Dead and down round wood fuels are a minor component of this fuel complex. During the summer months, the principal fire-carrying surface fuel consists chiefly of deciduous leaf litter and cured herbaceous material that are directly exposed to wind and solar radiation. Areas dominated by shrubs are also included in this type. These are dense plant communities with few trees and a variety of shrub species. In terms of fire behaviour potential these stands will all have a relatively low spread rate potential.

Photo 10: Example of a stand classified as D1/2 fuel type

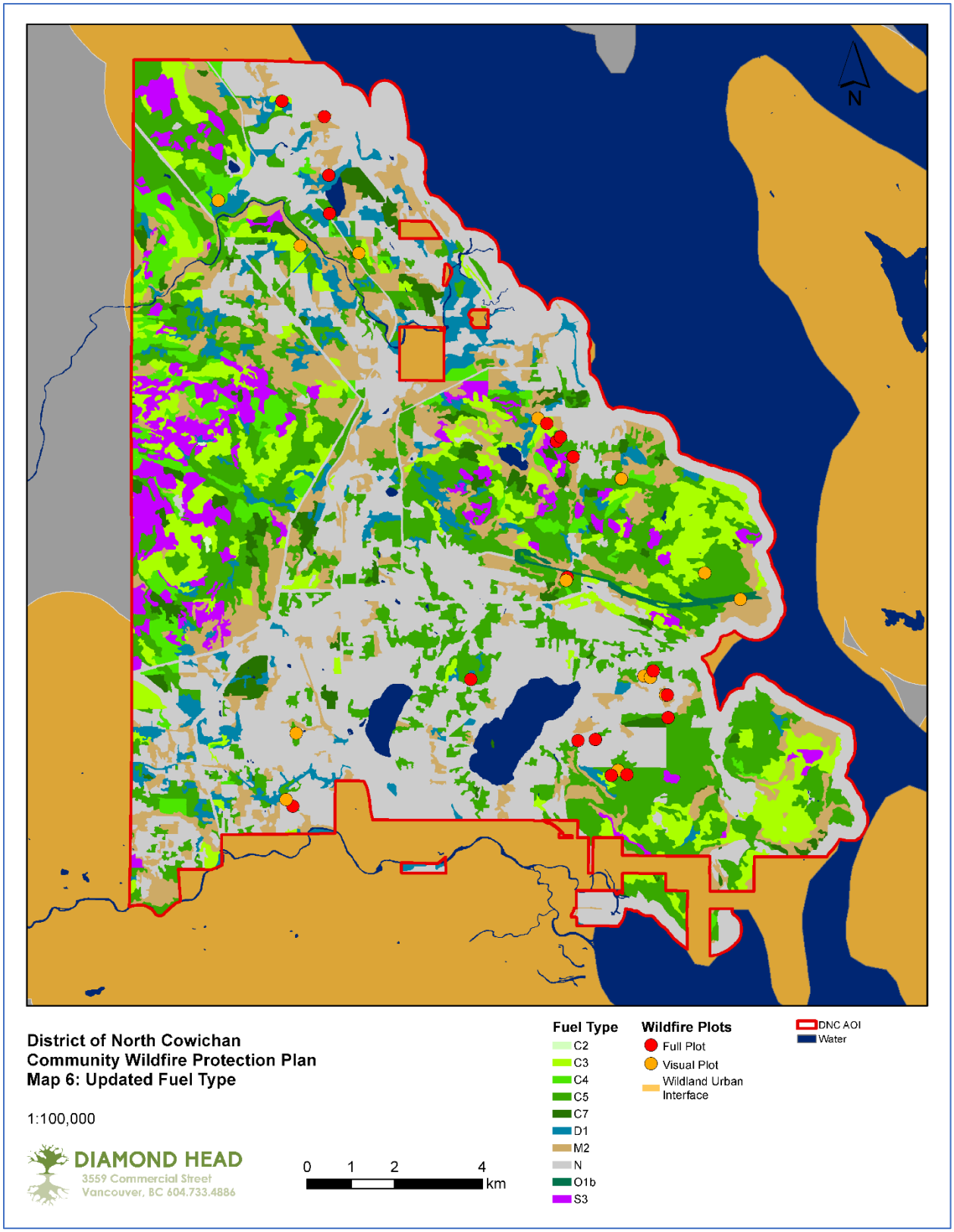


Figure 12 – Updated Local Fuel Type Map and Field Verification Plots

Fire Weather Inputs

Weather conditions used to calculate fire behaviour were derived from two weather stations maintained by the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), North Cowichan Station and Saltspring 2 station. Although North Cowichan is inside the study area, it has a smaller sample size that may not accurately capture fire weather indices. Saltspring 2 is 5km E of the study are and has a much more complete dataset, with fire weather indices for the last 30 fire seasons.

Table 15 MFLNRO weather stations

Station #	Station Name	LATITUDE	LONGITUDE	ELEV_M_	Years
1013	North Cowichan	48.82	-123.72	60	1983 – 1986, 2015
8	Saltspring 2	48.77	-123.47	18	1989-2018

Historical weather data was statistically analyzed for the months of May to September. The 90th percentile indices were used to represent the worst-case scenario for fire weather conditions. This information, in addition to ground fuel plot data, was used to model fire behaviour characteristics.

Table 16 Fire weather indices between the months of May to September

	Fine Fuel Moisture Code	Duff Moisture Code	Drought Code	Initial Spread Index	Build Up Index	Fire Weather Index	Relative Humidity	Precip. (mm)	Temp.
#1013 – North Cowichan									
90th Percentile	90.7	110.9	640.6	6.9	145.9	26.0	80	3.8	25.5
Average	77.1	48.8	336.2	3.5	66.5	11.0	57.9	1.2	19.4
Maximum	97.6	195.8	829.9	45.2	209.9	49.0	99	43.9	33.6
#8 – Saltspring 2									
90th Percentile	88.89	86.3	653.1	6.5	124.6	22.9	86	3.0	24.8
Average	76.2	43.0	378.4	3.2	63.5	10.2	64.6	1.1	19.2
Maximum	96.9	171.1	849.6	16.2	222.4	43.4	100	57.2	35

Fire Behavior Modeling

The updated fuel typing and weather data from the Saltspring weather station were used to model fire behavior potential. The objective of this modeling exercise is to predict how wildfire will behave under extreme weather conditions. It is based on the Canadian Fire Behaviour Prediction System (FPB) which provides quantitative outputs of selected fire behaviour characteristics for the major Canadian fuel types (Hirsch 1996).

Topographical attributes required to predict fire behaviour include slope and aspect. The study area was delineated into polygons based on slope breaks of 10% intervals and aspects of 45 degrees. Cardinal wind direction was calculated from the aspect so that it was blowing upslope and the elapsed time was set at 24 hours. Wind speed was set at 20 knots.

All of the data pertaining to fuel types, topographical attributes, and fire weather was compiled for the entire study area. This information was then run through the modelling software (Remsoft FPB97) to create output fire behaviour layers.

The output that provides a simple measure of fire behavior potential and is comparable between areas is fire intensity. This is a measure of the rate of heat energy released per unit time per unit length of fire front and is based on the rate of spread and the predicted fuel consumption. Units for this layer are kilowatts per meter. The categories used for fire intensity class are summarised in table 17.

Table 17 Fire intensity units and weighting

Layer	Units	Unit Value	Wildfire Behavior Threat
Fire Intensity	Kilowatts per meter (kW/m)	>0-500 501-1000 1001-2000 2001-4000 4001-10000 10001-30000 >30000	Very Low Low Low Medium Medium High Extreme

Generally the areas that have a high risk fire behaviour potential include fuel types that are dominated by conifer tree species and on steep slopes. These areas have high fuel loading that with both winds and the effects of slope will burn at a high intensity. Conifer dominated fuel types constitute almost 40% of the study area. These are found primarily within three municipal owned areas including the forest reserve along the west edge of the District boundaries, and at higher elevations in the mountainous areas inside the AOI. The risk generally increases with elevation in these mountains, as higher elevation conifer stands inside the AOI will have higher density. Specific areas of note with higher risk polygons are Mt Tzouhalem, Maple Mountain, and Mount Prevost. The areas within the AOI by fire intensity class is summarized in Table 17.

Table 18 Wildfire behavior category based on fire intensity

Wildfire Behavior Threat	Total Area (ha)	% of area
Very Low	1,691	8%
Low	1,183	5%
Moderate	3,590	16%
High	1,669	12%
Extreme	1,300	6%
Private	11,821	53%

Wildfire behaviour on public lands is illustrated in Figure 13.

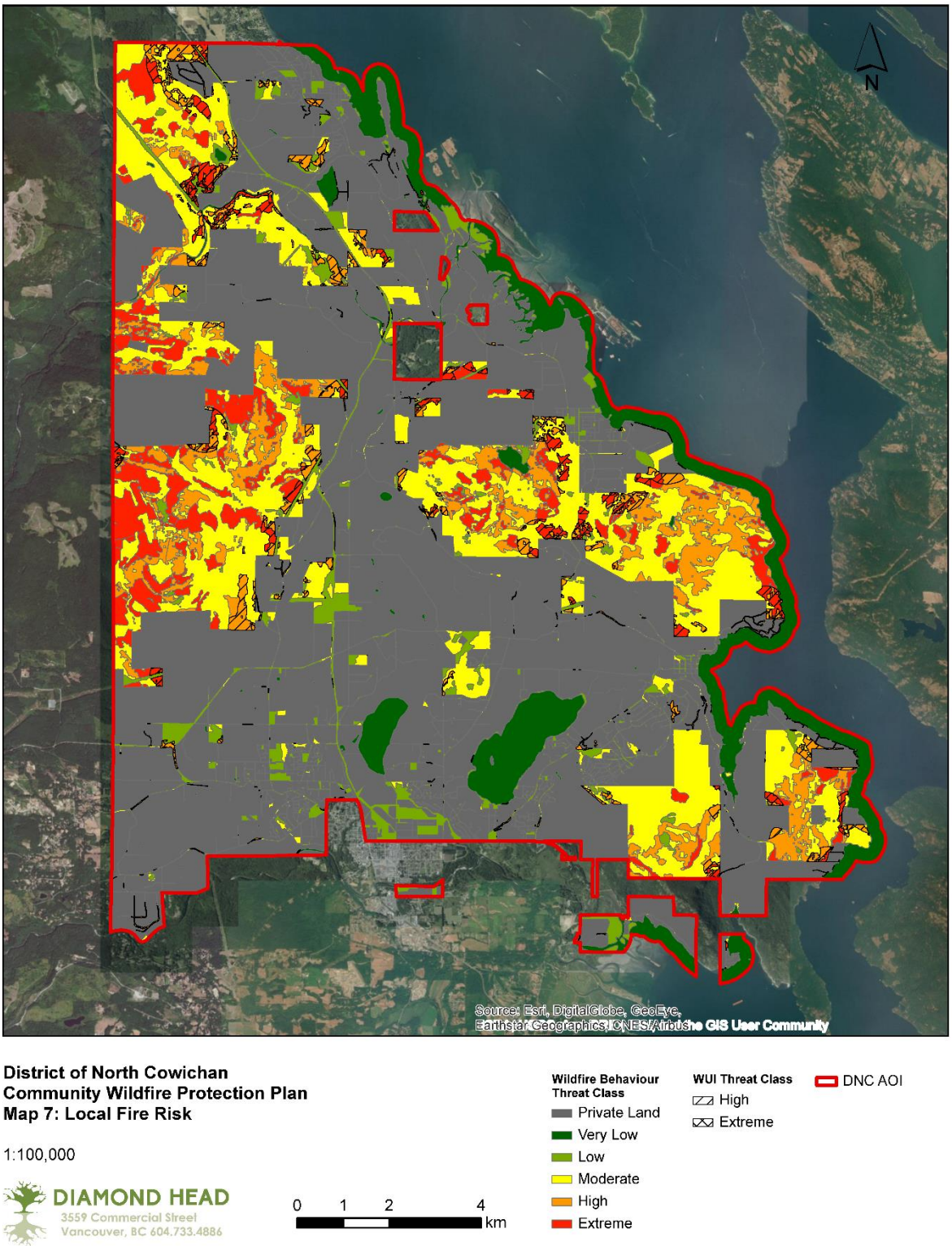


Figure 13 – Wildfire behavior threat highlighting interface areas with high to extreme rankings

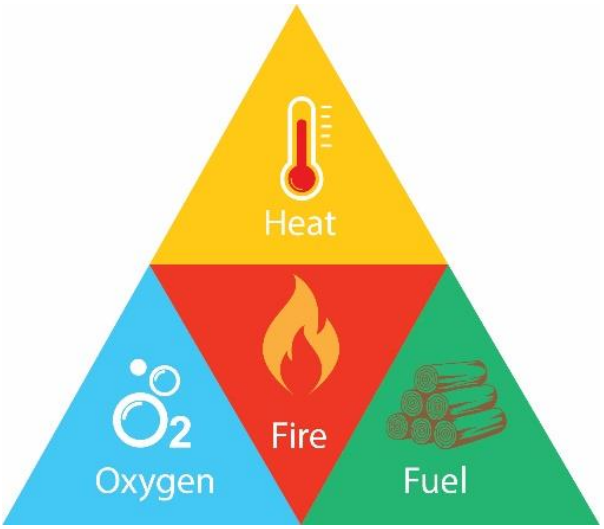
Section 5 Risk Management and Mitigation Factors

This section identifies strategies that can be implemented to reduce the risk of wildfire to the communities and values within the AOI. These strategies have been identified through the analysis of wildfire threat and risk, stakeholder consultation and review of best management practices. The recommendations vary in scope, implementation cost, timeline and the party(s) responsible.

1. Fuel Management
2. Planning and Preparedness
3. Communication and Education

5.1 Fuel Management

Fire requires three factors: a fuel source, oxygen and heat. The only factor that can be modified in the context of wildfire is fuel. The determination of wildfire threat and risk in this CWPP has identified areas that have high fire behaviour potential and threaten human lives and values at risk. The highest risk areas were visited in the field. The areas that were confirmed to pose a high risk have been identified as priority areas where future prescriptions should be developed for operational fuel treatments. In addition to treating fuels within high risk interface areas, larger scale fuel breaks have been recommended. For all prioritized treatment areas, options have been explored to partner and cooperate with other interest groups for initial treatment, maintenance and improving access.



Interface Fuel Treatments

Areas on public lands that were identified as high risk and are located within 100m of moderately dense interface communities were visited in the field. Fuel plots were established in representative areas. Assessments of the fuel condition were completed following the provincial assessment system, 2019 Wildfire Threat Assessment Guide and Worksheets (MFLNRO, 2019). This is the provincial standard for field assessments of fuel hazard in the WUI and is used to plan fuel hazard mitigation works. Fuel types are scored under this system which is used to help prioritise the areas for fuel hazard mitigation funding under the Community Resilience Investment Program (CRI). In total 18 worksheets were completed inside the AOI. (Figure 14).

The variability of the wildfire threat assessment inside the AOI was dependant on the deciduous component of the stand, as well as the density of conifer component. The highest threat stands observed in the field were young, dense conifer stands with high horizontal and vertical fuel continuity.

Photo 11: Example of a stand posing a high wildfire hazard.

Table 19 provides a summary of interface treatment areas that should be considered for subsequent detailed prescriptions and operational treatment. These are areas with fuel conditions that could support a high risk wildfire and are adjacent to critical values and/or dense communities. The threat and priority scores are from the findings of the ground assessment plots. Additional considerations included the size of the area, adjacent previous treatments that can be enhanced, and existing fuel breaks that can be expanded upon.

The overall objective of all the fuel treatment prescriptions is to change the fire behavior potential of these stands from a crown fire to a surface fire under 90th percentile weather conditions. This allows suppression resources to be able to act on the wildfire and defend the adjacent values. The detailed strategies for reducing fire behavior potential are detailed in a fuel management prescription, which is developed by a Registered Professional Forester with wildfire management experience. Potential strategies include tree thinning, spacing, pruning, surface debris removal, or creating fuel gaps.

Treatment areas should be linear adjacent to the values at risk, a target of at least 100m wide and located up against man made and natural fuel breaks when possible.

In addition to these identified areas, it is recommended that the District assess the condition of fuels on and around their properties and facilities, and develop fuel treatment prescriptions in areas that pose a risk of moderate of higher.

Photo 12: Examples of a stand condition before (left) and after (right) fuel mitigation treatment

Photo 13: Example of a stand crown density before (left) and after (right) fuel mitigation treatment. The goal of crown density reduction is to make the main canopy of trees separated and discontinuous.

Table 19 Fuel treatment summary table

Treatment Polygon ID	Threat Score	Threat	Priority Score	Fuel Type	Area (ha)	Treatment Rationale
MTRCH	58	Moderate	49	C-3/ C-5	57.2	This treatment area will act as fuel break to protect the adjacent community of Crofton. This treatment area directly interfaces with private residential land, with structures within 10m of the forest edge. A water reservoir inside this treatment area has been identified as critical infrastructure. Stands in this area range from high density conifer leading stands (C-3 fuel type) to mature conifer stands with moderate density (C-5 fuel type). The eastern portion of this stand has an area with severe blow down and high fuel loading, with severe mortality in the standing trees.
TZOU	44	Moderate	43	C-3	88.3	This treatment is located directly adjacent to private homes that border the Municipal Forest Reserve at Mount Tzouhalem. This area overlaps an approximately 3 hectares that was previously treated in 2007. There is a high density of trails inside this treatment unit, and is part of the heavily used Tzouhalem trail network. A water reservoir inside this treatment area has been identified as critical infrastructure. This area is dominated by moderate density conifer stands (C-5 fuel types), and treatment would likely include a commercial thin. This treatment area was previously recommended with slightly different boundaries in the 2017 Cowichan Valley Regional District CWPP.
MPLMT	N/A	Walkthrough Assessment	45	C-5	5.5	This treatment area surrounds a cell tower that has been identified as critical infrastructure at the top of Maple Mountain. Treatment would likely include light thinning and pruning to protect the structure and cell tower.

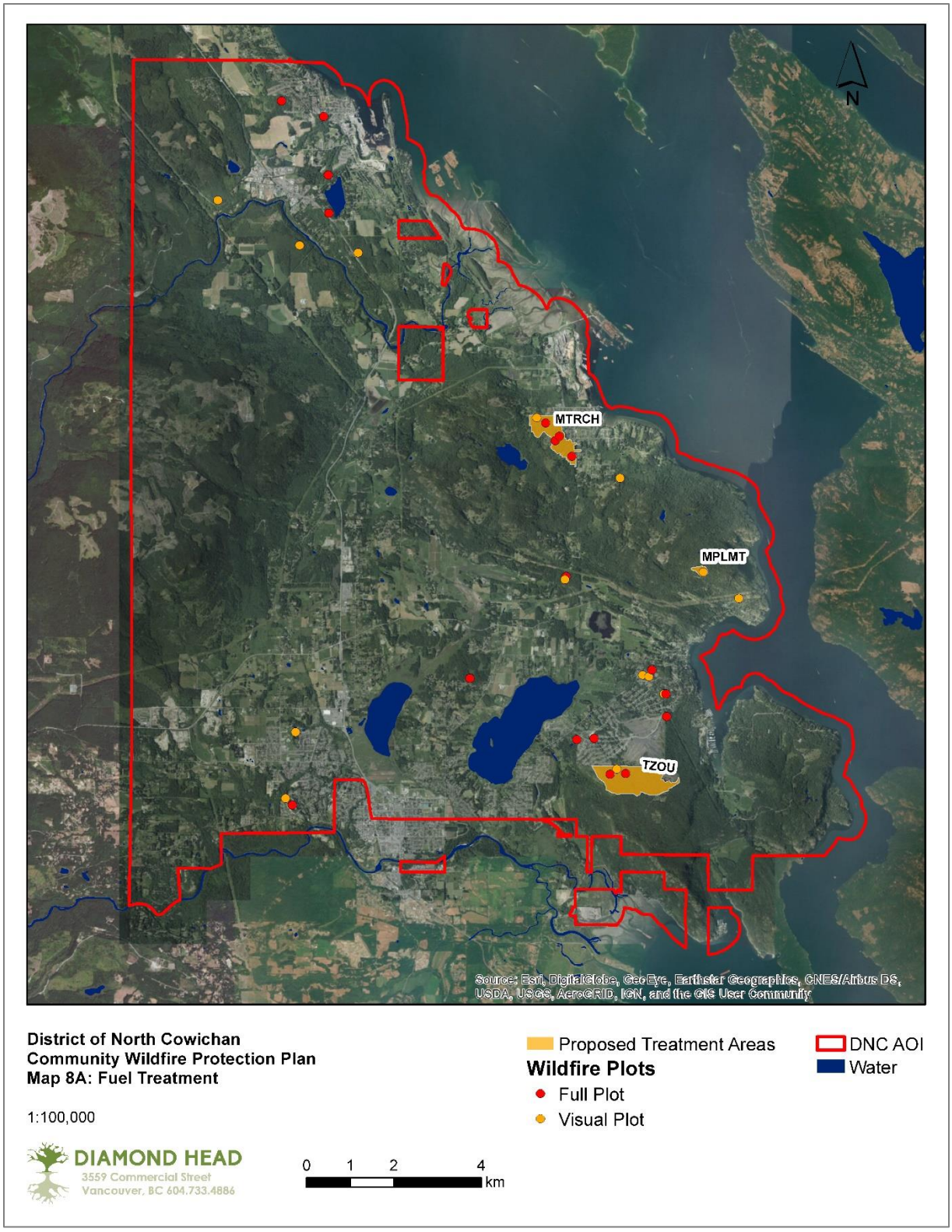


Figure 14 – Priority interface fuel break locations with ground plots locations

Municipal Forest Management

The District has recently began reviewing their forest management policy to guide how the MFR will be managed for the next several years. This process will involve stakeholder consultation on multiple levels to create a new set of objectives for forest management in the District. There are a multitude of values provided by the forest of North Cowichan, and preserving and enhancing those values through forest management begins with the development of a new forest management plan.

A unique opportunity is present in the District in the context of forest management: as a private landowner of a working forest, there are fewer constraints than in a typical municipality. Furthermore, the growing conditions are optimal for a variety of species, including lower flammability species such as western larch that have commercial viability. It is critical that the development of the forest management plan incorporates recommendations and findings from the CWPP: a key objective of the forest management plan should include planning for a resilient forest in the face of increasing wildfire activity. Specific strategies to achieve this objective may include:

- Preferential harvesting of higher risk stands inside the Municipal Forest Reserve.
- Thinning of stands to create shaded fuel breaks.
- Innovative silviculture practices including the planting of lower flammability commercial species.
- Retention of deciduous trees during harvests.

Specific wildfire management recommendations for the MFR should be developed in coordination with the development of the forest management plan. This may require the inclusion of a forester with wildfire experience to provide professional advice on landscape level forest management in the context of the local wildfire risk.

Other fuel treatment recommendations

A number of the identified Critical Values at risk do not have a suitable defensible space from the adjacent forest areas. There are several facilities that are critical for supplying clean water that are located within forested areas with reservoirs that are often at the tops of slopes. Many of these are within natural forested areas and do not have adequate fuel free zones around them. The District should assess the condition of fuels and wildfire risk around all of their facilities and develop fuel treatment prescriptions with the target of establish a 30m defensible spaces around them.

Photo 14: Dense conifers posing a wildfire risk within 10m of a water reservoir.

Summary of fuel management recommendations

Number	Action Item
Rec 2	Develop fuel treatment prescriptions for interface fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).
Rec 3	Integrate wildfire management considerations into the development of the Forest Management Plan for the Municipal Forest Reserve.
Rec 4	Advocate to the Province for making threat and risk mapping publicly available for lands that are owned by public entities (i.e. BC Hydro).
Rec 5	Consult and coordinate with BC Hydro to create defensible spaces and reduce risk around all substations.
Rec 6	The District should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them.

Fuel treatment implementation and funding opportunities

Mitigation of fuels for the purpose of altering fire behaviour potential can be costly as merchantable timber is not necessarily targeted for removal. The following are options for funding to help implement the recommended treatment areas.

Community Resilience Investment Program (CRI).

This CWPP update was funded through the UBCM Community Resiliency Investment program. CRI contains a variety of funding categories, including Education, Planning, Training, and Fuel Management activities. The available funding for communities ranges from $25,000 annually for low risk communities, to $150,000 annually for higher risk communities. The District of North Cowichan will be eligible as a high-risk community for up to $150,000 annually for wildfire related projects. Applications for 2020 funding grants will be due in late 2020.

North Cowichan is eligible to apply for funding through this program for a number of the initiatives and recommendations within this CWPP. Some of the eligible activities include:

- Development of detailed fuel treatment prescriptions for priority interface fuel treatment areas by a qualified professional.
- Operational fuel management treatments in the priority interface fuel treatment areas
- Hosting of neighbourhood level FireSmart education initiatives and workshops
- Development of a new development permit area and supporting resources
- Interagency co-operation including meeting with the District, BCWS, and fire departments for training exercises
- S100 training for staff
- Establishing a rebate program to support treatment on private lands and fund off site debris disposal

First Nations Emergency Services Society of BC

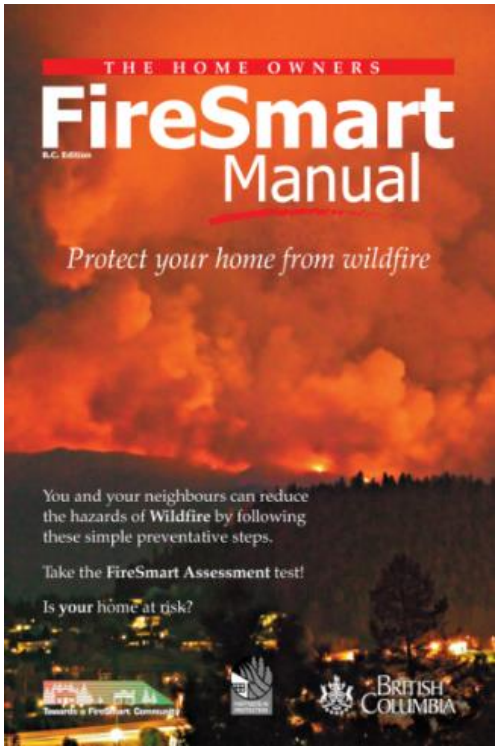
The First Nations Emergency Services Society of BC (FNESS) is a program that helps First Nations to develop and sustain safer communities. One of the programs is Forest Fuel Management which assists with wildfire prevention activities with a focus on Community Wildfire Protection Plans. The recommendations from this CWPP should be reviewed and applications made to this program to assist in their implementation.

Wildfire Risk Reduction Program

The Provincial government is transitioning to a new program for wildfire mitigation on crown land, the Wildfire Risk Reduction (WRR) program. Previously, public owned lands that did not qualify for funding through CRI could apply through the Forest Enhancement Society of BC (FES). The WRR will replace this, however at the time of writing this program was still being developed.

5.2 FireSmart Planning & Activities

During a large scale wildfire event the weather and topography cannot be controlled. For a private land owner, the factors that can be managed include the fire resilience of the structures and fuel conditions within the interface. This section provides recommendations to mitigate the risk of wildfire to existing and planned developments within the prioritized zones defined in the FireSmart Homeowners Manual (Partners in Protection and Province of BC, 2016).



During a wildfire homes are ignited as a result of:

- Sparks or embers landing and accumulating on vulnerable surfaces such as roofs, verandas, eaves and openings. Embers can also land on or in nearby flammable materials such as bushes, trees or woodpiles causing a fire close to a structure.
- Extreme radiant heat from flames within 30 m of a structure that melts or ignites siding, or breaks windows.
- Direct flame from nearby flammable materials such as bushes, trees or woodpiles.

A summary of FireSmart practices and activities that are eligible for CRI funding are provided in Table 20.

Figure 15 – Radiant heat and ember ignition. During a wildfire, homes are ignited as a result of radiant heat as well as embers carried by wind or convection.

The fire resistance of homes in the interface can be improved by achieving FireSmart standards for building materials, ignition sources and combustible fuels within each of the three FireSmart Priority Zones. In the event that a wildfire does threaten the area, suppression capability is improved with good access to the interface area, a defensible space to defend from and a good water supply.

Zone 1 is the area directly surround a structure out to 10m. In this area people and structures are at risk from radiant heat associated with a wildfire. It has been shown through analysis of recent large scale wildfire events such as the 2017 Fort McMurray fire that the most important factors in protecting structures is the exterior construction materials and immediate landscaping next to homes. The structure itself is sometimes considered on its own as the Home Ignition Zone (1A).

Zone 2 includes the area from 10 m to 30 m from a structure. In this area there is still a risk from radiant heat but also even earlier on from ember transport associated with a wildfire. Fuels are generally treated aggressively in this area to prevent a crown fire from establishing. Treatments include removal of ground fuel, thinning of trees and lift pruning of those retained.

Zone 3 includes the area from 30m out to around 100m. People and structures are at risk from ember transport associated with a wildfire in this area. Treatment of fuels in this area generally includes stand thinning and aims to prevent a crown fire but is generally not as aggressive as treatments in zone 2.

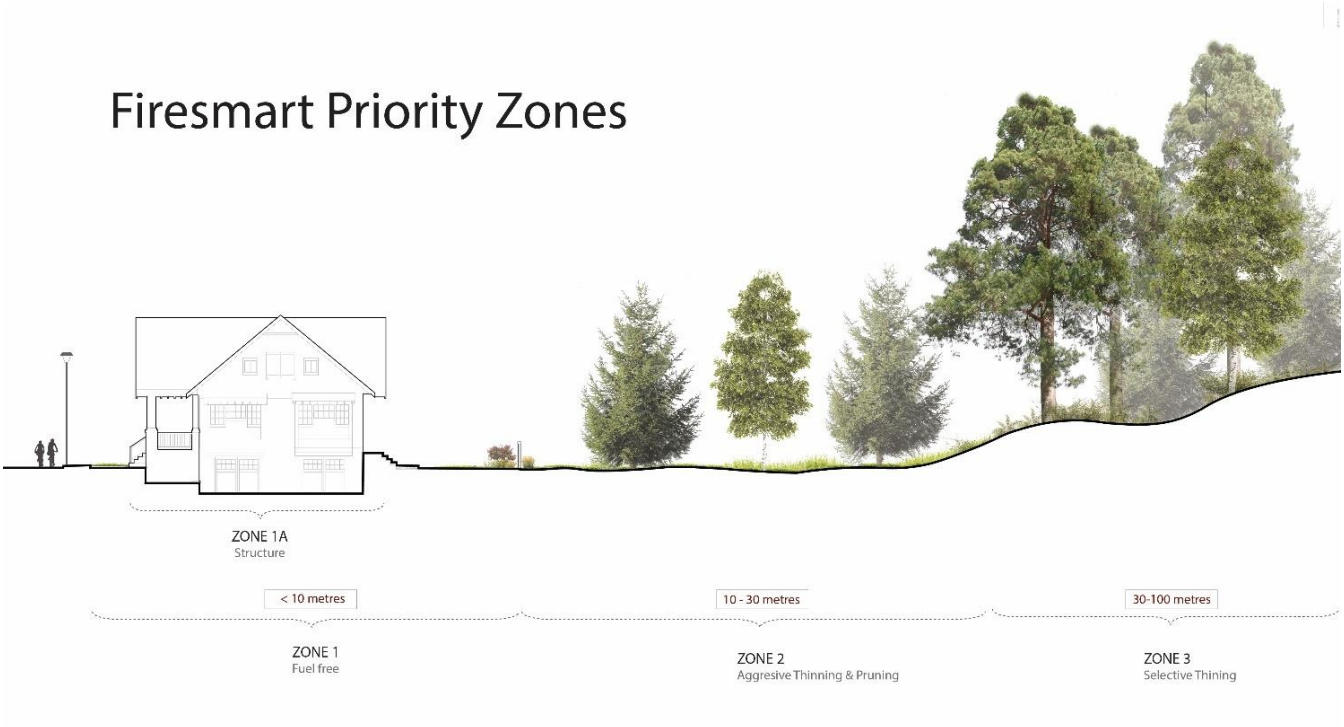


Figure 16 – FireSmart Management Zones

Photo 15: Examples of interface zones between critical structures and the forest

5.2.1 FireSmart Goals & Objectives

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 measures to minimize damages to assets on their property from wildfire. Objectives include:

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

5.2.2 Key Aspects of FireSmart for Local Governments and First Nations

The District has the ability to manage risks on public lands. However, the majority of structures at risk as well as interface fuels are located on private lands under which the District has limited influence. Neighbourhood level community based engagement can be effective in promoting FireSmart initiatives. This encourages residents to cooperate with each other for the mutual benefit of reducing risk to the neighbourhood.

Communities can apply for FireSmart Community Recognition status through FireSmart Canada. The District should encourage high risk neighbourhoods to establish wildfire awareness committees and apply for this status. This program includes resources for communities to establish a FireSmart Board and to designate Community Champions. Funding is available through FireSmart Canada to support activities aimed to reduce wildfire risk within communities.

New construction and landscaping can be addressed through a wildfire hazard development permit area (discussed below). However voluntary changes to existing structures and landscapes are required by private land owners. Education and outreach can provide some success on private lands. The District should distribute information on where residents can access wildfire awareness resources. These should include:

- http://www.bcwildfire.ca/Prevention/FireSmart.htm
- https://www.FireSmartcanada.ca/
- https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/wildfire-status/prevention/prevention-home-community/bcws_homeowner_FireSmart_manual.pdf

Materials to distribute should include the FireSmart Homeowner's manual which includes a questionnaire to help understand wildfire risk around private residences.

Table 20 FireSmart practices and activities

Category	Activity
1. Education	• Develop and/or promote local FireSmart educational activities and tools. Refer to BC FireSmart Resources for FireSmart materials that are currently available. • Develop and/or promote education for the reduction of human-caused fires • Encourage active participation in Wildfire Community Preparedness Day • Organize and host a community FireSmart day, FireSmart events and workshops, and wildfire season open houses • Apply for FireSmart Canada Community Recognition
2. Planning	• Develop or update a CWPP • Develop policies and practices for design and maintenance of FireSmart publicly owned land and First Nations land, such as parks and open spaces • Develop policies and practices for design and maintenance of FireSmart publicly owned buildings • Conduct site visits and FireSmart and/or risk assessments for publicly owned lands, First Nation lands and publicly owned buildings
3. Development considerations	• Amend Official Community Plans, Comprehensive Community Plans and/or land use, engineering and public works bylaws to incorporate FireSmart policies • Revise landscaping requirements in zoning and development permit documents to require fire resistant landscaping • Establish Development Permit Areas for Wildfire Hazard in order to establish requirements for the exterior design and finish of buildings1 • Include wildfire prevention and suppression considerations in the design of subdivisions (e.g. road widths, turning radius for emergency vehicles, and access and egress points) • Amend referral processes for new developments to ensure multiple departments, including the fire department and/or emergency management staff, are included
4. Interagency co-operation	• Develop and/or participate in regional or local FireSmart planning tables • Participate in multi-agency fire and/or fuel management tables
5. Emergency planning	• Develop and/or participate in cross-jurisdictional meetings and tabletop exercises, including seasonal readiness meetings • Review structural protection capacity (i.e. Fire safety assessments)
6. Cross training	• Cross-train fire departments to include structural fire and interface wildfire training (e.g. S-100) • Provide or attend training for Local FireSmart Representatives and community champions • Support professional development to increase capacity for FireSmart activities
7. FireSmart Demonstration Projects	• Undertake FireSmart Demonstration Projects for publicly owned buildings or publicly and provincially owned critical infrastructure. This may include: ○ Replacing building materials (i.e. siding or roofing) with fire-resistant materials

[1] Local governments should refer to Changes for Local Governments Under Section 5 of the Building Act: Appendix to Section B1 of the Building Act Guide (Revised February 2017) for information on the use of development permits for wildfire hazard.

	○ Replacing landscaping with fire-resistant plants as outlined in the FireSmart Guide to Landscaping
8. FireSmart Activities for Private Land	• Planning for private land (only with private property owners' consent) ○ Develop FireSmart Community Plans for specific areas ○ Conduct FireSmart home and property assessments • Offer local rebate programs to home owners on private land and First Nations land that complete eligible FireSmart activities on their own properties • Provide off-site debris disposal for private land owners who have undertaken their own vegetation management, including: ○ Provide a dumpster, chipper or other collection method ○ Waive tipping fees ○ Provide curbside debris pick-up

5.2.3 Priority Areas of Interest for FireSmart

FireSmart planning and outreach to communities should focus in neighborhoods at greatest risk. A number of these neighborhoods are built adjacent to large tracts of forests that have moderate to high fire behavior potential. Some general neighborhoods to consider focusing on for FireSmart initiatives and educational outreach include:

- Chemainus;
- Crofton;
- Genoa Bay;
- Maple Bay;
- Arbutus Point; and
- Upper slope residences adjacent to Mt Tzouhalem.

Table 21 Summary of FireSmart priority areas.

Area ID	Wildfire Risk Rating (E/H/M/L)	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Crofton	H	N	N	A comprehensive FireSmart plan is recommended for all areas. This should include communications and engagement goals, educational outreach, coordination with the BCWS, and FireSmart assessments. A committee made up of representatives from the District, Fire Department, BCWS, First
Maple Bay	H	N	N	
Arbutus Point	H	N	N	
Chemainus	M	N	N	
Genoa Bay	M	N	N	

Tzouhalem	M	N	N	Nations, and homeowners should guide the development of this plan.

Summary of FireSmart recommendations

Number	Action Item
Rec 7	Develop neighbourhood level FireSmart plans for the above priority neighbourhoods. This should include neighbourhood level FireSmart committees with the District, Fire Department, BCWS, and First Nations representative. This should also include a variety of strategies with the objective of increasing private land resilience to wildfire. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 8	Use recommended interface fuel treatment areas to promote similar projects on private lands. Showcase these treatments though a "FireSmart Day" with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 9	Develop and distribute FireSmart brochures to all houses within higher risk interface areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 10	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 11	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Private Land).

Wildfire Development Permit Area

A key challenge within the District is managing the wildfire hazard on private land. This is recognized in the Policy 2.2.3.4 of the Official Community Plan: "The Municipality will reduce risks to life and property in fire-prone areas." This can be achieved through the establishment of a Wildfire Development Permit Area. This enables the District to guide the development of neighbourhoods that can further the objective of increasing wildfire resiliency inside the community. Key strategies of the DPA for reducing wildfire risk to the overall community include:

- Increase the resiliency of development within the Wildland Urban Interface to wildfire by ensuring that all new homes are in compliance with FireSmart guidelines.
- Ensure that new buildings are constructed using FireSmart materials.

- Ensure that new buildings use FireSmart landscaping.
- Include requirements for overall neighbourhood safety in the event of a wildfire. This should include adequate access for fire suppression vehicles, adequate hydrant servicing, and water supply.
- Include requirements that ensure that land covenanted to the District as part of development are not High hazard.
- Require professional reporting and sign off as part of a development permit. This should require review of plans prior to application, as well as post-construction assessment to confirm construction complies with development permit requirements.

Not all areas should be included in the Wildfire DPA. Mapping analysis is required to determine the extents of the DPA, especially given the fragmentary nature of the WUI in the AOI. This can be determined by proximity to higher risk conifer fuels, density of development adjacent to fuels, or a combination of both. The development of the DPA should be done by a wildfire specialist in consultation with District staff to ensure that it is properly located for reducing the overall wildfire risk to the community, that the DPA contains sufficient requirements for reducing wildfire risk, and that the DPA can be easily implemented and enforced by District staff.

Number	Action Item
Rec 12	Include Wildfire as a Development Permit Area. The specific requirements and GIS area for this DPA should be developed with a Wildfire specialist. This should aim to include areas that are within 100m of moderate, high, or extreme Wildfire Threat/Risk as a starting point. The specific language should include FireSmart construction materials and landscaping, and the removal of hazardous fuels. Specific objectives should be established, as well as recommended strategies to meet those objectives. This DPA should also include professional review and sign off. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI #3 Development Considerations).
Rec 13	Ensure that Wildfire DPA applications are reviewed by District or Fire Department staff to ensure the objectives of the DPA are achieved. This will require coordination between District staff and Fire Department staff.

5.3 Community Communication and Education

Public engagement on community wildfire protection is an important action to support implementation of the plan and increase its effectiveness. Engagement can extent beyond explaining the purpose and function of the plan to address the contribution of forest cover and urban development on privately owned lands to fire hazard. As in many BC municipalities, a majority of the hazardous forest fuels in North Cowichan are located on privately owned lands. Building awareness of wildfire hazard and potential actions on public land can encourage property owners to consider and participate in community wildfire prevention through programs such as FireSmart. The following are general recommendations to be considered in preparing public communications or an education programme.

There are two main strategic goals of community communication and education:

1. Raising knowledge and awareness of wildfire risk and prevention; and
2. Encouraging informed individuals and community-based volunteer organizations to contribute to wildfire prevention through guided action on public and private land.

To support these goals, an effective community communication and education strategy will consider a) the appropriate audience or target for communications, b) appropriate desirable actions for the public in wildfire prevention, and c) the opportunities to create or adapt existing contacts between the municipality and the public for information sharing.

The Community Wildfire Protection Plan applies across the District of North Cowichan and is of interest to all residents, people doing regular business in the town, and neighbouring jurisdictions. Communication of the plan should be undertaken on a broad basis for the entire municipality and to neighbouring jurisdictions, including First Nations. However, a higher level of engagement is appropriate for specific groups that are the most likely to influence plan implementation. Homeowners near the interface zone, developers of subdivisions and new communities, and youth/schoolchildren are three audiences for communications and education who may have a higher level of influence on implementation success.

Homeowners and Developers

Homeowners and developers occupy a large percentage of the area's land base and can have direct impacts on the severity of forest fuel hazards on private land as well implement FireSmart construction. The appropriate desirable action for these groups is to work towards adopting FireSmart planning (5.3) in the maintenance of their owned properties and in the planning of new buildings or landscape improvements. Because of the dominance of private land within the District, supporting homeowners and developers to implement FireSmart is an important objective to achieve strategic goals in wildfire prevention and reduce the risk of wildfire to values in the community overall. Additional desirable actions for homeowners may be to form neighbourhood associations to encourage maintaining fuel-free areas around homes, reduce ignition sources, and report fuel hazard issues on public lands. Additional desirable actions for developers may be to partner with the municipality in providing landscape maintenance, conservation easements, and sites for ecological restoration to help maintain forest health and hazard levels in interface areas. Some actions may be supported through regulatory requirements, as under the District's existing Hazard Lands Development Permit Area.

Important existing contacts between these groups and the municipality are administered through the building and development permit process. Front counter requests and applications open the communication channel between the municipality and private landowners. Early in the process, the District should provide information on wildfire prevention and FireSmart resources to applicants. Deeper engagement at this stage could include offers to arrange site visits of FireSmart District properties as a form of extension service. Plan checking activities associated with development

applications offer the municipality important insight into the uptake of design supportive to wildfire prevention and may demonstrate common deficiencies that can be addressed through pre-emptive information sharing.

The District should make efforts to reach homeowners in interface areas who have not applied for a development permit. A summary of this CWPP, the associated maps of wildfire risk, and the Homeowners FireSmart Manual should be distributed to residents within 100m of moderate to high risk natural areas. These materials should also be made available at public locations, including the Municipal Hall, community centres, and libraries. The District should prepare front counter staff at Municipal Hall to address inquiries about wildfire prevention and direct residents to additional information. When a fuel treatment program is planned, an open house should be organized and used as a forum to inform and educate residents, with direct notification of households in adjacent neighbourhoods. Communication around the treatment can include information on appropriate activities to remove fuels or otherwise mitigate residual risk on private property.

Youth

Although youth rarely have the ability to directly influence the design of buildings or communities, they volunteer on environmental issues at higher rates than the general population, most are already organized into school groups that can be efficiently targeted with wildfire prevention information, and can significantly and rapidly impact the awareness of the community at large through their social and family networks. By actively engaging youth, the District can encourage the next generation of citizens to be educated and active in wildfire planning and management.

Desirable actions for youth include participating in environmental protection activities as volunteers in District parks and public lands and advocating within their families and social networks for increased wildfire prevention awareness or actions to reduce wildfire risk. Youth should also be encouraged to participate in the public process around community planning and design.

The District should explore educational opportunities in the school system. Classroom visits to the Municipal Forest Reserve are already a common point of contact between the Parks, Forestry, and Recreation Department and North Cowichan's youth. The basics of forest fuels as they relate to wildfire risk and hazard should be introduced during these contacts, with the District providing supporting information where possible to teachers for incorporation into larger lesson plans. The site of the recent Maple Mountain fire can act as an important visual teaching aid during field trips for many years to come.

Other opportunities exist within the school system. The Fire Department makes visits to school buildings for educational, community outreach, and public safety purposes. One or more of these visits could be combined with classroom presentations on Fire Safety, particularly how FireSmart principles can be used to decrease the likelihood of a wildfire destroying homes and buildings. Wildfire behavior and prevention overlap with many of the program areas within BC's new curriculum and there is potential

for the municipality to encourage and support School District 79 in developing a forests and wildfire module for inclusion in one or more offered courses. A model or possible vehicle for this kind of initiative is the District's Environmental Education Program, which brings an employee of the District, typically a secondary student or recent graduate, to develop and implement an educational workshop for elementary school students.

Outside of the classroom, environmental stewardship initiatives can have positive impacts for wildfire prevention by controlling forest fuels or limiting sources of ignition in interface areas. Multiple environmental groups are active within the District and could be partnered to deliver wildfire prevention information to event participants. There may be potential for environmental stewardship groups to participate in fuel hazard maintenance through manual removal of leaf litter and debris on public land. The District can support such activities through in-kind or cash contributions.

General outreach strategies

Broad-based engagement can take place in-person at community events and online. When large planned public events take place in the District, a representative from the Parks, Forestry, and Recreation or Fire Departments should be present to hand out educational material and help raise wildfire awareness.

The District should create a unique page on its website to present wildfire prevention information with the CWPP and related resources. Such a webpage should include links to the Provincial and Federal websites on wildfire awareness and the FireSmart program. The concept for the webpage is a "virtual open house", providing residents useful information and the flexibility to participate in wildfire prevention at their discretion. Online materials are an effective means of communicating with individuals who do not have time or cannot physically participate in open house and local events.

Video can be a compelling way to craft a narrative around wildfire prevention and share engaging stories of implementation success. Videos could include demonstrations of FireSmart construction and landscaping on property, testimonials from residents, environmental volunteers, school groups, or others who have participated in wildfire prevention, and reference information for development applicants. YouTube is a free and effective means to distribute educational material, where the Municipality already maintains a "channel" or homepage. Video can also be a way to invite the community to upcoming public events where more detailed wildfire information will be available.

A common, easy to implement wildfire awareness strategy is to place signs around the District at the public entrance of important natural areas. These should indicate the current Fire Danger level, restrictions during the fire season and the emergency number to call when a fire is detected (911, or for provincial response 1-800-663-5555 or *5555 from a cellular phone). Signs should be bold and placed in clear view, particularly at all major through routes into the District and all recreation sites in natural areas. The District should coordinate with the Ministry of Forests Lands, Natural Resource Operations

and Rural Development or owners of private property to place signs where required at desirable locations.

Summary of communication and education recommendations

Number	Action Item
Rec 14	When public events are planned to occur in, through, or near natural areas, a wildfire risk management checklist is created for vetting applications against. Vetting should include review and comments by the parks and fire departments prior to event approval. Have the public information brochure prepared in conjunction with this CWPP update available for distribution at these events.
Rec 15	Incorporate wildfire prevention and preparedness into presentations by the Parks, Forestry & Recreation department to schools, particularly when schools visit the Municipal Forest Reserve or District-owned lands. Consult with Cowichan Valley School District 79 on incorporating wildfire prevention and preparedness into the school curriculum.
Rec 16	Update the District's digital media, including multimedia and web content, to reflect this CWPP update. The District should create and host on its own website a webpage for wildfire awareness, to contain appropriate reference material for FireSmart Canada, BC Wildfire Service, and any other suitable resources as determined by representatives of the Parks, Forestry, and Recreation, Development Services, and Fire Departments.

5.4 Other Prevention Measures

Sources of ignition can be human, or lightning caused. Lightning caused ignition is difficult to predict or manage. Human caused ignitions, however, can be prevented and are the source of about one half of all wildfires in BC. The most common sources of human caused fires include:

- Campfires
- Industrial activity
- Discarded cigarettes and matches
- Vehicles
- Railways
- House-related fires
- Power lines
- Vandalism.

Predicting and preventing human caused ignitions is a cost-effective component of a wildfire prevention program. This is best achieved through public education campaigns. Road-side ditches and medians that contain grasses should be mowed periodically throughout the fire season. This will reduce fuel loading (standing cured grass) and reduce the ignition potential associated with vehicles, heavy machinery, and cigarettes during the fire season. Signs should be posted at camp sites, recreation areas and high use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires and not discard cigarettes.

There is also ignition potential from the numerous residences that back up against the interface. Private residents adjacent to wildland (grass or forested) should be reminded (e.g. through public bulletins or media notices) of common risks of ignition in these forested landscapes. A social media campaign in the late spring and early summer should be considered to enforce awareness of wildfire risk and the publics responsibility to prevent ignitions.

Trees can potentially fall on power lines, which can pose a fire risk. Risk is managed primarily by utility companies with regular assessments and tree hazard mitigation programs. The District should continue dialogue with BC Hydro to ensure they are removing hazardous trees from forested natural areas that could strike the power lines.

Photo 16: Power lines adjacent to forests are sources of ignition if trees or branches fail onto the lines.

Summary of prevention recommendations

Number	Action Item
Rec 17	Ensure all road edges are mowed frequently during the summer months when the fire hazard rating permits

Rec 18	Post wildfire danger signage along major transportation corridors, at campsites, parks and recreation, and at high use trail heads areas. Signages should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires and properly dispose of cigarettes.
Rec 19	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.
Rec 20	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated.

5.5 Summary of Recommendations

Below is a summary of all recommendations in Section 5.

Number	Action Item
Rec 2	Develop fuel treatment prescriptions for interface fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).
Rec 3	Integrate wildfire management considerations into the development of the Forest Management Plan for the Municipal Forest Reserve.
Rec 4	Advocate to the Province for making threat and risk mapping publicly available for lands that are owned by public entities (i.e. BC Hydro).
Rec 5	Consult and coordinate with BC Hydro to create defensible spaces and reduce risk around all substations.
Rec 6	The District should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them.
Rec 7	Develop neighbourhood level FireSmart plans for the above priority neighbourhoods. This should include neighbourhood level FireSmart committees with the District, Fire Department, BCWS, and First Nations representative. This should also include a variety of strategies with the objective of increasing private land resilience to wildfire. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 8	Use recommended interface fuel treatment areas to promote similar projects on private lands. Showcase these treatments though a “FireSmart Day” with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 9	Develop and distribute FireSmart brochures to all houses within higher risk interface areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).

Rec 10	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 11	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Private Land).
Rec 12	Include Wildfire as a Development Permit Area. The specific requirements and GIS area for this DPA should be developed with a Wildfire specialist. This should aim to include areas that are within 100m of moderate, high, or extreme Wildfire Threat/Risk as a starting point. The specific language should include FireSmart construction materials and landscaping, and the removal of hazardous fuels. Specific objectives should be established, as well as recommended strategies to meet those objectives. This DPA should also include professional review and sign off. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI #3 Development Considerations).
Rec 13	Ensure that Wildfire DPA applications are reviewed by District or Fire Department staff to ensure the objectives of the DPA are achieved. This will require coordination between District staff and Fire Department staff.
Rec 14	When public events are planned to occur in, through, or near natural areas, a wildfire risk management checklist is created for vetting applications against. Vetting should include review and comments by the parks and fire departments prior to event approval. Have the public information brochure prepared in conjunction with this CWPP update available for distribution at these events.
Rec 15	Incorporate wildfire prevention and preparedness into presentations by the Parks, Forestry & Recreation department to schools, particularly when schools visit the Municipal Forest Reserve or District-owned lands. Consult with Cowichan Valley School District 79 on incorporating wildfire prevention and preparedness into the school curriculum.
Rec 16	Update the District's digital media, including multimedia and web content, to reflect this CWPP update. The District should create and host on its own website a webpage for wildfire awareness, to contain appropriate reference material for FireSmart Canada, BC Wildfire Service, and any other suitable resources as determined by representatives of the Parks, Forestry, and Recreation, Development Services, and Fire Departments.
Rec 17	Ensure all road edges are mowed frequently during the summer months when the fire hazard rating permits
Rec 18	Post wildfire danger signage along major transportation corridors, at campsites, parks and recreation, and at high use trail heads areas. Signages should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires and properly dispose of cigarettes.
Rec 19	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.
Rec 20	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated.

Section 6 Wildfire Response Resources

This section provides a summary of the suppression response protocol and resources available to the communities as well as recommendations for improvement.

Wildfire Detection and Reporting

The District has a complicated and unique situation with regards to wildfire reporting. A majority of the AOI is private forested land in the MFR. Wildfire detection and reporting for these areas are the responsibility of the District, and detection would occur through 911 public calls. Fire detection on public crown land is the responsibility of BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD). Fires are located using a lightning locator system, aerial patrols, and public observation. While FLNRORD is not responsible for detection on MFR lands, there systems do overlap the MFR and would likely detect any wildfires.

In urban centers a wildfire is most likely to be detected and reported quickly by the public. Wildfire awareness signs should be posted at strategic locations (major transportation corridors, recreation areas and high use trail heads) that specify how to report a wildfire in the District.

Wildfires on crown land should be reported to the Provincial Forest Fire Reporting Center in Victoria through their toll free number 1-800-663-5555 or *5555 on a cellular phone. The agent will then collect as much information as possible regarding the fire and its characteristics including:

- The exact location of the fire
- Its estimated size
- The type of fuel burning
- How fast the fire is spreading and in what direction
- The colour of the smoke
- The location of any structures or lives at risk from the fire

While wildfires on MFR land should be reported using 911, the general public cannot be expected to be aware of the differences in reporting requirements inside the District. Signs should include both numbers to ensure wildfires are reported immediately. Contact details as well as the requirement for this information should be included in any public education campaigns.

6.1 Local Government and First Nation Firefighting Resources

6.1.1 Fire Departments and Equipment

The AOI is serviced by the North Cowichan Fire Department. This volunteer staffed fire department has four halls throughout the AOI, each of which is well equipped with engines and fire suppression equipment. Since the District owns a majority of the forested land in the AOI as part of the Municipal Forest Reserve, a majority of the initial wildfire response is the responsibility of the District Fire

Department. If a wildfire is beyond the capabilities of the fire department, assistance is provided by the BCWS. This has been the case in previous wildfire incidents, most notably in the 2018 Maple Mountain wildfire. During this incident, the BCWS was severely short-staffed, and thus the majority of the operation was handled by the North Cowichan Fire Department. It is critical that mutual aid fires that occur inside the AOI have a seamless and integrated response by BCWS and the local fire department; this can be achieved through training exercises that allow these agencies to work together and develop working relationships that can improve wildfire operations in the interface.

Table 22 Summary of Fire Suppression Resources

Fire Department	Volunteer staff, minimum certifications	Equipment
North Cowichan	• 112 Volunteer staff – a mix of NFPA 1001 level 2 and OFC Playbook interior level operations • Haz Mat operations trained but awareness response • Wildland SPP-WFF1 trained and SPU trained • Medical FR level 3 with spinal and AED trained • Low slope rope rescue • 1 Admin Chief NFPA 1021 level 3 Emergency incident management 3 ICS 300 SPP-WFF1 NFPA 1006 level 2 (rope, confined space, high angle, tower crane)	• Chemainus Hall 3 engines, 1 rescue, 1 UTV, 1 pick up • Crofton Hall 2 engines, 1 2500 gal tender, 1 pickup • Maple Bay 2 engines, 1 mini pumper, 1 pickup • South End 2 engines, 1 rescue, 1 Ladder truck, 1 UTV, 1 pickup truck

It is recommended that the District purchase Structural Protection Units (SPU). These are designed to protect against wildfire in the urban interface. The District is currently completing the packaging of one SPU, which is located at the District office. SPUs' are deployed during an interface fire to dampen roofs and areas around structures, to help prevent sparks and embers from igniting structural fires. These SPUs typically consist of pumps, sprinkler kits, foam and supporting equipment such as ladders, lights and generators. Contact the UBCM for specific advice on purchasing and the contents of an SPU.

Summary of fire department recommendations

Number	Action Item
Rec 21	Conduct interagency wildfire suppression training and annual mock wildfire response exercises in cooperation with the BC Wildfire Service. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec 22	Establish a mutual aid agreement between the District and the Regional District Fire Protection Areas to enable sharing of suppression resources when responding to a wildfire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec 23	Purchase and maintain two Structural Protection Units (SPU) with capacity to protect approximately 35 structures and train staff on their proper deployment.

6.1.2 Water Availability for Wildfire Suppression

Water is the single most important resource for suppression activities. Where hydrant coverage is limited, particularly in rural settings, alternative water sources such as reservoirs, lakes, and rivers should be located, assessed, and mapped. These provide sites for helicopter bucketing and pump sites for suppression crews. When new areas are planned for development, an adequate number of fire hydrants should be established in strategic locations that can access not only structures but also the interface zones.

Fire Hydrants are the main source of water delivery for fire suppression inside the District of North Cowichan. This infrastructure is reliant on the power grid to operate wells. There is a wide distribution of above ground reservoirs throughout the AOI, which can provide a limited supply of water if the water network is compromised. The AOI is subject to frequent water restrictions during periods of summer drought, which can limit the availability of water for wildfire suppression during peak wildfire season.

Summary of water and suppression recommendations

Number	Action Item
Rec 24	Complete an analysis of water availability in the AOI to identify strategic locations for water tanks and dry standpipes in high risk neighbourhoods with poor water availability. Identify and map alternative water sources including reservoirs, lakes and perennial rivers.

Rec 25	Require that all new fire hydrants systems for new development areas are able to serve adjacent high-risk interface areas.

6.1.3 Access and Evacuation

The primary concern when dealing with a wildfire is public safety and if necessary, their evacuation. The District should develop a comprehensive evacuation plan in case of wildfire or other large disaster. The objective of an evacuation plan is to ensure all people can be evacuated safely and to facilitate effective wildfire control measures. The District maintains a voluntarily eALERT service to inform residents of critical indicants in the municipality. This allows residents to sign up for digital notifications from the District during critical incidences.

After a wildfire is detected, the threat that it poses to the public should be quickly evaluated. The location, direction and rate of spread of the fire will indicate where the greatest risk is to public safety. The Wildfire Service and the Office of the Fire Commissioner, in communication with the District, will decide at what point during the wildfire event an evacuation is justified. Local police, RCMP and the local fire department are then responsible for implementing the evacuation.

The District should be aware of those populations that may require special assistance to evacuate. These include primary schools and day care, assisted living and care homes, and hospitals. All departments within the District should be aware of their responsibilities during an evacuation. This includes, but is not limited to: the police department, fire department, public works, utilities, and parks and recreation.

During a wildfire event, the movement of residents and suppression resources is critical. The AOI is generally well accessed, with egress routes in a variety of directions. Highway 1 is a major transportation route for the broader region and is capable of accommodating large volumes of traffic in an emergency. Highway 18 is another egress route which can be used to evacuate west. There are also secondary highways throughout the AOI that could be used to accommodate excess volumes. Road systems that have dead ends are a concern for evacuation. There are some less developed areas of the District that only have one access road. Alternative access routes to these areas should be considered during future land-use planning. Specific examples are Genoa Bay, Stoney Hills Road and Arbutus Ave.

A key concern inside the AOI is the large number of private roads that are gated. These include gates inside the MFR, but also private industrial roads to service private forested land in and adjacent to the AOI. These gates roads have been developed for industrial use in forest harvesting, and are not used as the normal access for residences. However, these could be used in the event of a wildfire for added evacuation capacity. This would require coordination with the forest operators that manage these roads, as well as the MFR. In the event of a wildfire that requires use of these roads, the District fire department has a set of keys and maps that are used to ensure adequate access for wildfire suppression. These maps and copies of these keys should be provided to the local ministry staff to ensure effective wildfire suppression.

There are a number of industrial sites, including saw mills, that require lengthy time to safely shut down their operations if they were to be evacuated. These facilities, contact information, and specific requirements should be maintained by the District to coordinate a safe evacuation.

Summary of access and evacuation recommendations

Number	Action Item
Rec 26	Continue to encourage residents to sign up for eALERT system.
Rec 27	Compile a spatial inventory of backroad, trails and gates for suppression access. Work with recreation groups and industrial operators to maintain roads through natural areas for wildfire suppression access and ensure local fire departments and BCWS have copies of gate keys and maps of gate locations.
Rec 28	Obtain keys, gate locations, and maps for private forest roads inside the AOI that may be required for evacuation and access. Develop a safety plan with industrial operator for use of these roads.
Rec 29	Develop on-line/social media that is coordinated with FLNRORD for distributing up to date info on wildfire threat and potential evacuation alerts.
Rec 30	Identify neighbourhoods that have only one main road in and out for evacuation. Consider developing alternative access for these areas through future land use planning.

6.1.4 Training

Early response time to an ignition is critical to controlling its spread. District staff and volunteer firefighters are often the first on a scene of a wildfire. Basic wildfire training and ensuring personnel have suitable equipment during the summer months could ensure early suppression of new ignitions. All District field staff and volunteer firefighters should undertake S100 Introductory fire suppression training. Annual updates to this training called S-100A is required to keep this certification current. Select firefighters should also take S-185 Fire Entrapment Avoidance and Safety, as well as Incident Comman System (ICS) 100 training to ensure seamless integration with the BCWS in operation.

The 2018 Maple Mountain wildfire showed that the District may be expected to play a large role in wildfire suppression, especially during peak wildfire season (July and August). The BCWS often spread thin during these busy months, and response and suppression resources may be limited. The District should conduct and coordinate annual training exercises with the BCWS to streamline operations in the events of a wildfire.

Summary of training recommendations

Number	Action Item
Rec 31	Cross-train structural fire fighters, as well as District staff that are frequently working in the interface areas in S-100 Basic Fire Suppression and Safety. Select firefighters should receive SS-185 Fire Entrapment Avoidance and Safety training, as wellas ICS 100 trianing.. Apply for

	funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).
Rec 32	Train District staff who would potentially work in a liaison role with fire suppression agencies in Incident Command Training to streamline integration with the Incident Command System as it is established. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).

6.2 Structure Protection

Structure protection discussed above in section 6.1.1.

6.3 Summary of Recommendations

Below is a summary of all recommendations in Section 6.

Number	Action Item
Rec 21	Conduct interagency wildfire suppression training and annual mock wildfire response exercises in cooperation with the BC Wildfire Service. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec 22	Establish a mutual aid agreement between the District and the Regional District Fire Protection Areas to enable sharing of suppression resources when responding to a wildfire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #4 Interagency Co-operation).
Rec 23	Purchase and maintain two Structural Protection Units (SPU) with capacity to protect approximately 35 structures and train staff on their proper deployment.
Rec 24	Complete an analysis of water availability in the AOI to identify strategic locations for water tanks and dry standpipes in high risk neighbourhoods with poor water availability. Identify and map alternative water sources including reservoirs, lakes and perennial rivers.
Rec 25	Require that all new fire hydrants systems for new development areas are able to serve adjacent high-risk interface areas.
Rec 26	Continue to encourage residents to sign up for eALERT system.
Rec 27	Compile a spatial inventory of backroad, trails and gates for suppression access. Work with recreation groups and industrial operators to maintain roads through natural areas for wildfire suppression access and ensure local fire departments and BCWS have copies of gate keys and maps of gate locations.
Rec 28	Obtain keys, gate locations, and maps for private forest roads inside the AOI that may be required for evacuation and access. Develop a safety plan with industrial operator for use of these roads.
Rec 29	Develop on-line/social media that is coordinated with FLNRORD for distributing up to date info on wildfire threat and potential evacuation alerts.
Rec 30	Identify neighbourhoods that have only one main road in and out for evacuation. Consider developing alternative access for these areas through future land use planning.
Rec 31	Cross-train structural fire fighters, as well as District staff that are frequently working in the interface areas in S-100 Basic Fire Suppression and Safety. Select firefighters should receive SS-185 Fire Entrapment Avoidance and Safety training, as wellas ICS 100 trianing.. Apply for funding

	for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).
Rec 32	Train District staff who would potentially work in a liaison role with fire suppression agencies in Incident Command Training to streamline integration with the Incident Command System as it is established. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).

Appendix 1 Local Wildfire Threat Process

A1.1 Fuel Type Attribute Assessment

The fuel typing layer is the primary geospatial data input used to estimate Wildfire Risk in a community. The fuel type layer is provided by the province through the Provincial Strategic Threat Analysis (PSTA) to inform the development of CWPPs. This layer is created on a broad scale province-wide to classify fuels according to the Canadian Forest Service Fire Behavior Prediction System (FBP). This layer is generated from multiple data sources including forest inventory mapping and silvicultural submissions to RESULTS.

The PSTA fuel typing layer is not shown on private lands. It can also be inaccurate in areas that are not inventoried for forest activities. The District of North Cowichan is heavily fragmented by private land, and also contains the privately owned (by the municipality) Municipal Forest Reserve. The PSTA Fuel Type layer provided by the province was coarse and highly pixelated and did not accurately represent the forest conditions to a level that could be used in the CWPP. Figure 17 illustrates the level of detail within the PSTA fuel layer.

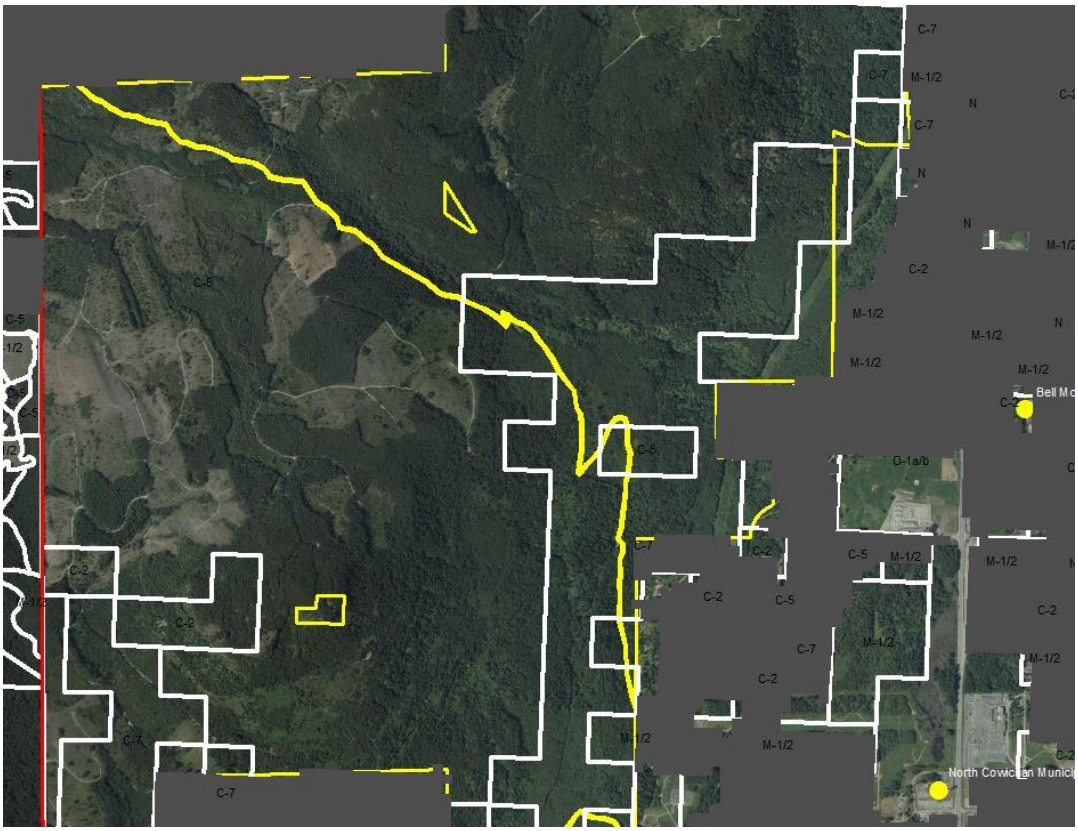


Figure 17 – Example of PSTA fuels layer illustrating the low level of accuracy

The fuel typing layers and subsequent fire behavior modeling provide critical analysis for assessing the risk from wildfire and to identify mitigation options within a CWPP. The District recently completed Vegetation Resource Inventory (VRI) mapping within the District that accurately represents the forest conditions. This spatial linework and data was analysed to classify fuel types within the AOI. The following is a summary of the process and rationale used for this analysis.

1. Separate polygons into fuel type "groups". Leading species from the VRI attribute table was used to separate tree stand into conifer, mixed, and deciduous stands. Conifer stands were trees with over 75% conifer, mixed were stands with 25-75% conifer, and deciduous were any stands with less than 25% conifer component. Non-tree polygons (ie: recently harvested polygons) were aggregated into another group.

2. Fuel types were stratified based on the provincial fuel type layer overview report (Perrakis & Eade, 2015), and the decisions made for the provincial layer were replicated where possible. These are summarized below:

    a. C-2:Young immature conifer stands. Typically 10 year old plantation of 100% conifer less than 10 m in height. Rare in the assessment area.

    b. C-3: Young stands of mostly Douglas-fir that is 40-80 years old. Heights in this fuel type varied between 18 and 30 m.

    c. C-4: Pole sapling stand of mostly Douglas-fir that is 20-40 years old. Heights in this fuel type varied between 10 and 20 m. Higher density stands with high crown closure. Rare in assessment area.

    d. C-5: Mature stands of mostly Douglas-fir that is older than ~80 years. Heights in this fuel type are generally greater than 30m. These stands have a lower density with large fuel strata gaps.

    e. C-7: 100% conifer stands with a low crown closure. These stands have low densities with canopy gaps separating the crowns of trees.

    f. M-2: These include stands of varying ages that have a mix of deciduous and conifer tree species.

    g. D-1: These include stands of varying ages that are dominated by deciduous trees or shrub communities.

    h. S03 – Areas recently harvested were classified into slash fuel types.

3. The outputs from the initial fuel type classifications were quality controlled using recent aerial imagery. Obvious errors in fuel typing were identified. Examples included areas types as forest but which had been recently harvested. Recent harvesting not captured by VRI

were generally typed as S-3, given the likely levels of slash post-harvest in this region of the South Coast. In some areas the VRI-derived fuel type was classified as grass or slash, but the polygon in the aerial imagery is clearly treed. These were classified using air photo interpretation and referencing the nearest treed polygons.

4. Field work was conducted to ground truth the fuel layers. Polygons adjacent to values were visited by foresters and the accuracy of the fuels typing layer confirmed.

5. Following field assessments, the spatial fuels layer was finalized.

The algorithm used for fuel typing went through several iterations before it was considered complete and accurate. Ground truthing of the fuel typing confirmed that it was accurate. Below (Figure 18) is an example of the final fuels layer, which is the same location as Figure 17.

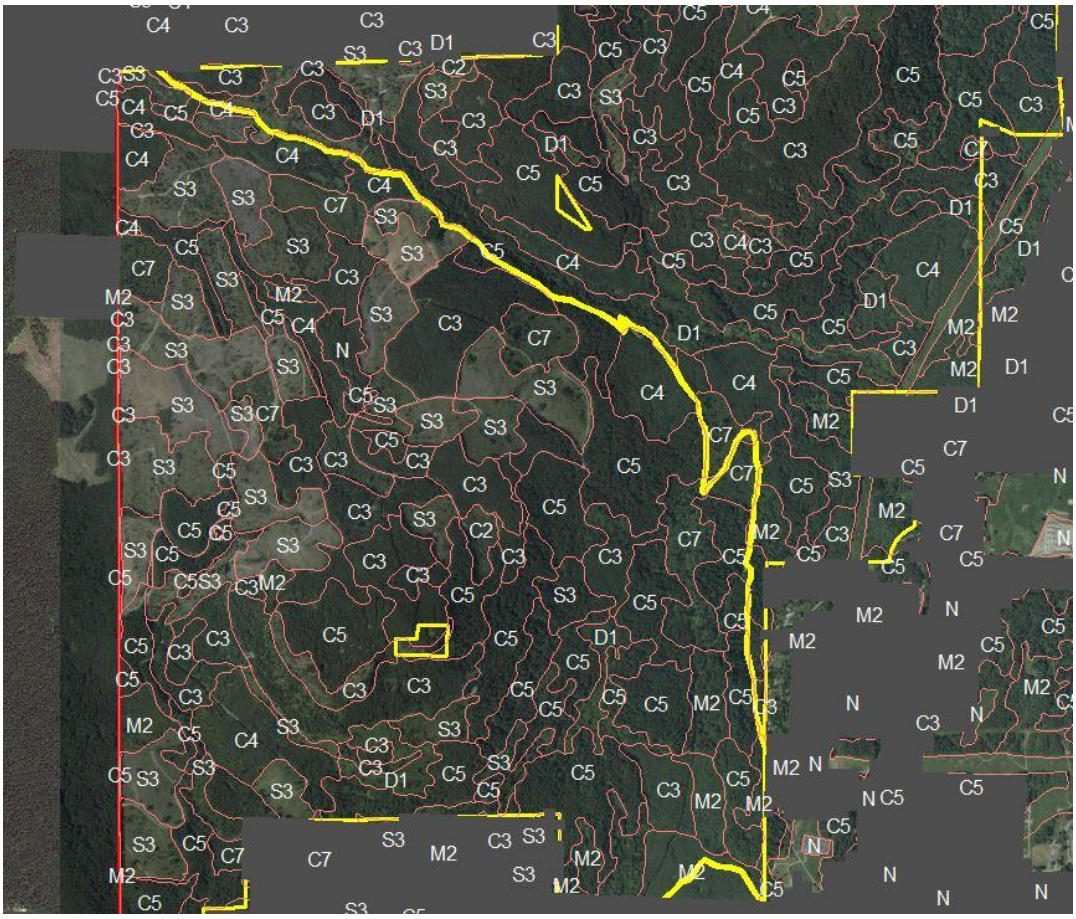


Figure 18 – Example of updated fuels layer.

The final findings from the fuel typing are summarized in the below table.

Table 23 Fuel Type Categories and Crown Fire Spot Potential.

Fuel Type Classification	Total Area (ha)	% of area	Crown Fire Spot Potential
C2	5.9	0.03	High
C3	2010.6	9.5	Moderate
C4	772.5	3.6	High
C5	4659.4	21.9	Low
C7	547.9	2.6	Moderate
D1	1091.5	5.1	Very Low
M2	2761.4	13.0	Low
01b	76.1	0.4	Low
S3	1020	4.8	Low
Non-Fuel Areas	8309.5	39.1	N/A

A1.2 Proximity of Fuel to the Community

Fuel closest to the community usually represents the highest hazard. 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 Wildland Urban Interface (WUI) into 3 areas (Table 24):

1. Areas within 100 meters of the WUI (WUI 100);
2. Areas from 101 to 500 meters from the WUI (the WUI 500);
3. Areas 501 to 2000 meters from the WUI (the WUI 2000).

Table 24 Proximity to the Interface

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

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

WUI threat classes of High or Extreme are depicted in Figure 13. These are identified through a combination of both wildfire behaviour and proximity to communities or values. High WUI Threat Class areas are those with High or Extreme wildfire behaviour and are within 500 m of a value or community. Extreme WUI Threat Class areas are those with High or Extreme wildfire behaviour and are directly adjacent a value or community.

A1.3 Fire Spread Patterns

Initial Spread Index (ISI) is a rating of the expected rate of spread of a fire. ISI and wind speed and direction data is recorded at local BCWS weather stations and are used to understand the predominant summer fire spread patterns. This data is illustrated as ISI Wind Roses (Figure 19 and Figure 20). Each rose shows the frequency of counts by wind direction with the frequency of the ISI values during that time period.

During fire season, the prevailing winds are easterlies, with strong northerlies and southeasterly winds common. The highly variable topography has significant influence on predicting winds, and therefore landscape winds should not be used to guide wildfire management without consideration of local topography. Historical fires mostly appear to have spread either east to west, or north to south: the most recent wildfire in the AOI, the Maple Mountain fire, spread from north to south. However, there are multiple exceptions to these overall trends, and wildfires in the AOI can have unpredictable spread patterns.

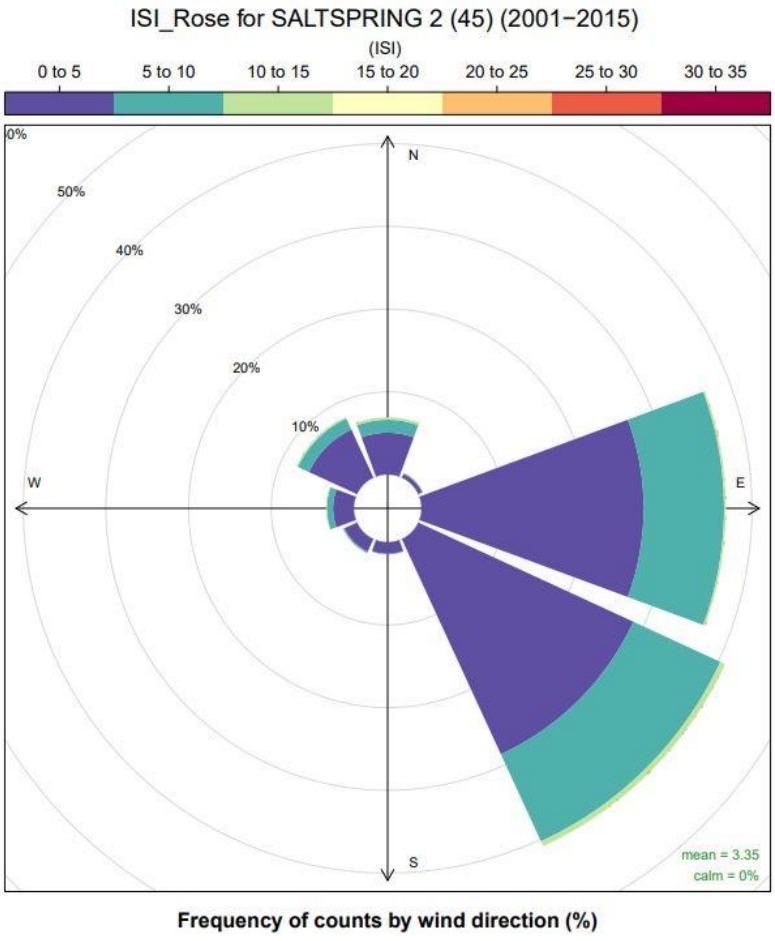


Figure 19 – Initial Spread Index (ISI) Rose from Saltspring2 Weather Station. (BC Wildfire Service, 2019)

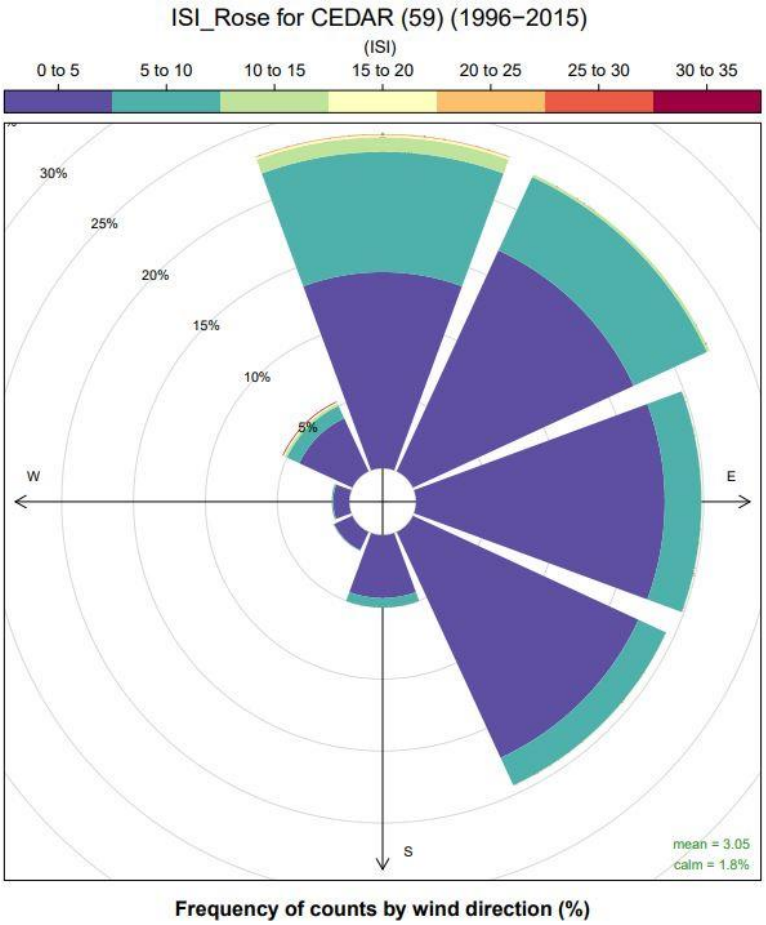


Figure 20 – Initial Spread Index (ISI) Rose from Cedar Weather Station. (BC Wildfire Service, 2019)

A1.4 Topography

Steep slopes significantly increase wildfire spread through increasing radiant and convective heat. Aspect on steep slopes will also affect wildfire spread, as south facing slopes will be much warmer and drier than other aspects. Areas with steep, vegetated slopes below them are at higher risk than flat areas with similar fuel loading. The topography in the AOI is highly varied. The centre of the District is located in a broad valley bottom, with mostly flat terrain. However, there are several mountains inside the AOI on the periphery of this valley with steep slopes. This includes Mount Tzouhalem, Maple Mountain, and Mount Prevost. These mountains are mostly located inside the MFR, and are mostly forested with conifer leading stands. The influence of slope on fire behaviour is summarized below.

Table 25 Slope percentage and fire behaviour implications.

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

Development is heavily concentrated in the valley bottom that dominates the AOI, and has made limited encroachment into the mountainous areas. Given that most of the mountains are located inside the MFR, there is very little development located above steep vegetated fuels. The exception to this is locations with critical infrastructure, such as the cell tower on top of Maple Mountain.

Table 26 Slope position of value and fire behaviour implications.

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

A1.5 Local Wildfire Threat Classification

The areas that have a high wildfire threat include fuel types that are dominated by conifer tree species and on steep slopes. These areas have high fuel loading that with both winds and the effects of slope will burn at a high intensity. Conifer dominated fuel types constitute almost 40% of the study area. These are found primarily within three municipal owned areas including the forest reserve along the west edge of the District boundaries, and at higher elevations in the mountainous areas inside the AOI. The risk generally increases with elevation in these mountains, as higher elevation conifer stands inside the AOI will have higher density. Specific areas of note with higher risk polygons are Mt Tzouhalem, Maple Mountain, and Mount Prevost. The areas within the AOI by fire intensity class is summarized below.

Table 27 Wildfire behavior category based on fire intensity

Wildfire Behavior Threat	Total Area (ha)	% of area
Very Low	1,691	8%
Low	1,183	5%
Moderate	3,590	16%
High	1,669	12%
Extreme	1,300	6%
Private	11,821	53%

A1.6 Local Wildfire Risk Classification

The 2012 wildfire risk methodology was used to determine wildfire risk. This method intersects the updated wildfire threat with the proximity to values to determine wildland urban interface threat class, which represents wildfire risk. This highlights areas of High or Extreme wildfire threat, and classifies their risk based on stratified distances. Areas of very low, low, or moderate wildfire threat are dropped from this analysis. Area of High wildfire risk are within 500m of a value and pose a high or extreme wildfire threat. Areas of Extreme risk are directly adjacent a value and pose a high or extreme wildfire threat.

Table 28. Wildland Urban Interface Threat Class

Wildfire Behavior Threat	Proximity of High or Extreme Threat to Value	Total Area (ha)
Low	>2,000m	57
Moderate	500 – 2,000m	2,176
High	Within 500m	659
Extreme	Directly adjacent	78

A1.7 Summary of Fire Risk Classes

The above table summarizes the total area by WUI threat class. This the total area of high wildfire threat that is adjacent values. This is summarized in Figure 13, which shows the spatial distribution of the areas of highest wildfire risk.

Appendix 2 Wildfire Threat Assessment Worksheets and Photos

Worksheets and photos submitted separately.

Appendix 3 Maps

Maps submitted separately.

Appendix 4 Description of Terminology

Term	Definition
Co-dominant Trees	Defines trees with crowns forming the general level of the main canopy in even-aged groups of trees, receiving full light from above and partial light from the sides.
Coarse fuels (coarse woody debris)	Combustible material over 7cm in diameter
Crown base height	The height, above ground, where the live crown of coniferous trees begins. Measured in meters (m).
Crown Closure	An assessment of the degree to which the crowns of trees are nearing general contact with one another. The percentage of the ground surface that would be considered by a downward vertical projection of foliage in the crowns of trees.
Diameter at Breast Height	The diameter of a tree measured at 1.3m above the point of germination.
Dominant Trees	Defines trees with crowns extending above the general level of the main canopy of even-aged groups of trees, receiving full light from above and comparatively little from the sides.
Fire-resistant materials	These meet the acceptance criteria of CAN/ULC-S101, (Fire Endurance Tests of Building Construction and Materials)
Fuel Break	An area of non-combustible materials that inhibits the continuous burning of fuels.
Fuel Load	The mass of combustible materials expressed as a weight of fuel per unit area.
Fuel Moisture	Percent water content of vegetation. This is an important factor in rate of spread.
Fuel Types	Classification of forested stands as described by Canadian Forest Fire Behavior Prediction (FBP) System. There are currently no fuel type classifications specific to coastal fuels.
Fine fuels (fine woody debris)	Combustible woody debris under 7cm in diameter.
Fire Behaviour	The manner in which a fire reacts to the influences of fuel, weather, and topography.
Intermediate Trees	Defines trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than the co-dominants. These receive little direct light from above and none from the sides, and usually have small crowns that are crowded on the sides.

Term	Definition
Ladder Fuels	Live or dead vegetation that allows a fire to burn into the canopy (crown) of a forested stand.
Lift Pruned	The removal of ladder fuels to increase the crown base height.
Litter Layer	Surface buildup of leaves and woody material.
Live Crown Ratio	Is the percentage of the total stem length covered with living branches. It provides a rough but convenient index of the ability of a tree's crown to nourish the remaining part of the tree. Trees with less than 30 percent live crown ratio are typically weak, lack vigor, and have low diameter growth, although this depends very much on the tree's age and species.
Non-combustible materials	Means that a material meets the acceptance criteria of CAN/ULC S114, (Standard Method of test for determination of non-combustibility in Building Materials)
Open Grown	Defines trees with crowns receiving full light from all sides due to the openness of the canopy.
Rated roofing materials	Class A, B or C is a measure of the external spread of flame on a roof surface. Tests are conducted using CAN/ULC S107M methods of fire tests of roof coverings, or equivalent. The best rating achieved is Class A, which may be described as effective against severe fire exposure.
Spotting	Fire producing sparks or embers that are carried by the wind and start new fires.
Stems Per Hectare	The number or size of a population (trees) in relation to some unit of space (one hectare). It is measured as the amount of tree biomass per unit area of land.
Suppressed Trees	Defines trees with entirely below the general level of the canopy of even-aged groups of trees, receiving no direct light either from above or from the sides.
Wildfire	An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, lightning strikes, downed power lines, and all other wildland fires where the objective is to put the fire out.

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