Cowichan Valley Regional District, South Zone Community Wildfire Protection Plan Update 2017

Submitted by:

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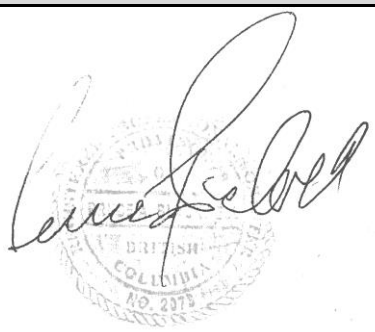
*Cover photo: Stefana Dranga, Old Baldy Mountain, Cowichan Valley Regional District

REGISTERED PROFESSIONAL SIGN AND SEAL

RPF PRINTED NAME	
Bruce A. Blackwell	RPF 2073
DATE SIGNED	
September 28, 2018	
I certify that the work described herein fulfills the standards expected of a member of the Association of British Columbia Forest Professionals and that I did personally supervise the work.	
Registered Professional Forester Signature and Seal	
	

EXECUTIVE SUMMARY/ SUMMARY OF CWPP RECOMMENDATIONS

The Community Wildfire Protection Plan (CWPP) process was created in British Columbia (BC) as a response to the devastating 2003 wildfire in Kelowna. As an integral part of the Strategic Wildfire Prevention Initiative (SWPI), managed and funded through the Strategic Wildfire Prevention Working Group, CWPPs aim to develop strategic recommendations to assist in improving safety and to reduce the risk of damage to property from wildfires.

This CWPP Update will provide the Cowichan Valley Regional District (CVRD) with a framework that can be used to review and assess areas of identified high fire risk within the CVRD South Zone. Additionally, the information contained in this report should help to guide the improvement and/or development of emergency plans, emergency response, evacuation plans, communication and education programs (including FireSmart), bylaw development in areas of fire risk, and the management of potentially hazardous forest lands adjacent to the community.

Wildfire management requires a multi-faceted approach for greatest efficacy and risk reduction outcomes. A total of 49 strategic recommendations are found in a tabularized format within this Executive Summary. In addition, these recommendations are more thoroughly discussed in their appropriate sections within the document and are found in written format. Because the area of interest extends outside the CVRD boundary onto private land and therefore outside CVRD jurisdiction, the CVRD's role may be limited to the role of an influencer in some instances, while other recommendations can be directly implemented by the CVRD. The recommendations are displayed in totality in Table 1. Ultimately, the recommendations within this strategy should be considered a toolbox of options to help reduce the wildfire threat to the community. There is not one combination or course of action which is the answer; the CVRD will have to further prioritize based on resources, strengths, constraints, and availability of funding and regularly update the prioritization and course of action as variables change through time.

Table 1. Summary of CWPP Recommendations by Document Section.

Document Section 2: Local Area Description (2.5.3: Local Government/First Nations Policies and Recommendations)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Review and amend the current CVRD regulatory framework to incorporate wildfire mitigation and preparedness considerations.				
1	12	Moderate	Review the Official Community Plan (OCP) and associated supporting documents (i.e., Shawnigan Lakes and Cobble Hill Community Parks and Trails Master Plans and bylaws) and consider parks acquisition and maintenance through a wildfire risk lens, including consideration for long-term maintenance costs and access.	~15-20 in-house hours (municipal funding)
2	13	High	Review the OCP and recognize natural hazards that have the potential to impact values within the CVRD South Zone. Natural hazards include, but are not limited to, wildfire and interface fire which has the potential to impact public health and safety, economics (i.e. through evacuations, loss of tourism, interruption of services), ecosystems, habitat, and water quality among other values.	~10-15 in-house hours (municipal funding)
3	14	High	Consider reviewing the South Cowichan Rural Development Permit Area mapping where Wildfire Interface Guidelines apply and update using the most recently developed wildfire threat mapping, completed as part of the CWPP update. Consider amending the map to include all areas within 100 m of moderate, high, or extreme threat class. The updated area should be made available via the CVRD's Web Map.	~15 in-house hours (municipal funding)
4	14	Moderate	Consider incorporating Qualified Professional (QP) reports (i.e., Registered Forest Professional) and sign-off as part of the Wildfire Interface Guidelines.	~5-15 hours (Consultant). Cost dependent on type of assessment
5	15	Moderate	Consider reviewing and amending the Koksilah OCP to include a growth management policy which considers wildfire risk and other natural hazards during strategy development.	Negligible cost ~ 5-10 in-house hours (municipal funding)
6	16	Moderate	Consider working with the Development Services Division (DSD) (i.e., building inspectors) to: ensure visible house numbering is posted prior to occupancy of new development and to provide instructions on how and where best to affix numbering to facilitate emergency response and evacuation efforts. Consider encouraging home owner participation via a CVRD-wide engagement campaign and providing incentives for an opportunity to acquire/purchase discounted address signs.	4-6 CVRD staff hours required for internal work with the DSD. Additional 16 hours for material development and distribution for incentive/ engagement campaign)

Document Section 2: Local Area Description (2.5.3: Local Government/First Nations Policies and Recommendations)				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
7	16	Moderate	Review CVRD Bylaw No. 1341, 1992 and include wording that specifically prohibits the accumulation of combustible materials on the property (including on and under exterior projections, such as decks and patios, near the home, and in gutters and roofs). The revised bylaw should provide the CVRD the authority to require removal/clean-up of combustible materials or to complete removal and recoup costs from the owner.	~15 in-house hours (Local Government funding)
8	17	Moderate	Complete updates to trails master plans through a wildfire lens, including consideration for the placement, type, width, and objective of trails. Consideration should also be given to trail building and maintenance as these activities can either increase wildfire risk (through fuels accumulations and unsafe work practices) or decrease wildfire risk (though proper placement, clean-up of combustible fuels trailside and work practices which adhere to Wildfire Act and Regulations).	~5-10 in house hours (Local Government funding)
Document Section 3: Values at Risk				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Protect critical infrastructure and mitigate post-wildfire impacts				
9	22	Moderate	The use of fire resistant construction materials, building design and landscaping should be considered for all CI when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines.	Negligible in-house cost
10	27	Low	The CVRD should consider the option of conducting future assessments to explore the potential hydrologic and geomorphic impacts of wildfire on the watershed and community. Alternatively, there may be an option to complete a stand-alone assessment to help identify and quantify the post-fire hazards and levels of risk to the community. Exploration of potential funding opportunities through the province and the National Disaster Mitigation Program may be worthwhile.[1]	$15,000-$20,000

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

Document Section 4: Wildfire Treat and Risk Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Maintain accurate fire weather data collection.				
11	40	Moderate	The CVRD should consider working with the BCWS to establish a permanent weather station within the South Zone AOI. The establishment of a permanent fire weather station within the South Zone AOI will ensure the collection of fire weather data representative of the AOI and which accounts for current climate-determined fire weather conditions.	4-5 CVRD staff hours to engage BCWS personnel and discuss funding opportunities/ $26,000 to purchase and install station
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Undertake Fuel Treatments to Improve Emergency Access				
12	67	Moderate	The CVRD should work with the Ministry of Transportation and Infrastructure (MOTI), to assess the entirety of Hwy 1 and reduce hazardous fuels within 100 m of either side of the road, where possible and with consideration of private land overlap. This is to increase public safety / improve emergency access in the event of an evacuation or wildfire event.	Appropriate funding stream to be identified. 10-person hours, however dependent upon CVRD's role within the project
Objective: Reduce Wildfire Threat through Fuel Management				
13	69	High	Proceed with detailed assessment, prescription development and treatment of hazardous fuel units and FireSmart fuel treatment demonstration treatment areas identified and prioritized in this CWPP.	UBCM CRI Program Funding[2] / Local Government Funding
14	69	Low	Consider developing a rationale for reduced stocking standards applicable to the CVRD, by employing a qualified wildfire management professional, and in consultation with the Fuel Management Specialist (Coastal Fire Centre) and MFLNRORD. Engage partners such as woodlot and/or Community Forest License Owners, and all other licensees to apply the MFLNRORD approved reduced fire management stocking standards in the wildland urban interface AOI to reduce interface wildfire threat.	$3,000

[2] Note that the UBCM SWPI funding stream has very recently transitioned into a new Community Resiliency Investment (CRI) Program. Refer to Section 5.1 and the Union of BC Municipality's website (https://www.ubcm.ca/EN/main/funding/lgps/community-resiliency-investment.html) for further information.

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Maintain Fuel Treated Areas to Maintain Acceptable Wildfire Threat Level				
15	77	High	Apply for funding for maintenance activities prioritized and scheduled in this CWPP Update.	UBCM CRI Funding/ Local Government Funding
16	77	Moderate	Treatment monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise.	UBCM CRI Funding/ Local Government Funding
Objective: Reduce Wildfire Hazard on Private Land				
17	85	Moderate	Review the Official Community Plans (OCPs); consider including wildfire as a natural hazard development permit area. A recommended development permit area for the CVRD would include all areas within the South Zone that are located within 200 m of moderate, high or extreme wildfire behaviour threat class areas. This is a suggested distance which should be validated and defined through a more comprehensive GIS analysis of hazardous fuels and their proximity to the interface. Review similar wildfire hazard DPAs established in other jurisdictions and use as models for various aspects of the DPA process. For more information regarding the DP process, see Section 5.2.2.	40-80 in-house hours and $5,000 for consultant analysis and support (Local Government Funding/ CRI Funding)
18	85	Moderate	Ensure that wildfire hazard DP applications are provided to fire departments for opportunity for input prior to approval. As more DP applications are received, the importance of communication and integration between fire departments and the Development Services Division will increase.	Dependent on the number of DP applications
19	86	Low	Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, avoid wildlife attractants, and reduce wildfire hazard. Consider including the landscaping standard as a requirement of Development Permit within the applicable area, as well as making it publicly available for residents and homeowners outside of the DP area.	$2,000 - $3,000 to outsource. Alternatively, general FireSmart landscaping information is available free of charge, but is not climate/ plant hardiness zone specific

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
20	86	Moderate	Consider engaging the development/building community (may include developers, builders, landscapers, and architects) in DP development process. This can be accomplished through a series of workshops/informational sessions	~40 hours
21	88	Moderate	The CVRD should hire a qualified professional or local fire services staff member to assist the various communities in complying with FireSmart principles at the neighbourhood and individual home-level.	~25 in-house hours (Consultant and/or Fire Department, Emergency CVRD staff)
Objective: Increase Public Wildfire Awareness				
22	90	High	This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings. In addition, this CWPP Update should be shared with local industry partners; in particular industrial forest companies who may be interested in collaborating on direct fuel management treatments or with other sections of this CWPP Update document.	3-6 hours depending on method of distribution
23	90	Moderate	Periodic updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.	UBCM/CRI funding / Local Government funding
24	91	Moderate	Develop a social media strategy and ensure that its full power is leveraged to communicate fire bans, high Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information in an accurate and timely manner. [3]	~40 hours to create strategy. ~20 hours to identify partners, initiate relationship and gain strategy support. Additional daily/weekly hours to implement and update depending on strategy

[3] Appendix L has general communication and social media information.

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
25	91	High	Consider promoting FireSmart approaches for wildfire risk reduction to CVRD residents through Town Hall meetings, workshops and/or presentations. Aim to conduct the engagement/promotion campaign prior and during the fire season. Consider supplying FireSmart materials to homeowners in the interface during these engagement campaigns.	~10 hours. May be eligible for UBCM / CRI grant
26	91	Moderate	Work towards FireSmart community recognition, at the neighbourhood level and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications.	FireSmart grant (when funding is available)
27	91	Moderate	Facilitate the FSCCRP uptake within the South Zone AOI and enhance its applications by including the following: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.	$5,000 / neighbourhood and an additional 40 hours / initiative UBCM/CRI grant(s) available
28	91	Moderate	Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk.	~1.5 hours / assessment
29	91	Low	Encourage schools to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (South Island Fire Zone), as well as local fire department and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary and/or secondary schools (field trips, guest speakers, etc.).	~30-40 hours

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Enhance Elected Official Awareness of Wildfire Initiatives				
30	92	High	Develop and work with all key stakeholders (Industrial operators, MFLNRORD, BCWS, recreational groups/representatives, CVRD staff) to formalize an Interface Steering Committee. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) Development of large, landscape level fuel breaks; 2) Public education and awareness needs; 3) Multi-disciplinary, multi-jurisdictional fuel treatment projects/ hazard abatement projects; 4) Development of a funding strategy; and 5) Reduction of human-caused fires, fire prevention and right of way management.	~ 40 hours to initiate group; an additional ~50 hours/year to plan, advertise/ communicate, attend, and debrief meetings; additional hours required depending on implementable actions and potential sub-committees developed
31	92	Moderate	Work towards educating homeowners within unprotected areas (i.e., outside of fire service areas). It is common, especially in the case of second homeowners/ vacation owners, for them to be unaware of the lack of fire services in their area (in the event they call 911).	5-10 CVRD staff hours
32	92	Moderate	Continue promoting and providing information to private landowners related to residential sprinklers as a FireSmart prevention measure.	10-20 hours to prepare materials and disseminate information to landowners
Objective: Reduce Wildfire Risk from Industrial Sources				
33	92	Moderate	Work with industrial operators such as BC Hydro and Fortis BC to ensure that high risk activities, such as grubbing/brushing work are restricted during high fire danger times to reduce chance of ignitions as per the Wildfire Act.	2-4 hours
34	92	Moderate	Work with industrial operators (i.e., BC Hydro) to ensure that rights-of-way do not contain fine fuel accumulations (easily cured) prior to and during the fire season and are maintained in a low hazard state (to serve as fuel breaks). Work with industrial operators to ensure that high risk activities, such as right-of-way mowing, do not occur during high or extreme fire danger times to reduce chance of ignitions as per the Wildfire Act.	2-4 hours

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Improve Water Availability for Emergency Response				
35	97	High	All new rural development outside Village Containment Boundaries (VCBs) should have a water system which meets or exceeds minimum standards of NFPA 1142, Standard on Water Supplies for Suburban and Rural Fire Fighting. Fire services should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression needs and that secondary power is available in the event of power outages.	~5-10 hours per development
36	97	High	Consider completing a fire flow/water vulnerability assessment to identify where upgrades to systems, flows, hydrant number or location, and water storage, or secondary power is required. Prioritize and rank projects and complete or require upgrades as resources allow.	$10,000
Objective: Improve Access/Egress to Enhance Emergency Preparedness				
37	99	High	Complete and participate in regular testing of, and updates to, the evacuation plan.	~30-40 hours to plan and stage; 8 hours to complete testing
38	99	Moderate	Consider developing a community wildfire pre-planning brochure that addresses the following: 1) locations of staging areas; 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of the area of interest.	~10,000- $15,000 to complete (contractor estimate)
Objective: Include Wildfire Considerations when Trail Planning				
39	99	Moderate	Develop a Total Access Plan for the CVRD to create, map and inventory trail and road network in natural areas for suppression planning, identification of areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and/or changes.	~8,000-$10,000 to build plan, map, populate attributes and update (contractor estimate)
40	99	Moderate	Include a qualified professional with experience in operational wildland/interface fire suppression in the planning and strategic siting of future trails and parks	10-20 hours to review current trails / map, provide recommendations

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
41	99	Moderate	Consider developing a map book or spatial file that displays the trail network available for fire department personnel to access during an emergency or for fire suppression planning (i.e., to accompany any fire access trail building activities).	$1,500-$2,500 total cost
Objective: Enhance Wildfire Equipment and Training				
42	100	High	Fire departments should work with BCWS to initiate and/or maintain an annual structural and interface training program. Interface training should include completion of a mock wildfire simulation in coordination with BCWS and safety training specific to wildland fire and risks inherent with natural areas.	Cost and time dependent upon training exercise (scope, number of participating members etc.)
43	100	Moderate	Fire Departments should engage in regular cadence of communication with the BCWS South Island Fire Zone / Cobble Hill Fire Base to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities.	~4 hours/ year
44	101	High	Ensure that the fire departments maintain the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs). The OFC is currently developing additional wildfire-specific Officer-level training courses (i.e., Engine Operations in the Wildland Urban Interface); the fire departments should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources / budgets allow.	Within current training budget (a combination of S-100/SPP-WFF1 and S-215 currently implemented)
45	101	High	It is recommended that all South Zone fire department members at minimum have SPP-WFF 1, and that the fire departments engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. The aforementioned cross-training opportunity could include, for example, a joint wildfire simulation exercise.	Within current training budget / 10-20 hours per year for cross training (cost depends on member attendance)

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation / Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Encourage FireSmart Initiatives				
46	102	Low	Consider working with local distributors and homeowners within CVRD South Zone and its communities. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include: 1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions/advice for homeowners 2) Advocating for a FireSmart branding in the retail stores 3) Compile a database of local service providers and retailers which can help to install or complete FireSmart home improvements.	~60 hours
47	102	High	Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. Programs may include scheduled community chipping opportunities, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends. Programs should be available during times of greatest resident activity (likely spring and fall).	Time dependent upon program. May be eligible for UBCM/CRI grant. Additional time for advertisement of program availability will be required.
Objective: Enhance Protection of Municipal Infrastructure from Wildfire				
48	102	High	Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized.	~ 20 hours to complete vulnerability assessment and upgrading dependent on project(s) chosen
49	102	Moderate	Consider acquiring a Type 2 SPU trailer to improve wildfire response (provides protection for 25-30 residences).	$100,000-$150,000 depending on configuration.

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COMMONLY USED ACRONYMS

BCWS	British Columbia Wildfire Service
BEC	Biogeoclimatic Ecosystem Classification
CBVFD	Cowichan Bay Volunteer Fire Department
CDC	Conservation Data Centre
CFFDRS	Canadian Forest Fire Danger Rating System
CRD	Capital Regional District
CRI	Community Resiliency Investment Program
CVRD	Cowichan Valley Regional District
CWPP	Community Wildfire Protection Plan
DFD	Duncan Fire Department
DP	Development Permit
FBP	Fire Behaviour Prediction System
FESBC	Forest Enhancement Society of British Columbia
FMP	Fire Management Plan
FRS	Fire Rescue Services
FSCCRP	FireSmart Canada Community Recognition Program
GAR	Government Actions Regulation
HIZ	Home Ignition Zone
LRMP	Land and Resource Management Plan
MBVFD	Mill Bay Volunteer Fire Department
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development
MOTI	Ministry of Transportation and Infrastructure
MVFD	Malahat Volunteer Fire Department
NFPA	National Fire Protection Agency
OFC	Office of the Fire Commissioner
PSTA	Provincial Strategic Threat Analysis
PTU	Proposed Treatment Unit
SLVFD	Shawnigan Lake Volunteer Fire Department
SWPI	Strategic Wildfire Prevention Initiative
TSA	Timber Supply Area
UBCM	Union of British Columbian Municipalities
VCB	Village Containment Boundary
VFD	Volunteer Fire Department
WUI	Wildland Urban Interface

SECTION 1: INTRODUCTION

In 2017, B.A. Blackwell and Associates Ltd. was retained to assist the Cowichan Valley Regional District (CVRD) in developing an update to the Community Wildfire Protection Plan (CWPP); hereinafter referred to as the CWPP, for the CVRD South Zone. The original 2005 CWPP was completed for the entire CVRD and was titled *Cowichan Valley Regional District Community Wildfire Protection Plan*, hereinafter referred to as the 2005 CWPP. This CWPP Update document revisits the 2005 CWPP and will focus on integrating the updated Provincial Strategic Threat Analysis (PSTA), updated BC Wildfire Service (BCWS) Fuel Type mapping, and the updated and improved wildfire threat analysis methodology. Furthermore, CVRD staff recognized that there have been significant changes since 2005, which have a direct impact on wildfire mitigation activities and programs. The aforementioned changes include: significant growth and development in the last decade; implementation of bylaws regarding smoke control, building regulation and land clearing management; fuel treatments completed; and changes in fuels surrounding the community. CVRD staff have recognized that wildfire mitigation and planning is an important component of emergency planning and preparedness for the communities in the South Zone.

Although forest fires are both inevitable and essential to the health of forested ecosystems, the 2003, 2004, 2009, 2010, 2015 and 2017 wildfire seasons resulted in significant economic, social and environmental losses in BC. The 2018 fire season was the most extensive in terms of area burned, surpassing the 2017 fire season. While final suppression costs for the 2018 season are yet to be calculated, the 2017 fire season costs were estimated at over $568 million. Recent wildfire disasters like those experienced in Slave Lake, Alberta (2011), Washington State (2014 and 2015), Fort McMurray, Alberta (2016) and BC and California (2017) all display the vulnerability of communities and the potential toll of wildfires on families, neighbourhoods and the economy of entire regions. These events, along with critical lessons learned and important advances in knowledge and loss prevention programs have spurred the need for greater consideration and due diligence with respect to fire risk in the wildland urban interface[4] (WUI).

1.1 PURPOSE

The purpose of this CWPP Update is to identify and update the wildfire risks within and surrounding the CVRD South Zone, to describe the potential consequences if a wildfire was to impact the community, and to examine options and strategies to reduce the wildfire risks. Each community has a unique risk profile. This CWPP provides a reassessment of the level of risk with respect to changes in the area that have occurred recently and gives the CVRD a current and accurate understanding of the threats to human life, property and critical infrastructure faced by their communities from wildfires. The goal of this CWPP, in addition to defining the threats, is to identify measures necessary to mitigate these threats, and outline a plan of action for implementing these measures. Specifically, this CWPP is intended to

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

serve as a framework to inform the implementation of specific actions and strategies that will serve to: 1) reduce the likelihood of wildfire entering the community, 2) reduce the impacts and losses to property and critical infrastructure if wildfire were to enter, and 3) reduce the negative economic and social impacts of wildfire to the community.

1.2 CWPP UPDATE PLANNING PROCESS

This CWPP Update is a review and synthesis of the background information and current data related to the Area of Interest (AOI) which represents a two-kilometer spotting buffer around values at risk (structures) within the CVRD South Zone. The CWPP process consists of four general phases:

1) **Consultation involving key local government representatives, structural and wildfire specialists, and stakeholders**. Information sharing with First Nations at various stages of the Plan development and ensuring linkages with relevant existing land use plans, legislation, and policy currently in place.
2) **Identification of the values at risk and assessment of the local wildfire threat**. Wildfire threat assessment takes into consideration Natural Fire Regime and Ecology, Provincial Strategic Threat Analysis (2015), and field work, fuel type verification, completion of WUI Threat Forms and GIS wildfire threat analyses.
3) **Developing a risk mitigation strategy**. A guide for the CVRD to implement mitigation and risk reduction activities. The risk mitigation strategy accounts for prioritization of fuel treatments, FireSmart Activities, and wildfire response recommendations that will reduce wildfire risk locally.
4) **Building a community engagement and education strategy**. This phase includes presentation of the CWPP to the Board or Council, the formation of a Wildfire Working Group as well as comprehensive outside consultation with First Nations, government and non-governmental agencies (See Section 1.2.1 for specifics).

1.2.1 Consultation

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

The first step in the consultation process was to assemble the key players in the 'Wildfire Working Group'. This group was composed of key internal CVRD staff, which included: Fire Rescue Services Coordinator, Public Safety Manager, GIS/Mapping Supervisor, GIS/Mapping technician, Asset Coordinator, CVRD Planner, and Parks and Development representatives. Non-CVRD staff included in the Working Group were: Fire Chiefs for Mill Bay and Shawnigan Lake and a local fire management specialist. At the initial meeting of the Wildfire Working Group, the objective was to obtain information on wildfire risk mitigation initiatives currently in place or completed, existing plans and policies, current resources, identify areas of concern, identify CVRD vulnerabilities, and to determine priorities and potential mitigation strategies. Members of the Working Group were consulted on an ongoing basis throughout plan development and were integral in providing Plan review and approval. The Wildfire

Working Group was integral in the review of the draft of this CWPP and provided ongoing support throughout the CWPP process.

BCWS representatives from the Coastal Fire Centre and South Island Fire Zone – Cobble Hill (Fuel Management Specialist and Forest Protection Specialist) were consulted as follows: 1) at the onset of the project planning phase and 2) throughout the CWPP update development process, both via the submission of Fuel Type Change Rationales and questionnaire regarding concerns and priorities of BCWS with respect to wildfire and emergency planning in the CVRD; and 3) revision of draft document upon plan completion.

Information sharing took place with the Malahat First Nation, Cowichan Tribes, and the Pauquachin First Nation as identified through the Consultative Areas Database and in consultation with MFLNRORD and the CVRD, regarding the CWPP and locations or potential for possible cultural values at risk requiring protection consideration. Information sharing consisted of an initial phone call, and subsequent distribution of a referral letter and information package (maps, explanation of CWPP, and CWPP draft).

Additional stakeholders were consulted to identify synergies, opportunities for collaboration, and ensure linkages with adjacent and overlapping planning. These stakeholders included the MFLNRORD South Island Natural Resource District's Stewardship Forester; the MFLNRORD Sunshine - South Island Recreation Officer; BC Parks staff including the Haida Gwaii / South Island Section Head and Conservation Specialist (Black Creek); and the owner of Woodlot W0021. Combined, these various consultation and engagement opportunities have generated a shared understanding of the CWPP objectives and expected outcomes among local government, stakeholders, residents, and land managers.

1.2.2 Identification of Values at Risk and Local Wildfire Threat Assessment

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

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

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

$$\textit{Wildfire risk} = \textit{Probability x Consequence}$$

Where:

- Wildfire risk is defined as the potential losses incurred to human life, property and critical infrastructure within a community in the event of a wildfire;

- Probability is the likelihood of fire occurring in an area and is related to the susceptibility of an area to fire (fuel type, climate, probability of ignition etc.); and
- Consequences refer to the repercussions associated with fire occurrence in a given area (higher consequences are associated with densely populated areas, or areas of high biodiversity etc.).

1.2.3 Development of a Risk Management Strategy

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

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

1.2.4 Building Community Engagement and Education Strategy

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

A presentation to CVRD Board will aim to ensure high level approval and support for this CWPP.

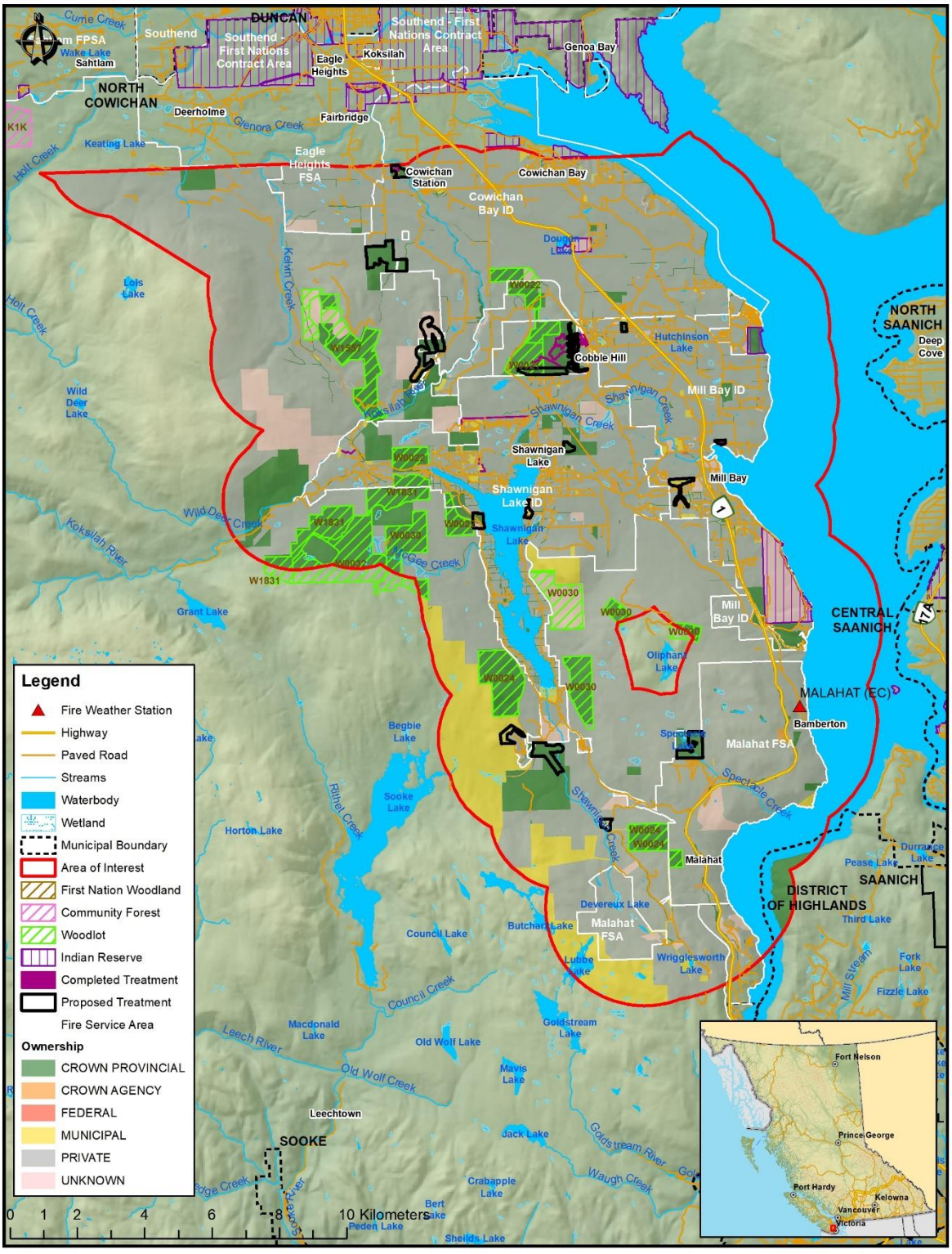
SECTION 2: LOCAL AREA DESCRIPTION

This section describes communities within the CVRD South Zone AOI. It also summarizes the current community engagement in wildfire prevention and mitigation and identifies linkages to other plans and policies with relevance to wildfire planning.

2.1 AREA OF INTEREST

The Cowichan Valley Regional District South Zone is located in southern Vancouver Island, approximately 25km northwest of Victoria. The CVRD South Zone AOI is comprised of multiple small communities, including Shawnigan Lake, Cobble Hill, Mill Bay, Cowichan Station, Cowichan Bay, Bamberton, and Malahat. Due to buffering around values at risk (described below), there is overlap of the South Zone AOI with the Central Zone AOI in the case of Cowichan Station and Cowichan Bay Village.

The AOI for the CWPP is illustrated below in Map 1. The AOI represents a two-kilometer (km) spotting buffer around values at risk (structures) within the CVRD South Zone. The current AOI differs significantly from the previous CWPP's AOI which included all developed areas within the entire CVRD plus a 2km buffer. The northern end of the current AOI extends 1km to Cowichan Bay, and to Lubbe Lake on the southern end, south of Malahat. The AOI encompasses 35,534 ha of land in total. A breakdown of the AOI's land ownership is provided in Table 2.



Map 1. Area of Interest (AOI).

Table 2. Summary of AOI by land ownership.

Land Ownership*	Hectares
Private	21,413
Municipal	1,956
Provincial Crown	10,404
Crown Agency	110
Federal Crown	2
Unknown (Includes First Nation Indian Reserves ~302 ha)	1,650
Total	**35,534**

*The land ownership source is ParcelMap BC, provided by the Land Title and Survey Authority (LTSA). This dataset does not differentiate Indian Reserves as Federal Crown parcels.

2.2 COMMUNITY DESCRIPTION

The South Zone AOI represents the southernmost developed portion of the CVRD and encompasses Electoral areas A, B and C. The CVRD in its entirety has a population of 80,000 and covers approximately 3,473 km.[5] Services to residents of the CVRD South Zone are provided both at the regional and the electoral level. The regional government provides waste management, emergency planning, economic development and regional parks planning. At the electoral level, services provided include land use planning, fire protection services, water/waste water services and bylaw development and enforcement.

The South Island region has been inhabited by the Coast Salish Aboriginal Peoples since before recorded time. The Cowichan, Tsawout, Malahat, Penelakut, Pauquachin, Tsartlip Nations are among the Coast Salish First Nations that historically occupied land, some of whom continue to live within the AOI today. At present, the CVRD South Zone includes multiple distinct communities (as listed in Section 2.1 above), including 3 First Nations Reserves, which range from rural/remote communities to town centres with high population density. The First Nations reserves include: Est-Patrolas 4, Hatch Point 12, and Malahat 11.

The CVRD South Zone is comprised of CVRD Electoral Areas A (Mill Bay/Malahat), B (Shawnigan Lake), and C (Cobble Hill). These represent three of the nine Electoral Areas that make up the CVRD. The South Zone is bounded by the Capital Regional District (CRD) and Islands Trust Area on its south end, and CVRD Electoral Areas D, E, and F on its north end. The CVRD South Zone is topographically diverse, with low lying agriculturally productive lands, rolling hills and mountainous terrain. Due to this variable topography, the elevation varies significantly within the AOI, from sea level to 800m. Shawnigan Lake is the largest freshwater body in the AOI, with an area of over 500 ha, however the AOI also includes

[5] CVRD, 2018. Our Regional District. Retrieved online from: https://www.cvrd.bc.ca/2379/Our-Regional-District

dozens of other lakes and streams and the entire east side of the AOI is bordered by the Pacific Ocean's Saanich Inlet.

The CVRD South Zone economy was historically driven by forestry, mining, and fishing.[6] Although these industries remain important to the communities within the AOI, the economic focus has shifted in recent decades to tourism, residential development, and agriculture, specifically food producers and vineyards.

Fire protection within the AOI is the responsibility of several fire departments including: Cowichan Bay Volunteer Fire Department (VFD), Mill Bay VFD, Shawnigan Lake VFD and Malahat VFD. Additionally, the Duncan Fire Department is responsible for fire protection (under contract) in the Eagle Heights Fire Service Area in the northern reaches of the AOI. Mutual aid agreements exist between these departments, and the Langford Fire Department (south of the AOI). Each department has a particular Fire Service Area. BCWS is responsible for responding to fires that are beyond the boundaries of the department Fire Service Areas. In the event of a wildfire, the CVRD has limited emergency egress routes. The Malahat Highway (Highway 1), which runs north and south from the AOI, is the only reliable, paved access route. Paved roads also connect Shawnigan Lake, Cobble Hill, Cowichan Bay, and Cowichan Station to the Malahat Highway. Many developments within the CVRD South Zone are located on single access roads which branch off of the Malahat Highway. This not only presents a challenge for emergency egress, but also limits the ability of fire crews to respond to fires and safely evacuate residents.

2.3 PAST WILDFIRES, EVACUATIONS AND IMPACTS

BCWS South Island Fire Zone staff (Gene Drew and Dimitri Vaisius) communicated that the majority of past wildfire activity within the AOI was human-caused and ignitions often occur in the fall after fire bans have been lifted. BCWS staff reported that slash accumulations following industrial logging tend to be an issue when smaller companies are operating, whereas there are generally higher rates of compliance with fuel hazard abatement requirements with larger logging companies. In terms of the general public, the BCWS has found that fire bans are very effective in the CVRD and compliance with fire use restrictions is high.

Based on the BCWS historical wildfire dataset, the two largest fires to burn within and adjacent to the CVRD South Zone AOI occurred in 1922, with a combined area of over 3,400 ha. The most significant fires to occur in recent years were in 2016 and were 2.7 ha, northwest of Bamberton, and 0.9 ha, in Malahat. In 2015, a 400ha fire burned 35km west of the AOI near Port Renfrew's Lizard Lake. This fire burned for several weeks and resulted in the closure of the Pacific Circle Highway, which connects Port Renfrew with Lake Cowichan. In early August of 2018, 34 new fires were ignited on Vancouver Island, primarily due to lightning events.[7] Several of the fires in northern Vancouver Island and near Nanaimo Lakes resulted in evacuation alerts and orders. The Lizard Lake wildfire, and the Vancouver Island

[6] CVRD, 2016.Bylaw 3510: South Cowichan Official Community Plan – Schedule A.

[7] BC Wildfire Service, Interactive Map

wildfires of 2018, in combination with the 2017 and 2018 Province-wide wildfires, have alerted BCWS to the potential for large, catastrophic wildfires occurring within and surrounding the present AOI.

The BC Wildfire Service historical ignition dataset demonstrates that the proportion of human-caused fires within the CVRD South AOI is substantially greater than that of the province as a whole.[8] This ignition data shows that within the CVRD South AOI, approximately 68% of ignitions since 1919 have been human-caused (a conservative estimate not including miscellaneous/undetermined causes), versus 40% in the province of BC.[9] This statistic may be explained by the lower proportion and occurrence of lightning strikes on Vancouver Island relative to other areas in the province. Additionally, high recreational use within many parts of the AOI, specifically for camping, and the prevalence of forestry activities, railways, and other industrial activities within the AOI, also contribute to this statistic.

2.4 CURRENT COMMUNITY ENGAGEMENT

There is widespread recognition and awareness, from both CVRD staff and the community, of the threat posed to the community by wildfire. There has been moderate community engagement in FireSmart initiatives to this point. FireSmart presentations and workshops are provided by the CVRD, as requested by interested groups. Furthermore, bylaw amendment reviews have been undertaken to address issues relating to public safety, including road and pathway design for access and egress and the integration of FireSmart principles into bylaws. However, there is currently no established wildfire development permit area within the CVRD South Zone, which can set standards based upon FireSmart principles for building material use, landscaping and appropriate setbacks from forested areas. FireSmart brochures and flyers were distributed several years ago, however, CVRD staff noted that the CVRD has limited capacity for delivering information to the public. The CVRD website has a FireSmart page, which communicates important information to the public such as the current Fire Danger Rating, a FireSmart workshop request contact, links to FireSmart resources, a “how-to” video on FireSmarting your home, and purchasing information for Wildfire Automated Sprinkler Protection (WASP) systems. CVRD staff have expressed that public uptake for FireSmart and initiatives in the CVRD is much higher during and following an active fire season in BC but dwindles considerably in low fire years. Future initiatives should focus efforts during times of high public uptake in order to maximize the resources available for community engagement.

Fire department-initiated education regarding wildfire threat and prevention varies by department. Some fire departments within the AOI also provide public information through their websites in the form of burn status updates, current fire hazard rating, and information on fire prevention and open burning.

[8] BC Wildfire Service: Fire Incident Locations - Historical

[9] BCWS, 2018

2.5 LINKAGES TO OTHER PLANS AND POLICIES

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

2.5.1 Local Authority Emergency Plan

Emergency preparedness and response is managed by the CVRD, which has created a comprehensive Emergency Management Plan to serve the region including the municipalities and electoral areas, and working collaboratively with the First Nations.[10] The plan was developed to optimize the response, resources and planning for incidents that may occur within the CVRD. The plan outlines the Emergency Operations Centre (EOC) functions, EOC activation, the evacuation plan for the CVRD, contingency plans for specific disasters, and the chain of command and the roles of each section (operations, planning, logistics, and finance/administration) in the event of an emergency. The contingency plan for wildland interface fires lists the possible major effects of such an event, the potential site actions that may be required to address these effects, and the associated actions of the EOC and equipment that could aid in response. Emergency response is coordinated at a regional scale, with designated EOC locations throughout the CVRD and Incident Command (IC) for site level response. Due to the fact that the CVRD is made up of many municipalities, First Nations Reserves, and unincorporated localities, the Emergency Management Plan provides important information about jurisdiction, emergency management agreements between jurisdictions, and cost sharing.[10]

The CVRD has also developed a specific framework for Farm Emergency Planning, which includes a guide and template for landowners to create their own Farm Emergency Plan. For individual homeowner preparedness, the Emergency Preparedness Workbook provides direction on protecting homes when a fire is approaching (prior to an evacuation order).[11] The CVRD's Local Emergency Response Neighbourhoods (LERN) Program provides residents with training and information for staying safe and being self-sufficient for seven days in the event of a disaster or emergency.

2.5.2 Affiliated CWPPs

CWPPs have been developed for the City of Nanaimo (2015), Lake Cowichan (2017), North Cowichan (2005), Extension (2006), and the District of North Saanich (2011). These documents, when available were reviewed for relevance (i.e., synergistic project opportunities, as well as to confirm that there are no contradicting recommendations). Furthermore, CWPPs are currently under development for the CVRD Central, West, and North Zones. The AOI of the CVRD Central CWPP overlaps significantly with that of the CVRD South Zone. CWPPs for each of these four CVRD zones are being developed by the same consultant ensuring consistency in recommendations and synergies within proposed future fuel treatment works.

[10] Mid Island Emergency Coordinators & Managers, 2015.

[11] Mid Island Emergency Coordinators & Managers, 2017.

2.5.3 Local Government/First Nation Policies and Recommendations

The intent of this section is to review all relevant local government plans, policies and bylaws and identify sections within that are relevant to the CWPP update. The following municipal bylaws, strategies and policies are relevant to wildfire planning in the AOI.

Bylaw No. 3510, 2016: South Cowichan Official Community Plan

The South Cowichan Official Community Plan (OCP) provides guidance for land use, development, and community evolution within the CVRD spanning a 15-year period, specifically for Electoral Areas A, B and C. Numerous sections contain objectives and policies which are directly relevant to wildfire risk reduction, emergency response, and community resilience post-disaster as described below.

2016 OCP Section 3: The Natural Environment

Section 3 recognizes the need for village containment boundaries to be set in order to limit urban and rural sprawl, which otherwise would lead to fragmented ecosystems and watersheds, further spreading out emergency service coverage and increasing emergency response times or leading to development in areas where fire services are not available. This section also recognizes the need to reduce wildfire interface areas in order to reduce the potential for loss of life and property during a wildfire event. This idea is recognized explicitly in Section 23 of the OCP (details below).

2016 OCP Section 4: Marine Shoreline Management Policies

This section supports the continued public control over road access to the marine shoreline in order to allow for easier access for emergency response vehicles.

2016 OCP Section 9: Community Heritage Conservation

Section 9 outlines the CVRD's commitment to identify and protect heritage and archaeological sites and recognize the history and contributions of First Nations to the South Cowichan area. This is particularly relevant in the case that the CVRD undertakes fuel management projects where there is potential to damage archaeological values. See Section 3.3.2 for more details on the Heritage Conservation Act and how to ensure that archaeological values are protected during on-the-ground operational projects through the use of desk-top and field-based value identification and First Nations consultation.

2016 OCP Section 10: Village Containment Boundaries

Section 10 outlines the objectives and policies regarding Village Containment Boundaries (VCB). Although the objectives do not include emergency response, preparedness, or wildfire risk reduction, by containing development within a specified area, the overall fire risk is less than when compared to areas of intermixed development (rural sprawl). In intermixed or rural areas there is often higher potential to have inadequate or unreliable water supply for suppression, as well as longer emergency response times. By constraining development to VCBs, the CVRD can ensure that future development occurs where urban services, such as water for fire suppression, are available, reliable, and accessible.

2016 OCP Section 12: Rural Resource Designation

One of the main objectives outlined in section 12 focuses on minimizing the overall occurrence of interface fires by minimizing the creation of new interface areas.

2016 OCP Section 17: Parks and Institutional Designations

This section outlines the CVRD's park acquisition objectives and acquisition process through development and other means. Parks provide a multitude of ecosystem, social, and economic benefits to the CVRD, but also have the potential to impact the interface fire risk and increase the liability of the CVRD should they not be maintained in an appropriate range of wildfire threat. New parks should be reviewed by a Qualified Professional (QP) such as a Registered Professional Forester, competent in fire suppression and fire behaviour to ensure that they are received in an acceptable range of threat at the time of assumption. Furthermore, assumed parks should have reasonable access to maintain an acceptable level of threat within the park in the future, as well as facilitate suppression access in the event of an interface fire. QPs competent in the field of wildfire threat and fire behavior can provide insight to the CVRD regarding siting and access of future parks and trails.

This section also identifies the zoning measures being taken in order to facilitate current fire bases (Cobble Hill) and the creation of new fire halls where these services may be lacking.

RECOMMENDATION #1: Review the OCP and associated supporting documents (i.e., Shawnigan Lakes and Cobble Hill Community Parks and Trails Master Plans and bylaws) and consider parks acquisition and maintenance through a wildfire risk lens, including consideration for long-term maintenance costs and access. Consider amendments where needed, including the following: 1) require the use of a QP in review, assessment, and siting of parks and park access prior to acceptance; and 2) ensure that bylaws provide the CVRD authority to request modification (either fuels, access, or siting) based upon QP recommendation and prior to acceptance to ensure that the park is received in, and able to be maintained in, an acceptable range of risk. (See Section 6.1.3 for related recommendations specific to access).

2016 OCP Section 20: Community Water Services

There are three different types of water systems in the South Cowichan: those run and maintained by the CVRD, those run and maintained by a Land Improvement District, and those systems which are privately owned and maintained. The OCP identifies considerable challenges associated with numerous water systems. During consultation with the CVRD, additional challenges introduced by multiple water systems, owners and models of governance specific to suppression capabilities were recognized. These include but are not limited to: unreliable flows; insufficient hydrants or ineffective hydrant placement; systems not built or maintained to current standards; systems with unknown, unreliable, or lacking secondary power; and, potential inaccessibility to private water systems during emergency response.

In 2017, a Water and Wastewater Utilities Review and Assessment document was completed for the CVRD.[12] A number of the recommendations stemming from the assessment will work towards improving water access and suppression capability (asset condition assessment, long range financial planning, change in governance structures, CVRD approval of subdivisions, etc.). For more details on water systems and water availability, see Section 3.2.3.

Policy 20.15 recommends the improvement of water storage systems in order to help with handling periods of drought and/or fire.

Policy 20.17 states that in the few cases where a new business park is created outside of a village containment boundary, a community water system will be created in order to service said area.

RECOMMENDATION #2: Review the OCP and recognize natural hazards that have the potential to impact values within the CVRD South Zone. Natural hazards include, but are not limited to, wildfire and interface fire which has the potential to impact public health and safety, economics (i.e. through evacuations, loss of tourism, interruption of services), ecosystems, habitat, and water quality among other values. Identification of natural hazards can allow for planning and policies to be put in place to increase CVRD resilience, mitigate potential damages and increase public and official awareness of risk.

2016 OCP Section 23: Fire Protection

The Cowichan Valley Regional District South is covered by four different organizations, collectively they control Electoral Areas A, B and C (though remote areas or areas outside of VCBs are not covered). Section 23 outlines three primary objectives:

a) To ensure there are adequate water supplies available for fire protection;
b) To minimize the overall potential for a wildfire interface event; and
c) To ensure that residential development does not occur outside of a fire service area.

Policy 23.3 outlines the need for subdivisions on community water systems to meet appropriate fire protection standards such as adequate hydrant placement and proper emergency vehicle access. This is supported through the Subdivision Servicing Bylaw.

Policy 23.4 states that for fire protection purposes, community water service providers will be encouraged to improve water storage systems where needed.

Policy 23.5 states that the Regional District will encourage the Ministry of Transportation and Infrastructure to improve road access to water sources such as lakes, major streams and the sea in order to access such areas easier in the case of a fire event.

[12] Innova Strategy Group. 2017.

See recommendations in Section 3.3.1 and 6.1.1 that address water availability for fire suppression and fire department equipment requirements to draft from natural water sources.

2016 OCP Section 24: South Cowichan Rural Development Permit (DP) Area:

There are a number of DP guidelines which apply within the Rural DP Area, depending on a number of factors. Prior to development of any type within the Rural DP Area, the owner must submit information that demonstrates how the proposed development will meet all applicable guidelines within the DP Area, or demonstrate that an exemption is appropriate.

Within the Rural DP Area, the following guidelines are relevant to wildfire and interface fire risk reduction:

> **General**: In all cases where a development permit is required, owners must remove / eradicate invasive plant species such as Scotch Broom. Scotch Broom is a highly flammable shrub species, common in disturbed areas and right of ways (i.e. under power lines and the side of highways).
>
> **Community Land Stewardship Guidelines:** In lands being developed that fall within the community land stewardship designation, FireSmart measures shall be taken in order to mitigate the chance of a fire starting or spreading. These measures include ensuring the appropriate firefighting equipment is on site, the thinning of fuels around buildings, and the design of all new dwellings with sprinklers and non-combustible roofing materials.
>
> **Wildfire Interface:** These guidelines apply to the construction of buildings which fall outside the VCB and in areas that are rated as high to extreme hazard rating as shown on the CVRD Wildland Urban Interface Map. This section covers a variety of safety measures that should be taken in order to make homes less at risk for fires and are based upon FireSmart guidelines.
>
> **Industrial/Business Park:** At the subdivision application stage, a report will be conducted regarding the potential natural hazards to the subdivision and will include assessments of the geotechnical risk and wildland/urban fire risk by qualified professionals in each respected field. Said report will contain advice regarding the layout of the subdivision and provide recommendations surrounding protective measures to take in order to mitigate risk.

RECOMMENDATION #3: Consider reviewing the South Cowichan Rural Development Permit Area mapping where Wildfire Interface Guidelines apply and update using the most recently developed wildfire threat mapping, completed as part of the CWPP update. Consider amending the map to include all areas within 100 m of moderate, high, or extreme threat class. The updated area should be made available via the CVRD's Web Map.

RECOMMENDATION #4: Consider incorporating QP reports and sign-off as part of the Wildfire Interface Guidelines.

2016 OCP Section 25: Administration and Implementation

This section mentions the expansion of fire service coverage into previously underserviced areas by building a new fire station in South Shawnigan. By doing so there is an increase in suppression capacity, reduced response times and overall it provides more effective fire suppression coverage during interface fire events. This is consistent with other strategies and recommendations within this document.

Cowichan-Koksilah Official Community Plan: Technical Background Report 2015

The Cowichan-Koksilah Official Community Plan covers the entirety of Electoral Area E, the easternmost part of Electoral Area F (Cowichan Lake South, Skutz Falls, West Sahtlam and Paldi) and the northeastern side of Electoral Area B (Shawnigan Lake and First Nations Reserves 1, 5 and 6 which are within Federal jurisdiction).

2015 Cowichan-Koksilah OCP Technical Background Report Section 2.4: Hazards

This section touches on the hazards within the area, specifically wildfires, landslides and flooding. A map[13] of the Wildfire Hazard is also provided, in which much of the area falls within the high to extreme categories.

2015 Cowichan-Koksilah OCP Section 6.7: Fire Protection

This section outlines the fire coverage throughout the plan area and which department covers each area. Both Electoral Area B and E have large sections left unassigned, notably in extreme wildfire hazard areas.

2015 Cowichan-Koksilah OCP Section 7.7: Growth Management Policy

This section points out a shortcoming in this current version of the OCP, that being the absence of a strategic growth management policy. Having growth management policies is a legal requirement for official community plans; they not only serve to meet the housing development needs of the area but they also outline potential interface areas that could be at risk for wildfire.

RECOMMENDATION #5: Consider reviewing and amending the Koksilah OCP to include a growth management policy which considers wildfire risk and other natural hazards during strategy development. By containing development within a specified area, the overall fire risk is less than when compared to areas of intermixed development, i.e. rural sprawl. In intermixed or rural areas there is often the potential to have inadequate or unreliable water supply for suppression, as well as longer emergency response times. By constraining development, the CVRD can ensure that future development occurs where urban services, such as water for fire suppression, is available, reliable, and accessible. Overall intermix and rural areas are generally more vulnerable (at higher risk) for interface fires.

CVRD Bylaw No. 2020, 2009: Landclearing Management Regulation Bylaw

This bylaw overviews the use/permittance of landclearing and burning within the CVRD, which only applies to machine-piled landclearing debris and regulated quantities of landclearing debris. An air curtain burner shall be used for all open burning of landclearing debris and must be registered in

[13] Cowichan-Koksilah Official Community Plan Technical Background Report. 2015.

accordance with the BC Open Burning Smoke Control Regulation prior to use by a certified operator. Both a bylaw enforcement officer and a fire chief have authority and final say in the open burning practices that will be taking place.

CVRD Bylaw No. 3716, 2013: Smoke Control Regulation Bylaw

The smoke regulation bylaw outlines the permitting of smoke caused by open burning, incinerators and campfires as well as the size of such fires, the distance from property boundaries, the dates which these fires are allowed to occur and the person in charge who can order/cause the extinguishment of such fires. The bylaw allows for burning of clean wood waste, such as that resulting from fuel reduction or wildfire risk mitigation activities (pruning, thinning, brushing, etc.), in the case that the burn conforms with the bylaw in all other aspects.

CVRD Bylaw No. 3422, 2011: Building Regulation Bylaw

Section 2.1.4 – Essential Services: states that a driveway must have the appropriate dimensions, strength and grade for emergency service vehicles to access all principal buildings.

CVRD Bylaw No. 738, 1983: Cowichan Valley Regional District Parks Bylaw

Section 10: Fires: restricts the use of fire outside of designated fire areas (i.e. fire ring) as well as during a fire restriction as laid out by the provincial government. It also restricts the burning of prohibited material within the entirety of the park as well as the placement of any lighted material on the ground (i.e. cigar, cigarette, candle, etc.).

CVRD Bylaw No. 1341, 1992: House Numbering, Unsightly Premises and Graffiti

This bylaw states that house numbers must be clearly visible from the highway to assist in safe and prompt emergency response. The bylaw also states that the owner or occupier must not have any accumulation of filth, discarded material or garbage of any kind.

RECOMMENDATION #6: Consider working with the Development Services Division (i.e., building inspectors) to ensure house numbering is posted prior to occupancy of new development and to provide instructions on how and where best to affix numbering to facilitate emergency response and evacuation efforts. Consider encouraging home owner participation via a CVRD-wide engagement campaign and providing incentives such as the opportunity to acquire/purchase discounted address signs.

RECOMMENDATION #7: Review CVRD Bylaw No. 1341, 1992 and include wording that specifically prohibits the accumulation of combustible materials on the property (including on and under exterior projections, such as decks and patios, near the home, and in gutters and roofs). The revised bylaw should provide the CVRD the authority to require removal/clean-up of combustible materials or to complete removal and recoup costs from the owner.

Shawnigan Lake Parks & Trails Master Plan, 2010

The Shawnigan Lake Parks & Trails Master Plan provides a comprehensive strategy for the maintenance and development of the trails throughout the Shawnigan Lake area for the next 10 to 20 years. From

ignition potential to access, detection, and suppression, trails can have a significant impact on the wildfire risk of a community. High-use recreational trails can be beneficial when high-use times provide increased early detection and reporting. Alternatively, trails are potentially locations of increased ignitions in the interface (high–use areas). Furthermore, depending upon width, clearance, and surfacing, trails can provide points of access for suppression efforts, serve as surface fire fuel breaks, and act as control lines for suppression efforts.

2010 Trails Master Plan Section 5.2: Priority Recommendations

A priority action identified in this section summarizes the need to acquire some or all of the undeveloped roads running into Shawnigan Lake with the objective of public access to the lake, but also to include the local fire district in trail placement / layout, as they can note the most ideal places for filling up fire trucks in the case of wildfire event

Cobble Hill Community Parks & Trails Master Plan, 2012

2012 Trails Master Plan Section 5.4.2: Community Park Operations and Management

This section overviews the need to the develop and implement an emergency response plan to deal with the associated risks of fire within parks. It aims to follow the protocol and reduction techniques based on the information found within the 2003 Firestorm report conducted by the province.

RECOMMENDATION #8: Complete updates to trails master plans through a wildfire lens, including consideration for the placement, type, width, and objective of trails. Consideration should also be given to trail building and maintenance as these activities can either increase wildfire risk (through fuels accumulations and unsafe work practices) or decrease wildfire risk (though proper placement, clean-up of combustible fuels trailside and work practices which adhere to Wildfire Act and Regulations).

2.5.4 Higher Level Plans and Relevant Legislation

Vancouver Island Land Use Plan (VLUP)[14]

The Vancouver Island Land Use Plan (VLUP) is the higher-level planning document for all of Vancouver Island, including the CVRD South Zone. The plan provides strategic direction for the following categories: 1) Protected Areas Network; 2) Forest Land Base; 3) Regional Biodiversity Direction; 4) Food Production Activities; 5) Settlement Lands; 6) Energy and Mining Opportunities; 7) Integrated Coastal Management; and 8) Community Stability. The plan also identifies Land Use Zones, which are used to delineate areas which require specific management.

Relevant Legislation

There are a few spatially explicit ministerial orders pertaining to Ungulate Winter Range (UWR) and Scenic Areas in the AOI which may impact potential fuel treatment activities. Further, non-legal Old Growth Management Area (OGMAs) were identified within the AOI. These spatially explicit ministerial orders must be reviewed, considered, and addressed during the fuel management prescription-level phase. Fuel management within these areas should aim to enhance these values, whenever possible,

[14] The Province of BC, 2000.

and the land manager and/or stewardship forester (South Island Natural Resource District) must be consulted regarding any overlapping values at risk, spatially explicit ministerial orders, or other notable values on the land base, during prescription development.

2.5.5 Ministry or Industry Plans

Reviewing and incorporating other important forest management planning initiatives into the CWPP planning process is a critical step in ensuring a proactive and effective wildfire mitigation approach in the AOI.

The Vancouver Island Central Coast Response Fire Management Plan (FMP)[15] that encompasses the CVRD South Zone was reviewed to identify future landscape level fire management planning at the Natural Resource District level. The FMP was completed in 2018 for the Coastal Fire Centre and three Natural Resource Districts, including the South Island District relevant to the AOI. The FMP identifies values at risk and prioritizes broad categories of values as 'themes' for categorizing response through the Resource Strategic Wildfire Allocation Protocol (RSWAP). The FMP briefly speaks to the concept of wildfire prevention engineering within the region, which includes fuel management such as locally identified fuel breaks, proposed treatment areas, or demonstration and operational treatment areas. The FMP does not identify potential fuel breaks around the municipalities within the AOI. To address this gap, landscape level fuel break opportunities have been identified as part of this CWPP. These fuel breaks have been recommended in order to protect access and egress routes in the CVRD South Zone as well as to serve as strategic anchors for fire suppression and to reduce the potential for extreme crown fire behaviour.

Due to the fact that the CVRD South Zone has limited access and egress options, improving access and increasing public safety in the event of an emergency evacuation should be a priority. There may be funding opportunities for fuel breaks on Crown land along the Malahat Highway and other single-access roads through the Forest Enhancement Society of British Columbia (FESBC). Communication with the Natural Resource District and Ministry of Transportation and Infrastructure should be initiated to explore potential fuel treatments.

Three approved Forest Development Units (FDUs) are located within the AOI with associated Forest Stewardship Plans (FSPs) which set specific forest practices obligations applicable to specific forest licensees.

Four Provincial Parks are also located within the AOI, including Bamberton, Spectacle Lake, West Shawnigan Lake and Koksilah River Provincial Parks. Management plans for these parks consist of Purpose Statement and Zoning Plans (PSZP 2003) for the first three developed parks, and a more comprehensive Management Plan (MP 2001) for the undeveloped Koksilah River. In consultation with

[15] Ministry of Forests, Lands, Natural Resource Operations and Rural Development, 2018.

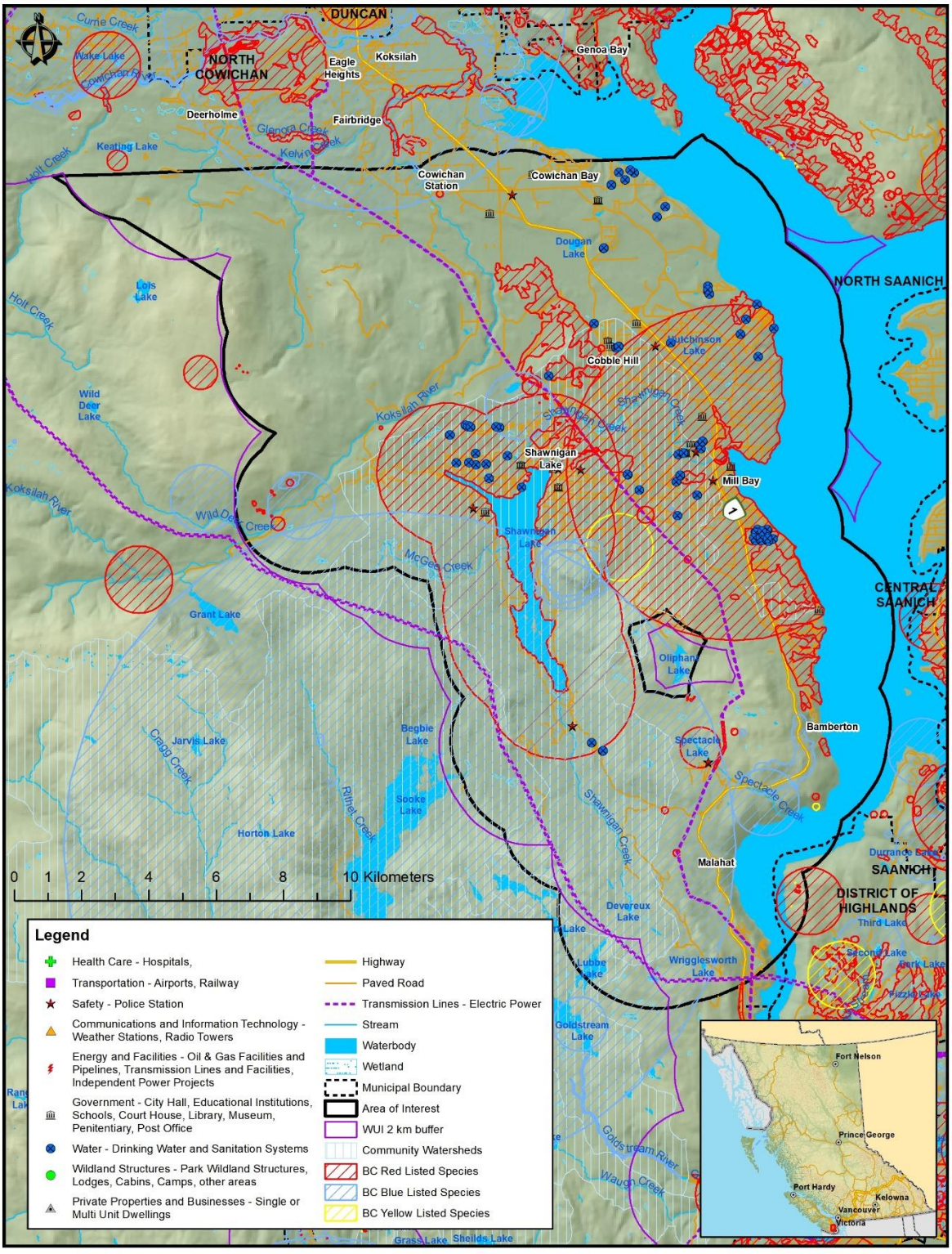
BC Parks staff, two fire management plans were developed for Bamberton (fully implemented in 2017-2018) and Spectacle Lake Parks (implementation status unconfirmed).

Forest health management and associated initiatives within the Arrowsmith Timber Supply Area (TSA) are guided by the Coast Area 2015-17 Coastal Timber Supply Areas Forest Health Overview[16]. This plan must be reviewed, considered, and addressed during the prescription-level phase. Fuel management and prescriptions aimed at reducing wildfire hazard within the AOI should aim to incorporate the guiding principles and best management practices (BMPs) presented within this aforementioned plan.

SECTION 3: VALUES AT RISK

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

[16] Ministry of Forests, Lands and Natural Resource Operations. 2015



Map 2. Values at Risk within the AOI.

3.1 HUMAN LIFE AND SAFETY

One of the primary goals of the BCWS is to support emergency response and provide efficient wildfire management on behalf of the BC government. BCWS aims to protect life and values at risk, while ensuring the maintenance and enhancing the sustainability, health and resilience of BC ecosystems.[17]

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

The population distribution (both people and structures) within the AOI is important in determining the wildfire risk and identifying mitigation activities. The population of the CVRD South Zone has increased moderately in recent years. It was last measured at approximately 18,310 persons in 2016, up 5.7% from 2011.[18] This compares to 4.2% growth in the Cowichan Valley as a whole during the same years. According to the 2016 Census, there are 7961 private dwellings in the South Zone, approximately 475 of which are occupied on a part-time basis. These figures are calculations based on the Census population statistics of CVRD Electoral Areas A, B, and C, which overlap with the CVRD South Zone AOI. Small portions of Electoral Areas D and E also partially overlap the AOI, however, these estimates were not included in the calculation. Population density is the greatest in Shawnigan Lake, Cobble Hill, and Mill Bay. The population of these three electoral areas is projected to increase to 23,735 by the year 2026.[19] The CVRD South Zone also attracts visitors for camping, hiking, canoeing, summer camps, and other recreational endeavors, particularly during the fire season (May – October). Several parks throughout the AOI are highly used during the summer months, including Cobble Hill Mountain Regional Recreation Area, Spectacle Lake Provincial Park, Hollings Creek Park, West Shawnigan Lake Provincial Park, Bamberton Provincial Park, and Old Baldy Mountain Park. Furthermore, the Malahat Highway is frequently used as an access corridor from the central island to Victoria, Sooke, and the Southern Gulf Islands, which increases the number of people to evacuate in the event of a wildfire.

Knowledge of and access to updated structure locations within an area is a critical step in efficient and successful emergency response planning and the development of mitigation strategies and recommendations. Field visits to the CVRD South Zone AOI and access to recent orthophotography and spatial data from the CVRD has enabled the development a spatial layer with structure locations that accounts for the most recent development.

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

[18] Statistics Canada. 2016 Census.

[19] CVRD Bylaw 3510: South Cowichan Official Community Plan – Schedule A

3.2 CRITICAL INFRASTRUCTURE

Protection of critical infrastructure (CI) during a wildfire event is an important consideration for emergency response effectiveness, ensuring that coordinated evacuation can occur if necessary, and that essential services can be maintained and/or restored quickly in the case of an emergency. Critical infrastructure includes emergency and medical services, electrical and gas services, transportation, water, social services, and communications infrastructure. A critical infrastructure dataset was provided by the CVRD's GIS staff and these data were included in Map 2. Table 3 details an inventory of critical infrastructure identified by the CVRD and via field visits.

Protection of critical infrastructure has shown itself to be an essential wildfire preparedness function. Survival and continued functionality of these facilities not only support the community during an emergency but also determine, to a great degree, the extent and cost of wildfire recovery and economic and public disruption during post wildfire reconstruction. Critical infrastructure provides important services that may be required during a wildfire event or may require additional considerations or protection. As outlined in Section 5.2, FireSmart principles are important when reducing wildfire risk to both classes of structure and are reflected in the outlined recommendations. During field visits, it was observed that the CVRD's critical infrastructure (i.e., fire halls, community centres, etc.) is in various levels of compliance with FireSmart principles.

RECOMMENDATION #9: The use of fire resistant construction materials, building design and landscaping should be considered for all CI when completing upgrades or establishing new infrastructure. Additionally, vegetation setbacks around critical infrastructure should be compliant with FireSmart guidelines. Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which cuts power for days, or even weeks.

3.2.1 Electrical Power

Electrical service for most of the CVRD South Zone is received through a network of wood pole transmission and underground distribution infrastructure supplied by BC Hydro. Neighbourhoods with small, street-side wooden poles to connect homes are particularly vulnerable to fire. It is recommended that utility right-of-way BMPs such as, regular brushing and clearing of woody debris and shrubs be employed to help reduce fire risk, utility pole damage and subsequent outages.

Two major radial transmission lines bisect the CVRD South Zone, connecting the Vancouver Island substation to the Goward substation and the Sahtlam substation to the Pike Lake substation. This system is well-mapped and BC Hydro states that staff will work with local fire departments and BCWS to mitigate impacts to this infrastructure in the event of a wildfire.[20]

A large fire has the potential to impact electrical service by causing disruption in network distribution through direct or indirect means. For example, heat from flames or fallen trees associated with a fire

[20] https://www.bchydro.com/safety-outages/emergency-preparation/natural-disasters.html

event may cause power outages. Consideration must be given to protecting this critical service and providing power back up at key facilities to ensure that the emergency response functions are reliable.

Secondary power sources are important to reduce critical infrastructure vulnerability in the event of an emergency which cuts power for days, or even weeks. Secondary power is largely available for some critical infrastructure such as the fire halls, emergency operations centre, and RCMP, and most water pumping stations via backup generators. Vulnerabilities for secondary power sources include mechanical failure, potentially insufficient power sources should a wide-scale outage occur, and fuel shortage in the event of very long outages. Refer to Section 6.1 for discussion and recommendations related to backup power and water availability for fire suppression.

3.2.2 Communications, Pipelines and Municipal Buildings

The CVRD South Zone does not contain any hospitals or airports, as residents are serviced by Victoria General Hospital, Cowichan District Hospital or Royal Jubilee Hospital. There is a Fortis BC gas line that supplies the CVRD South Zone. A map of the FortisBC natural gas distribution system is not available to external companies. As such, it is not possible to identify specific areas that may be vulnerable to wildfire. A publicly available service area map[21] indicates that a natural gas pipeline transects the Zone. The FortisBC company website states that employees will consult with local authorities and BCWS in the event of a wildfire. A full inventory of critical infrastructure for communications, pipelines and Regional District buildings with updated locations is presented in Table 3, below.

Table 3. Critical Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
Communication Infrastructure and Climate/Weather Stations	2 RCMP Radio Towers (Shawnigan Lake Detachment and Sheepshanks – Malahat)
RCMP Detachment	2780 Shawnigan Lake Road, Shawnigan Lake
Mill Bay Fire Department Station 1	2675 Lodge Pole Road, Mill Bay
Mill Bay Fire Department Station 2	1171 Hutchinson Road, Cobble Hill
Shawnigan Lake Volunteer Fire Department Station 1	1645 Shawnigan Lake-Mill Bay Road, Shawnigan Lake
Shawnigan Lake Volunteer Fire Department Station 2	2560 West Shawnigan Lake Road, Shawnigan Lake West
Shawinigan Lake Volunteer Fire Department Station 3	1750 Sooke Lake Road, Shawnigan Lake
Malahat Volunteer Fire Department Primary Hall	935 Whittaker Road, Malahat
Cowichan Bay Volunteer Fire Department	4461 Trans-Canada Highway, Cowichan Bay
Ambulance Station #137	955 Shawnigan Lake-Mill Bay Road

[21] https://www.fortisbc.com/About/ServiceAreas/Pages/default.aspx

Critical Infrastructure Type	Location
Emergency Operations Centre (EOC) 1 – Mill Bay Community League Hall	1001 Shawnigan Lake-Mill Bay Road, Mill Bay
EOC 2 – Malahat First Nation Council Office	110 Thunder Road, Mill Bay
Emergency Social Services (ESS) – Primary Reception Centre – Kerry Park Recreation Centre	1035 Shawnigan Lake-Mill Bay Road
ESS Secondary Reception Centre - Cobble Hill Farmers Institute	3550 Watson Avenue, Cobble Hill
ESS Secondary Reception Centre – Shawnigan Lake East Community Centre	2804 Shawnigan Lake Road, Shawnigan Lake East
ESS Secondary Reception Centre – Camp Pringle	2520 West Shawnigan Lake Road, Shawnigan Lake West
ESS Secondary Reception Centre – Container at Coverdale Watson Park	Wilmot Road, Cowichan Bay
ESS Long Term Care – Acacia Ty Mawr	2655 Shawnigan Lake Road, Shawnigan Lake
Bench Elementary	1501 Cowichan Bay Rd, Cowichan Bay
Brentwood College	2735 Mt. Baker Road, Mill Bay
Discovery Elementary	2204 McKean Road, Shawnigan Lake
Ecole Cobble Hill Elementary	3642 Learning Way, Cobble Hill
Evergreen Independent School	3515 Watson Avenue, Cobble Hill
Frances Kelsey Secondary	953 Shawnigan Lake-Mill Bay Road, Mill Bay
George Bonner Elementary	3060 Cobble Hill Road, Mill Bay
Shawnigan Lake School	1975 Renfrew Road, Shawnigan Lake
Sunrise Waldorf School	2148 Lakeside Road, Duncan

3.2.3 Water and Sewage

The CVRD operates and maintains 19 water systems, which provide 3,700 connections to residents and commercial operators within the region.[22] In the CVRD South Zone, water is supplied through both groundwater and surface water sources; with a heavy reliance on groundwater. In the CVRD as a whole, approximately 25 private operators, First Nations, and local governments supply water to the Regional District.[23] In 2017, the CVRD released a report titled "Water & Wastewater Utilities Review and Assessment for the Cowichan Valley Regional District"[24], which was developed to address the lack of CVRD-level utilities planning and the inherent challenges the CVRD faces when operating multiple distinct systems with a quickly growing population.

[22] CVRD. 2018. CVRD Water Utilities. Water Withdrawal. Retrieved online at: http://cvrdnewnormalcowichan.ca/total-water-withdrawal/cvrd-utilities-water-withdrawal-graph/

[23] 2010 State of the Environment Report. Retrieved online at: http://www.12things.ca/uploads/2010S0Ereportsm.pdf

[24] Innova Strategy Group. 2017. Retrieved online at: https://www.cvrd.bc.ca/DocumentCenter/View/79863/Attachment-A---CVRD-WWURA-Innova-FULL-Report-Feb-03

The South Zone AOI is serviced by a total of 11 CVRD-operated water systems. Additional water service is provided by several improvement districts, and private systems. The CVRD tracks surface water storage levels and targets for all its reservoirs and maintains updated maps of all water systems within its jurisdiction.[25] A detailed account of water availability for wildfire suppression is provided in Section 6.1.2.

The CVRD operates and maintains 16 sewer systems (12 within the South Zone) and is currently working to combine the Twin Cedars and Cobble Hill Sewer Systems in one system.[26] Additional sewer systems throughout the CVRD are managed by individual private operators, improvement districts, and municipalities.

Critical water supply and sewage system infrastructure was not identified in the 2005 CWPP. Locations for water and sewage infrastructure (current as of 2018) within the CVRD South Zone AOI are detailed below in Table 4.

Table 4. Critical Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
Water supply	Communities including Cowichan Bay, Cobble Hill and Mill Bay are served by their respective Water Improvement Districts and Shawnigan Lake is served by Lidstech (private water system), and Shawnigan Lake North (CVRD water system). CVRD water systems and associated infrastructure include the following: • Arbutus Ridge, including a reservoir and pump station on Country Club Parkway; • Carlton, including a well and a meter box at 2640 Nora Place and a reservoir/treatment building at 1356 Carlton Place; • Douglas Hill, including a reservoir and pump station at 4108 St. Catherines Drive and a pump station at 1451 Freeman Road (on right-of-way off Cowichan Bay Road); • Kerry Village, with a reservoir, pump station and treatment building at 1045 Bourban Road; • Lambourn Estates, with 2 reservoirs (one steel and one concrete) and a pump station on Chestnut Road (fire pump and three Volunteer Fire Department pumps) and a treatment building on Hurtin Road; • Shawnigan Lake North, with 2 reservoirs on Gregory Road, one pump station at 2126 Ingot Drive and another pump station and break tank, both located at 2660 Decca Road; • Arbutus Mountain Estates, with a reservoir and one treatment building at 1003 Easton Place; • Burnum with a 76,000-gallon reservoir at 3330 Andy Place;

[25] CVRD. 2018. Cowichan Valley Water Systems Map. Retrieved online at: http://cvrdnewnormalcowichan.ca/water-systems/#CVRD

[26] https://www.cvrd.bc.ca/2670/Utility-Services

Critical Infrastructure Type	Location
	• Cherry Point Estates, with a 45,000-gallon reservoir at 1105 Cherry Point Road and a treatment building at 4361 Brentview Drive; • Fern Ridge with a reservoir on the right-of-way off 1058 Fern Ridge Drive; • Satellite Park, with a reservoir at 3841 Lefran Road, a pump station on Aros Road, and pressure reducing valve stations (2) on Granfield Place and Satellite Park Drive. Additionally, the following 6 private water systems are located in the South Zone: • Garnett Creek Water Users, Millar's Water Supply, Vanland Developments in Area C – Cobble Hill; • Kilmalu Developments and Knute Johnson in Area A – Mill Bay/Malahat; • Lidstech Holdings Ltd. in Area B – Shawnigan Lake
Sanitary sewer system	Sewage is transported, treated, stored and discharged through 12 CVRD systems, and through other improvement district, municipal and privately-operated independent systems. The CVRD systems and associated infrastructure include the following: • Mill Springs, including a treatment building; • Twin Cedars, including a pump station and a treatment building; • Maple Hills, including a pump station; • Cobble Hill, including a treatment building; • Arbutus Ridge, with 3 pump stations; • Brulette Place (upgrades are proposed and/or in progress). including a pump station and treatment buildings (phases A-1, A-2 and B); • Kerry Village, including a multi-building sewer treatment plan and 2 pump stations; • Sentinel Ridge, including a treatment building, 2 pump stations and 18 inspection ports; • Arbutus Mountain Estates, with a treatment building; • Shawnigan Beach Estates, 9 pump stations and an office building; • Cowichan Bay, with a pump station; and • Lambourn Estates, with a treatment building and 2 pump stations.
Sewage lagoons	Dual lagoons at Shawnigan Beach Estates.

3.3 HIGH ENVIRONMENTAL AND CULTURAL VALUES

The following section identifies high environmental and cultural values and where they are located. Environmental, cultural and recreational values are high throughout the AOI. A more detailed account of environmental and biodiversity aspects of this region is presented in Section 3.3.3.

3.3.1 Drinking Water Supply Area and Community Watersheds

The CVRD South Zone draws its domestic water from various surface and groundwater sources. Shawnigan Lake supplies the towns of Shawnigan Lake and Mill Bay with drinking water.[27] Water levels are tracked from this source and information about storage is updated every 1-2 weeks from April to September. The target storage for the lake is updated every 4 to 8 weeks between October and March and every 1 to 2 weeks from April to September based on Provincial guidance and requirement for minimum storage levels.[28] In February 2017, the province revoked a permit which allowed a landfill near Shawnigan Lake to accept 100,000 tonnes of contaminated soil each year due to public concerns relating to the contamination of this water supply.[29] Currently, the material that was deposited prior to the permit cancellation remains onsite and water contamination levels are being monitored. Drinking water availability is a concern in the CVRD due to the dry spells that typically occur during the summer and is exacerbated by growing demand and climate change impacts[23] [30].

Five Community Watersheds intersect the CVRD South Zone AOI: Shawnigan, Bird, Malahat, Sooke Lake and Goldstream. However, the former three dominate the South Zone and provide water to the communities located in the AOI. The potential impacts of wildfire extend past the time a fire is extinguished. Depending on fire size and severity, there is the potential for significant hydrological impacts, extending for years post-burn.[31] Some areas may have a lower threshold for precipitation triggered events and would be particularly vulnerable to post-wildfire debris flows, mass wasting, landslides, or flooding. This may directly impact the community (i.e., structure loss, risk to public safety) or indirectly, through loss or damage of critical infrastructure, roads, or impacts on the watershed affecting water quality.

RECOMMENDATION #10: The CVRD should consider the option of conducting future assessments to explore the potential hydrologic and geomorphic impacts of wildfire on the watershed and community. Alternatively, there may be an option to complete a stand-alone assessment to help identify and quantify the post-fire hazards and levels of risk to the community. Exploration of potential funding opportunities through the province and the National Disaster Mitigation Program may be worthwhile.[32]

3.3.2 Cultural Values

The Coast Salish are the main First Nations group whose territory overlaps the CVRD. Within this group, a total of 15 First Nations and one treaty organization with aboriginal interests in the AOI were identified in the BC Consultative Areas Database. These include the Semiahmoo First Nation, Halalt First Nation,

[27] https://www.cvrd.bc.ca/2159/Water-Supply

[28] http://cvrdnewnormalcowichan.ca/water-storage-levels/

[29] Thomas, Megan. *Residents of Shawnigan Lake, B.C., await decision on fate of contaminated soil.* March 12, 2018.

[30] Cowichan Region State of the Environment Report Update 2014. Retrieved online at: https://www.cvrd.bc.ca/DocumentCenter/View/83154/SOER-2014-Introduction

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

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

Stz'uminus First Nation, Cowichan Tribes, Lake Cowichan First Nation, Lyackson First Nation, Penelakut Tribe, Te'Mexw Treaty Association, Malahat First Nation, T'sou-ke First Nation, Scia'new First Nation, Tsawwassen First Nation, Tseycum Indian Band, Pauquachin First Nation, Tsartlip Indian Band, and Tsawout First Nation.

The Stz'uminus First Nation is in Stage 4 of the treaty process and the Te'mexw Treaty Association signed their Agreement-in-Principle and is currently in Stage 5 of the treaty process. The Scia'new First Nation, Pauquachin First Nation, Tsartlip First Nation, Tsawout First Nation, Tseycum First Nation and T'sou-ke First Nation are Douglas Treaty Nations, granted the rights to hunt over unoccupied lands and carry on their traditional fisheries[33]. The 2009 Tsawwassen First Nation Treaty defines Tsawwassen First Nation's Aboriginal rights throughout their claimed traditional territory which includes the waters of the southern Strait of Georgia.

Archaeological sites in BC that pre-date 1846 are protected by the *Heritage Conservation Act* (HCA), which applies on both private and public lands. Archaeological remains in the Province of British Columbia are protected from disturbance, intentional and inadvertent, by the Heritage Conservation Act (HCA). Archaeological sites that pre-date 1846 are automatically protected under the Heritage Conservation Act whether on public or private land[34]. Sites that are of an unknown age that have a likely probability of dating prior to 1846 (e.g., lithic scatters) as well as Aboriginal pictographs, petroglyphs, and burials (which are likely not as old but are still considered to have historical or archaeological value) are also protected. Under the HCA, protected sites may not be damaged, altered or moved in any way without a permit. It is a Best Practice that cultural heritage resources such as culturally modified tree (CMT) sites be inventoried and considered in both operational and strategic planning.

Due to site sensitivity, the locations of archaeological sites may not be made publicly available, however, data provided by the MFLNRORD Archaeology Branch confirms that multiple sites do exist. The CVRD should ensure that they have direct access to Remote Access to Archaeological Data (RAAD), which allows the CVRD to look up or track any archeological sites in the area.[35] Prior to stand modification for fire hazard reduction, and depending on treatment location, preliminary reconnaissance surveys may be undertaken to ensure that cultural heritage features are not inadvertently damaged or destroyed. Pile burning and the use of machinery have the potential to damage artifacts that may be buried in the upper soil horizons. Above ground archaeological resources may include features such as CMTs, which could be damaged or accidentally harvested during fire hazard reduction activities. Fuel treatment activities should include consultation with all identified First Nations at the site level and with sufficient time for review and input regarding their rights and interests prior to prescription finalization or implementation.

[33] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/arrowsmith_tsa_discussion_paper.pdf

[34] Snetsinger, 2010.

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

3.3.3 High Environmental Values

The AOI overlaps with multiple non-legal OGMAs. Any proposed fuel treatment that may overlap these areas requires MNFLRORD oversight at the prescription development phase, and works can only occur following MNFLRORD consultation and approval.

Two Ungulate Winter Range (UWR) polygons intersect the AOI. Both of these polygons are "No Harvest Zones" as per Government Actions Regulation (GAR) Order U-1-107. This GAR Order is intended to protect critical winter foraging habitats for black-tailed deer and Roosevelt elk populations and have specific management requirements associated with them.

The Conservation Data Centre (CDC), which is part of the Environmental Stewardship Division of the Ministry of Environment, is the repository for information related to plants, animals and ecosystems at risk in BC. To identify species and ecosystems at risk within the study area, the CDC database was referenced. Two classes of data are kept by the CDC: non-sensitive occurrences for which all information is available (species or ecosystems at risk and location); and masked, or sensitive, occurrences where only generalized location information is available.

There are 13 occurrences of Red-listed species, two Red-listed ecological communities and 13 occurrences of Blue-listed species within the AOI (Table 5). There are two overlaps with a masked occurrence. Through consultation with the CDC and a biologist or qualified professional, all site level operational plans must determine if these occurrences will be impacted by fuel management or other wildfire mitigation activities. All future fuel treatment activities or those associated with recommendations made in this plan should consider the presence of, and impact upon, potentially affected species. Additionally, all site level operational plans should consult the most recent data available to ensure that any new occurrences or relevant masked occurrences are known and considered in the operational plan to mitigate any potential impacts on species at risk. The BC Species & Ecosystems Explorer, which allows combined searches for species and ecological communities, should also be consulted at the prescription phase. Due to potential limitations of existing databases, consultation with a QP with local knowledge may also be recommended at the prescription phase.

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

Common Name	Scientific Name	Category	BC List	Habitat Type
Banded Cord-moss	*Entosthodon fascicularis*	Nonvascular Plant	Blue	Terrestrial: on soil, rock outcrop
Batwing vinyl	*Leptogium platynum*	Fungus	Red	Terrestrial: forest mixed, cliff, seepage
Common Bluecup	*Githopsis specularioides*	Vascular Plant	Red	Palustrine: temporary pool, grassland/herbaceous

Common Name	Scientific Name	Category	BC List	Habitat Type
Common Ringlet, Insulana Subspecies	*Coenonympha tullia insulana*	Invertebrate Animal	Red	Terrestrial: forest mixedleaf, roadside, seepage, shrubland, grassland/herbaceous
Douglas-fir / Dull Oregon-grape	*Pseudotsuga menziesii / Mahonia nervosa*	Ecological Community	Red	
Dun Skipper	*Euphyes vestris*	Invertebrate Animal	Red	Clearcut; terrestrial: grassland/herbaceous, suburban/orchard; roadside
Edwards' Beach Moth	*Anarta edwardsii*	Invertebrate Animal	Red	Terrestrial
Ermine, Anguinae Subspecies	*Mustela erminea anguinae*	Vertebrate Animal	Blue	Terrestrial; forest needleleaf
Giant Chain Fern	*Woodwardia fimbriata*	Vascular Plant	Blue	Terrestrial: forest needleleaf
Grand Fir / Dull Oregon-grape	*Abies grandis / Mahonia nervosa*	Ecological Community	Red	
Great Blue Heron, Fannini Subspecies	*Ardea herodias fannini*	Vertebrate Animal	Blue	Terrestrial: urban
Heterocodon	*Heterocodon rariflorus*	Vascular Plant	Blue	Terrestrial: grassland/herbaceous, rock outcrop
Howell's Triteleia	*Triteleia howellii*	Vascular Plant	Red	Terrestrial: grassland/herbaceous
Howell's Violet	*Viola howellii*	Vascular Plant	Red	Terrestrial; forest broadleaf
Leafless Wintergreen	*Pyrola aphylla*	Vascular Plant	Blue	Terrestrial: forest mixed
Macoun's Groundsel	*Packera macounii*	Vascular Plant	Blue	Forest needleleaf; terrestrial: rock outcrop
Moss' Elfin, Mossii Subspecies	*Callophrys mossii mossii*	Invertebrate Animal	Blue	Terrestrial
Northern Goshawk, Laingi Subspecies	*Accipiter gentilis laingi*	Vertebrate Animal	Red	Terrestrial: Forest needleleaf
Northern Red-legged Frog	*Rana aurora*	Vertebrate Animal	Blue	Palustrine: forested wetland, swamp
Peacock vinyl	*Leptogium polycarpum*	Fungus	Red	Terrestrial: forest mixed

Common Name	Scientific Name	Category	BC List	Habitat Type
Pine Broomrape	*Orobanche pinorum*	Vascular Plant	Red	Terrestrial: forest needleleaf
Poison Oak	*Toxicodendron diversilobum*	Vascular Plant	Blue	Terrestrial; forest needleleaf; old growth
Roemer's Fescue - Junegrass	*Festuca roemeri - Koeleria macrantha*	Ecological Community	Red	Terrestrial; grassland/herbaceous
Scalepod	*Idahoa scapigera*	Vascular Plant	Blue	Terrestrial: rock outcrop
Slimleaf Onion	*Allium amplectens*	Vascular Plant	Blue	Terrestrial: woodland needleleaf, rock outcrop
Vancouver Island Beggarticks	*Bidens amplissima*	Vascular Plant	Blue	Lacustrine: beach
White-lip Rein Orchid	*Platanthera ephemerantha*	Vascular Plant	Red	Terrestrial: grassland/herbaceous
White Meconella	*Meconella oregana*	Vascular Plant	Red	Terrestrial: seepage slope

3.4 OTHER RESOURCE VALUES

There are multiple resources values associated with the land base, including recreation and tourism, wildlife habitat, drinking water supplies, and many others including timber supply.

The AOI is located in the Arrowsmith TSA, which encompasses 1,574,719 hectares of land. The Arrowsmith TSA is within the West Coast Natural Resource Region and is administered by the South Island Natural Resource District. The effective timber harvesting land base in the TSA is 54,444 ha or approximately 6.5% of the total land area.[36] The last Timber Supply Review (TSR) was completed in 2016[37] and the most recent Allowable Annual Cut (AAC) determination was completed in early 2018. The current AAC is 348,000 cubic meters per year (the AAC is not applicable to private managed forest land).

Fuel reduction treatments are not anticipated to have a measurable effect on the timber harvesting land base. Typically, forest stands identified for fuels treatments are highly constrained for conventional logging and are often in undesirable or uneconomic stand types. Numerous forest tenures exist on crown land in the AOI including, but not limited to Tree Farm License (TFL) 46 operated by Teal Cedar

[36] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/arrowsmith_tsa_rationale_2018.pdf

[37] Arrowsmith TSA Discussion Paper,2016: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/stewardship/forest-analysis-inventory/tsr-annual-allowable-cut/arrowsmith_tsa_discussion_paper.pdf

Products Ltd. and multiple Woodlot Licenses (see Map 1). The opportunity exists to work with local licensees on commercial thinning projects that meet fuels management objectives.

Within the AOI, the CVRD manages two community forests: Sooke Lake Road Community Forest and Stebbings Road Community Forest. These public lands are managed by the CVRD for community benefits including habitat protection, passive recreation and public trails development. Any potential selective harvesting in these community forests in the future would be subject to the CVRD establishing a community forest program through bylaw.[38]

3.5 HAZARDOUS VALUES

Hazardous values are defined as values that pose a safety hazard to emergency responders. Generally, the South Zone does not have a significant number of industrial sites and facilities that can be considered hazardous values. Fisher Road Recycling, a private recycling and garbage transfer station located in Cobble Hill (Table 6) receives solid waste and recyclables, including household and industrial organic waste and a variety of household hazardous materials and/or combustible materials (e.g., tires, vehicle batteries, propane tanks, oil and oil filters and containers)[39]. The management and treatment of fuels in proximity to hazardous infrastructure is critical in order to reduce the risks associated with both structural fire and wildfire. Specifically, best management practices recommended for management of hazardous values include: 1) incorporating FireSmart planning and setback requirements for all infrastructure in this category; and 2) maintaining emergency fuel/propane emergency shut off procedures to be enacted immediately and efficiently in the event of an approaching wildfire or ember shower. The CVRD did not identify any other hazardous values.

Table 6. Hazardous Infrastructure Identified in CWPP field visits.

Critical/Hazardous Infrastructure Name	2018 Location
Fisher Road Recycling	1355 Fisher Road, Cobble Hill

SECTION 4: WILDFIRE THREAT AND RISK

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

4.1 FIRE REGIME, FIRE DANGER DAYS AND CLIMATE CHANGE

The ecological context of wildfire and the role of fire in the local ecosystem under historical conditions is an important basis for understanding the current conditions and the potential implications of future

[38] Shawnigan Lake Parks and Trails Master Plan. 2010. Accessed at: https://www.cvrd.bc.ca/DocumentCenter/View/6344/SL-Master-Plan-June-2010?bidId=

[39] https://www.cvrd.bc.ca/DocumentCenter/View/89171/Current-Solid-Waste-Management-System-Overview-Rev1_IFU

conditions on wildfire threat to the community. Historical conditions may be altered by the interruption of the natural fire cycle (i.e., due to fire exclusion, forest health issues, human development) and/or climate change.

4.1.1 Fire Regime

Ecological Context and Forest Structure

The Biogeoclimatic Ecosystem Classification (BEC) system describes zones by vegetation, soils, and climate. Map 3 outlines the BEC zones found within the AOI. Regional subzones are derived from relative precipitation and temperature. Subzones may be further divided into variants based upon climatic variation and the resulting changes in the vegetative communities; variants are generally slightly drier, wetter, snowier, warmer, or colder than the climate of the regional subzone.[40]The following section is synthesized from information found on MFLRNORD's Research Branch BECWeb.[40]

BEC zones have been used to classify the Province into five Natural Disturbance Types (NDTs). NDTs have influenced the vegetation dynamics and ecological functions and pathways that determine many of the characteristics of our natural systems. The physical and temporal patterns, structural complexity, vegetation communities, and other resultant attributes should be used to help design fuel treatments, and where possible, to help ensure that treatments are ecologically and socially acceptable[41].

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

1. **Coastal Western Hemlock, Very Dry Maritime (CWHxm), Eastern Variant (CWHxm1) and Western Variant (CWHxm2) BEC Zone – NDT 2**

The CWHxm1 makes up 50% of the CVRD South Zone AOI and the CWHxm2 encompasses approximately 5% of the AOI (Table 7). The CWHxm supports forests on zonal sites that are dominated by Douglas-fir, accompanied by western hemlock and minor amounts of western red cedar and is normally found at elevations between sea level and 700 m[42]. The CWHxm is characterized by warm, dry summers and moist, mild winters. The CWHxm is classified as a Natural Disturbance Type 2 – forest ecosystems with infrequent stand initiating events where fires are often of moderate size (20 to 1000 ha) with a mean return interval of fire of approximately 200 years.[39] Many of these fires occur after periods of extended drought and produce a forested landscape characterized by extensive areas of mature forest with intermixed patches of younger forests.[39] Although the fire frequency is not high and fires are generally not large, pre-planning and preparation are essential to reduce the negative impacts of a wildfire.

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

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

[42] Green & Klinka, 1994

2. Coastal Douglas-fir, Moist Maritime (CDFmm) – NDT 2

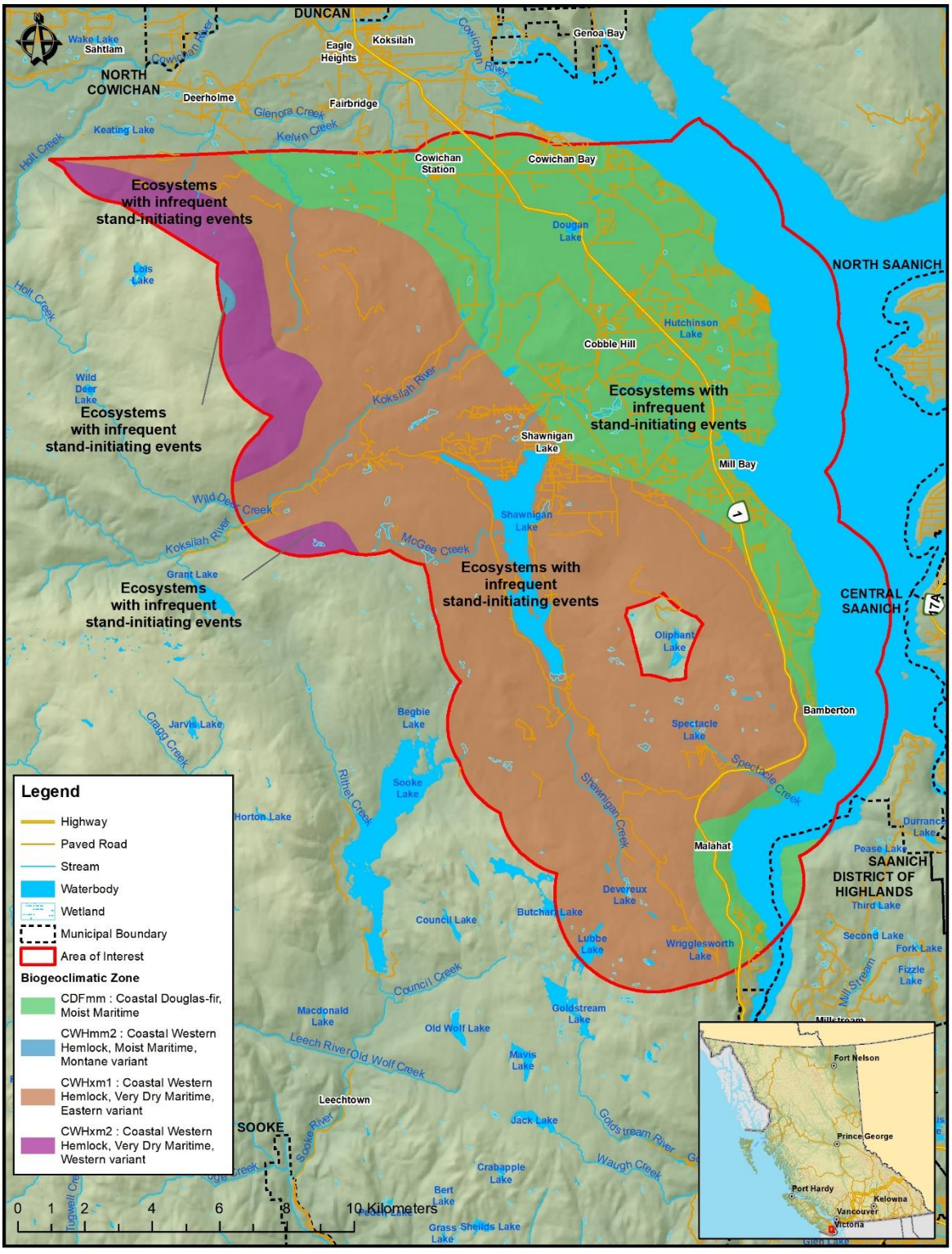
The CDFmm is the second-most common BEC unit occurring within the AOI (approximately 44%, Table 7). The CDFmm is characterized mainly by Douglas-fir, as well as grand fir and western red cedar and ranges generally in elevation from sea level to 150 m.[42] These ecosystems represent the mildest climate in Canada with warm, dry summers and mild, wet winters resulting in very long growing seasons. Moisture deficiencies are pronounced on zonal and drier sites. The historical wildfire regime characteristics are similar to the CWHxm (NDT 2). [42]

3. Coastal Western Hemlock, Moist Maritime, Montane Variant (CWHmm2) – NDT 2

The CWHmm2 is present in a very small proportion of the AOI, in pockets above the CWHxm2 from approximately 700-1100m at the northwestern extent of the AOI. Forests on zonal sites are dominated by western hemlock, amabilis fir, and Douglas-fir and minor amounts of yellow cedar and mountain hemlock.[42] The CWHmm2 commonly has a growing season moisture deficit. The historical wildfire regime characteristic of CWHmm2 is similar to that of CWHxm and CDFmm.[39]

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

Biogeoclimatic Zone	Natural Disturbance Type	Area (ha)	Percent (%)
CDFmm: Coastal Douglas-fir, Moist Maritime	NDT2	15,730	44.3%
CWHmm2: Coastal Western Hemlock, Moist Maritime, Montane variant	NDT2	41	0.1%
CWHxm1: Coastal Western Hemlock, Very Dry Maritime, Eastern variant	NDT2	17,846	50.2%
CWHxm2: Coastal Western Hemlock, Very Dry Maritime, Western variant	NDT2	1,918	5.4%
TOTAL		**35,534**	100%



Map 3. Biogeoclimatic Zones within the AOI.

Forest Health Issues

The Coast Forest Health Overview outlines forest health issues present within the Arrowsmith TSA.[43] This overview and forest health strategy (2015-2017) outlines ten forest health issues that are most prevalent within this timber supply area: Douglas-fir beetle, drought, gypsy moth, mountain pine beetle, root diseases (primarily laminated root disease and armillaria spp.), spruce aphid, western black headed budworm, western hemlock looper, western spruce budworm and windthrow. The 2017 provincial summary of forest health conditions identified recent forest health impacts in the Arrowsmith TSA.[44] These include laminated root disease, a common damaging agent in southern BC; balsam bark beetle; and only five spot disturbances of armillaria root disease; Douglas-fir beetle infestations, which rose in the West Coast Region; and white pine blister rust (primarily north of the AOI).

Spatial data available through DataBC[45] indicates that historic outbreaks of western spruce budworm occurred between 1909-1930. More recently (2012-2017) the forest health impacts reported in DataBC are generally small in scope and include armillaria root disease (96 ha), bear damage (72 ha), laminated root rot (31 ha), Douglas-fir beetle (15 ha), wind damage (15 ha), fire damage (5 ha) and drought damage (3 ha).

These forest health factors have implications for the level of surface fuel accumulation in affected stands, as well as access and working conditions for fire fighters in the event of wildfire. Both laminated and armillaria root rot can result in high levels of windthrow due to the destabilization of infected trees' root systems.

Human Development and Natural Events

Most land cover change in the AOI can be described as residential and commercial/industrial development. This process entails land clearing and road building. Forest harvesting is also common on Provincial Crown land as well as on private land within the AOI. Abiotic and biotic natural events occur at small geographic scales. The overall implication of human development is an increase in human ignition potential with a decrease in hazardous fuels cover as land clearing for human development generally increases the non-fuel and O1a/b fuel types.

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

- Agricultural development – approximately 15% of land base is characterized as Agricultural Land Reserve (ALR). This area is dominated by farmland, cattle rearing, and wineries where the

[43] 2015-17 Coastal Timber Supply Areas Forest Health Overview. 2015.

[44] 2017 Summary of Forest Health Conditions in British Columbia. 2017.

[45] https://catalogue.data.gov.bc.ca/pt_BR/dataset/pest-infestation-polygons (current as of September, 2017)

potential wildfire behaviour is greatly reduced due to the year-round irrigation, resulting in lower potential for curing during the wildfire season.

- Residential land development has occurred across the AOI since the mid-19th century following wide-spread settlement by early pioneers engaging in resource-based activities. This has generally resulted in an increased wildland-urban interface in particular areas (Section 5.2.3) and an increase in fire suppression in an ecosystem that had a historic fire interval of 200 years. Population growth is expected to continue and the area's proximity to larger urban area (Duncan and Victoria), favourable climate and high recreational and landscape values make it a desirable place to live and work
- Forest industry activities – forest harvesting is common on provincial crown land as well as on private land within the AOI. Poor slash hazard abatement practices have been attributed to some operations which can lead to high fuel loading along roadsides.
- FireSmart fuel treatments have been undertaken adjacent to trails in various CVRD parks and recreation areas, in Bamberton Provincial Park and along the Silvermine trail/CVRD right-of-way between subdivisions/neighbourhoods in 2008 and 2011 as a means to reduce fuel loading. The majority of these treatments have reduced fuel loading to moderate level. However, further monitoring and management of these areas will be required in the future in order to maintain the fire threat and behaviour potential at the current low-moderate levels.
- Developed areas in the AOI include the main communities of Cowichan Station, Cowichan Bay, Cobble Hill, Shawnigan Lake, Mill Bay, Bamberton and Malahat and numerous satellite intermix neighbourhood. These satellite neighbourhoods are highly intermixed within conifer leading stands, and are in most situations neighbourhoods with one access/egress route.

4.1.2 Fire Weather Rating

The Canadian Forestry Service developed the Canadian Forest Fire Danger Rating System (CFFDRS) to assess fire danger and potential fire behaviour. Fire Danger Classes provide a relative index of the ease of ignition and the difficulty of suppression. A network of fire weather stations is maintained during the fire season by MFLNRORD and the recorded data are used to determine fire danger, represented by Fire Danger Classes, on forestlands within a community. The information can be obtained from the BCWS and is most commonly utilized by municipalities and regional districts to monitor fire weather, restrict high risk activities when appropriate, and to determine hazard ratings associated with bans and closures.

The BC *Wildfire Act* [BC 2004] and *Wildfire Regulation* [BC Reg. 38/2005], which specify responsibilities and obligations with respect to fire use, prevention, control and rehabilitation, and restrict high risk activities based on these classes. Fire Danger Classes are defined as follows:

- **Class 1 (Very Low)**: Fires are likely to be self-extinguishing and new ignitions are unlikely. Any existing fires are limited to smoldering in deep, drier layers.
- **Class 2 (Low)**: Creeping or gentle surface fires. Ground crews easily contain fires with pumps and hand tools.

- **Class 3 (Moderate)**: Moderate to vigorous surface fires with intermittent crown involvement. They are challenging for ground crews to handle; heavy equipment (bulldozers, tanker trucks, and aircraft) are often required to contain these fires.
- **Class 4 (High)**: High-intensity fires with partial to full crown involvement. Head fire conditions are beyond the ability of ground crews; air attack with retardant is required to effectively attack the fire's head.
- **Class 5 (Extreme)**: Fires with fast spreading, high-intensity crown fire. These fires are very difficult to control. Suppression actions are limited to flanks, with only indirect actions possible against the fire's head.

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

Figure 1 displays the average frequency of Fire Danger Class days between the months of April and October. The data summarized comes from the Malahat (EC) weather station (years 1994 – 2004) which provides the longest fire weather data collection interval within the AOI. However, in consultation with the CVRD, it was determined that recent trends (i.e., last decade) noted within the CVRD South AOI such as longer fire seasons and higher frequency of 'high' and 'extreme' danger class days are an important consideration and should be presented as part of this plan. Given the lack of data post-2004 at the Malahat (EC) weather station, a nearby BCWS weather station (North Basin, CRD), located southeast of the AOI, in the Sooke Watershed was used to provide more recent fire weather trends (Figure 2).

According to Figure 1, the months with the highest average number of 'high' fire danger class days are June, July, August and September. June and September are comparable while July historically has the highest overall average number of 'high' fire danger class days followed by August. Although highest fire danger is within these four months, it should be noted that there are 'high' danger class days which extend into May (Figure 1). Historically, there is an average of only one 'extreme' fire danger class day in August.

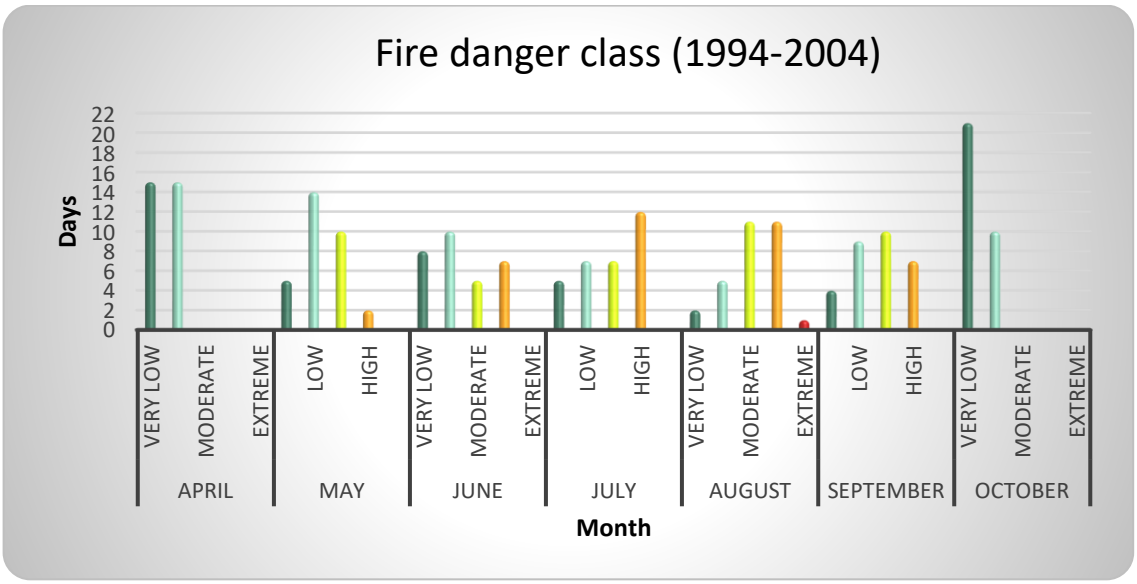


Figure 1. Average number of danger class days for the Malahat (EC) weather station. Summary of fire weather data for the years 1994 - 2004.

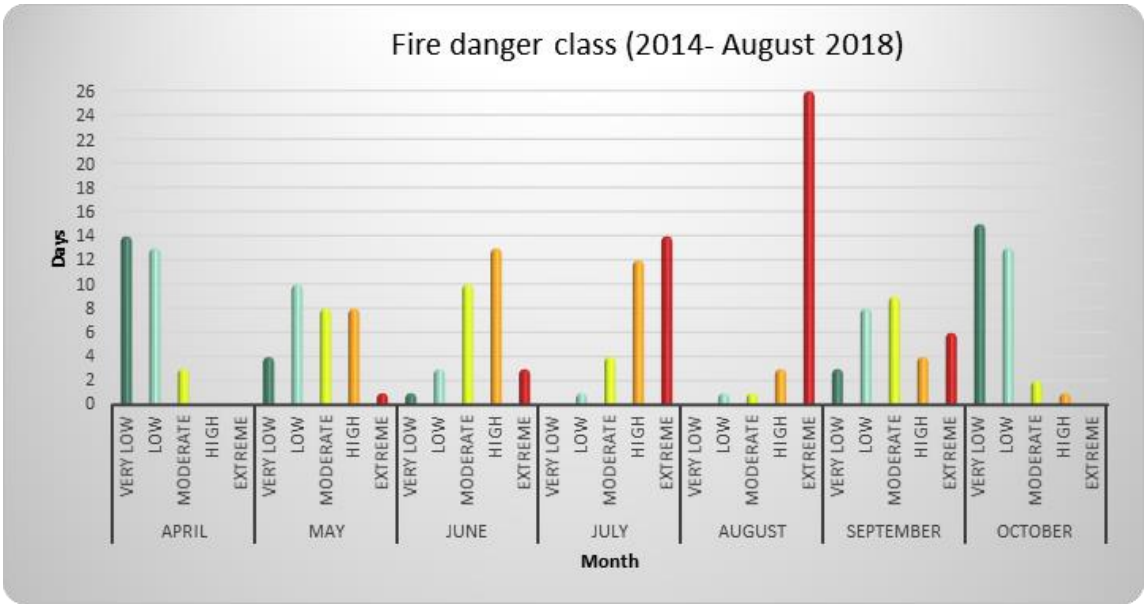


Figure 2. Average number of danger class days for the North Basin (CRD) weather station. Summary of fire weather data for the years 2014 – August 2018.

As a comparison, the North Basin (CRD) weather station depicts a significantly different trend between 2014 and August 2018, with 'high' fire danger days extending between the months of May-October, and a total of 51 'extreme' fire danger days extending between the months of May and September (Figure 2). At the North Basin (CRD) weather station, the month of August has the highest overall average number of 'extreme' fire danger class days (26) followed by September (6). It is anticipated that recent

trends in fire weather, as depicted in Figure 2, will be sustained into the future, and may be exacerbated by climate change (see Section 4.1.3).

RECOMMENDATION #11: The CVRD should consider working with the BCWS to establish a permanent weather station within the South Zone AOI. The establishment of a permanent fire weather station within the South Zone AOI will ensure the collection of fire weather data representative of the AOI and which accounts for current climate-determined fire weather conditions.

4.1.3 Climate Change

Climate change is a serious and complex aspect to consider in wildfire management planning. Warming of the climate system is unequivocal, and since the 1950s, each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere.[46]

Numerous studies outline the nature of these impacts on wildland fire across Canada, and globally. Although there are uncertainties regarding the extent of the impacts of climate change on wildfire, it is clear that the frequency, intensity, severity, duration and timing of wildfire and other natural disturbances is expected to be altered significantly with the changing climate.[47] Despite the uncertainties, trends within the data are visible. As outlined *in Climate Projections for the Cowichan Valley Regional District*[48], the following climate projections for the CVRD are made:

- Year round increases in temperature, with the greatest increases occurring in the summer months (an increase in average summer daytime high temperatures of 3.2 °C by the 2050s and 5.2 °C by the 2080s);
- More than doubling in the number of days above 25°C from a past average of 16 days per year to 39 days per year by the 2050s and 59 days per year by the 2080s;
- Increase in the 1-in-20 hottest temperature from a past of 33 °C to 37°C by the 2050s and 39 °C by the 2080s;
- Decline in summer precipitation (up to 17% by the 2050s), and longer dry spells in summer months, leading to drier fuels and soils (increasing fire behaviour potential).
- Increase in fall, winter and spring precipitation.
- As average winter temperatures increase, more intense winter precipitation is expected to fall as rain during extreme events, and less falling as snow; potentially influencing watershed and groundwater storage ability, timing and amount of run-off, and soil and fuel moisture during early fire season.

An increased frequency of natural disturbance events is expected to occur as a result of climate change with coincident impacts to ecosystems. These include:

[46] International Panel on Climate Change. (2014) Climate change 2014: Synthesis report, summary for policymakers. 32p.
[47] Dale, V., L. Joyce. S. McNulty, R. Neilson, M. Ayres, M. Flannigan, P. Hanson, L. Irland, A. Lugo. C. Peterson, D. Simberloff, F. Swanson, B. Stocks, B. Wotton. *Climate Change and Forest Disturbances*. BioScience 2001 51 (9), 723-734.
[48] Cowichan Valley Regional District. 2017. Accessed online at: https://www.cvrd.bc.ca/DocumentCenter/View/81884/Climate-Projections-Report?bidId=

- Storm events, including catastrophic blowdown and damage to trees from snow and ice;
- Wildfire events and drought;
- Increased winter precipitation may result in slope instability, mass wasting, increased peak flows (loss of forest cover from fire or other disturbance may increase the chance of mass wasting); and

Insects and disease occurrence of spruce beetle and Swiss needle cast may increase; outbreaks of western hemlock looper may increase.[49] Other research regarding the intricacies of climate change and potential impacts on wildfire threats to Canadian forests has found that:

- Fuel moisture is highly sensitive to temperature change and projected precipitation increases will be insufficient to counteract the impacts of the projected increase in temperature. Results conclude that future conditions will include drier fuels and a higher frequency of extreme fire weather days.[50]
- The future daily fire severity rating (a seasonally cumulative value) is expected to have higher peak levels and head fire intensity is expected to increase significantly in Western Canada. A bi-modal (spring-late summer) pattern of peak values may evolve to replace the historical late summer peak which is the current norm.[51]The length of fire seasons is expected to increase and the increase will be most pronounced in the northern hemisphere, specifically at higher latitude northern regions. Fire season severity seems to be sensitive to increasing global temperatures; larger and more intense fires are expected and fire management will become more challenging.[52, 53]
- More extreme precipitation events (increased intensity and magnitude of extreme rainfall) along with more extreme heat events, that along with drier summers, will contribute to increased wildfire risk in the CVRD.[54]
- Future climatic conditions may be more suitable for, or give competitive advantage to, new species of plants, including invasive species.[55]

In summary, climate scientists expect that the warming global climate will trend towards wildfires that are increasingly larger, more intense and difficult to control. Furthermore, it is likely that these fires will

[49] MFLNRO, 2016. BC Provincial Government extension note '*Adapting natural resource management to climate change in the West and South Coast Regions*'. Accessed online at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nrs-climate-change/regional-extension-notes/coasten160222.pdf

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

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

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

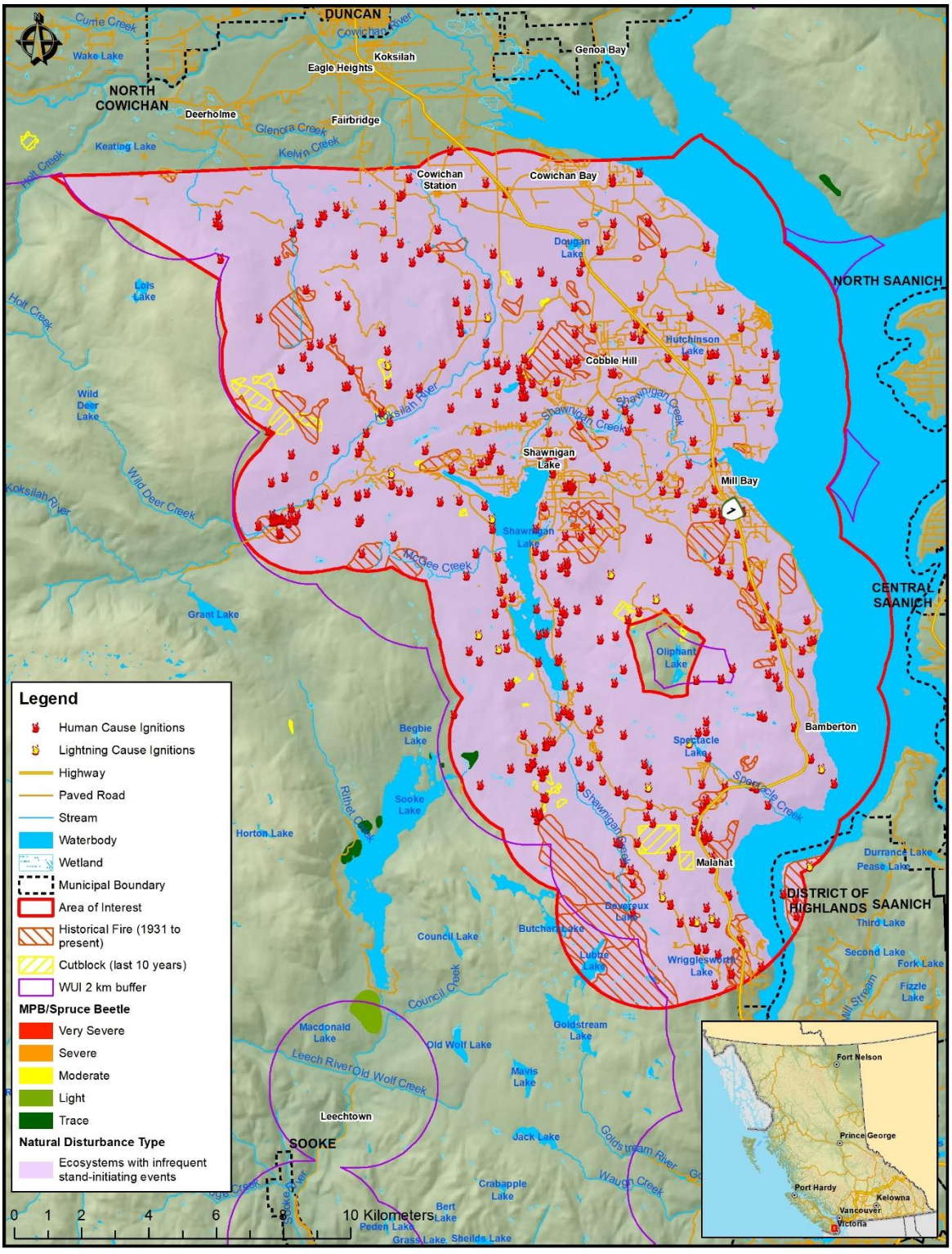
[53] Jandt, R. 2013. Alaska Fire Science Consortium Research Brief 2013-3.

[54] British Columbia Agriculture & Food Climate Action Initiative, 2013. Available online at: https://www.bcagclimateaction.ca/wp/wp-content/media/RegionalStrategies-Cowichan.pdf

[55] Pacific Climate Impacts Consortium, 2017. Climate Extremes in the Georgia Basin Summary Report, Available online at: https://www.pacificclimate.org/sites/default/files/publications/Summary-Climate_Extremes_in_the_Georgia_Basin-Final.pdf

be more threatening to WUI communities due to increased potential fire behaviour, fire season length, and fire severity. This trend is expected to be disproportionately felt in northern latitudes.[56]

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



Map 4. Fire Regime, Ecology and Climate Change.

4.2 PROVINCIAL STRATEGIC THREAT ANALYSIS

The Provincial Strategic Threat Analysis (PSTA) evaluates multiple data sets to provide a coarse (high-level) spatial representation of wildfire threats across BC. The information in this section is a synthesis of the BCWS' Provincial Strategic Threat Analysis 2017 Wildfire Threat Analysis Component.[57] Three inputs are combined to create the PSTA Wildfire Threat Analysis (WTA) Component:

1) **Historic fire density**: represents the ignition and fire spread potential based upon historic patterns and fire density weighted by fire size (larger fire perimeters were given a higher weight in order to reflect the greater cost and damage usually associated with larger fires) (see Map 5 below).
2) **Spotting impact**: represents the ability of embers or firebrands from a burning fire to be sent aloft and start new fires in advance of the firefront, or outside of the fire perimeter. Spotting is most associated with high intensity crown fires in coniferous fuels and structure losses. For the WTA, the spotting analysis is based on estimating the threat to a given point on the landscape from the fuels surrounding it, up to a distance of 2 km. Spotting distances greater than 2 km are rare and unpredictable.
3) **Head fire intensity (HFI)**: represents the intensity (kW/m) of the fire front, a measure of the energy output of the flaming front. HFI is directly related to flame length, fire spread rate and fuel consumption and a fire's leading edge. There is a strong correlation between HFI, suppression effort required and danger posed to suppression personnel. The HFI used in the WTA was developed using the 90th percentile fire weather index value.

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

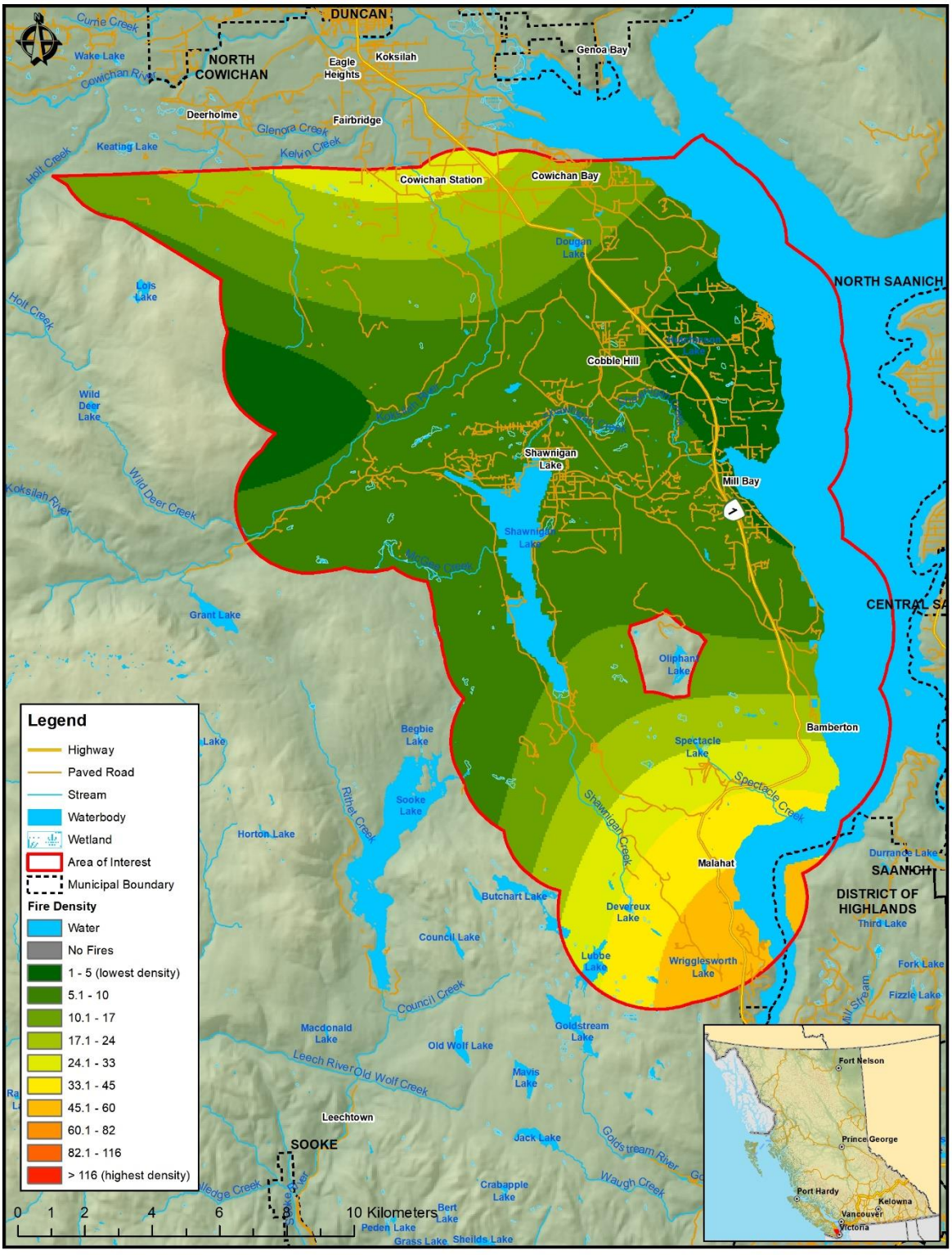
There are considerable limitations associated with the WTA Component based upon the accuracy of the source data and the modelling tools, the most notable being:

- Limited accuracy and variability of the fire history point data;
- Sensitivity to fuel type and the associated limitations of using fuel type approximations for fire behaviour modelling; and,

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

- 90th percentile rating for HFI, which represents a near worst-case scenario which may be artificial in some circumstances.

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



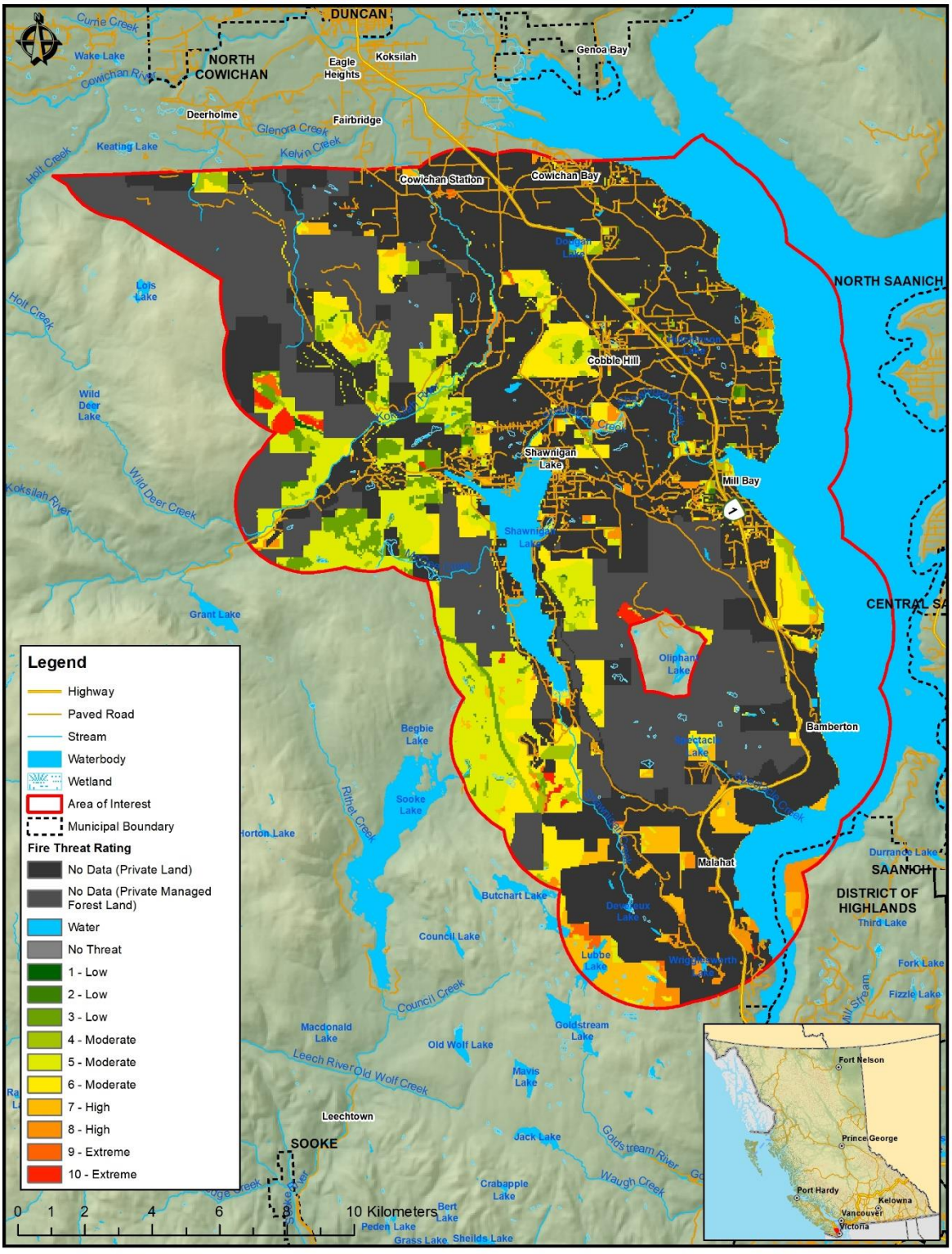
Map 5. Historical Fire Density.

4.2.1 PSTA Final Wildfire Threat Rating

More than half of the AOI (62%) is categorized as either private land or private managed forest land and has no data for wildfire threat in the Provincial Wildfire Threat Analysis dataset (PSTA). Low threat areas cover 2% of the AOI and water covers 17%. Approximately 15% of the AOI is categorized as having a moderate wildfire threat rating in the provincial Wildfire Threat Analysis (Table 8). High and extreme threat rating covers less than 5% of the study area, with the most notable high-threat areas being concentrated at the south end of the AOI and in small concentrations south of Shawnigan Lake and northwest of Koksilah River Park (Map 6).

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

Threat Class	Area (ha)	Threat Class Description	Percent of AOI
-3	14,281	No Data (Private Land)	40%
-2	7,711	No Data (Private Managed Forest Land)	22%
-1	5,884	Water	17%
0	0	No Threat	0%
1	12	Low	2%
2	108		
3	558		
4	532	Moderate	15%
5	3,054		
6	1,800		
7	891	High	4%
8	467		
9	**97**	Extreme	<1%
10	**139**		
Total	**35,534**	-	**100%**



Map 6. Provincial Strategic Threat Rating.

4.2.2 Spotting Impact

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

It has been found that, during extreme wildfire events, most home destruction has been a result of low-intensity surface fire flame exposures, usually ignited by embers in advance of the fire front. Firebrands can be transported long distances ahead of the wildfire, across fire guards and fuel breaks, and accumulate in densities that can exceed 600 embers per square meter. Combustible materials found adjacent or near to values at risk can provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

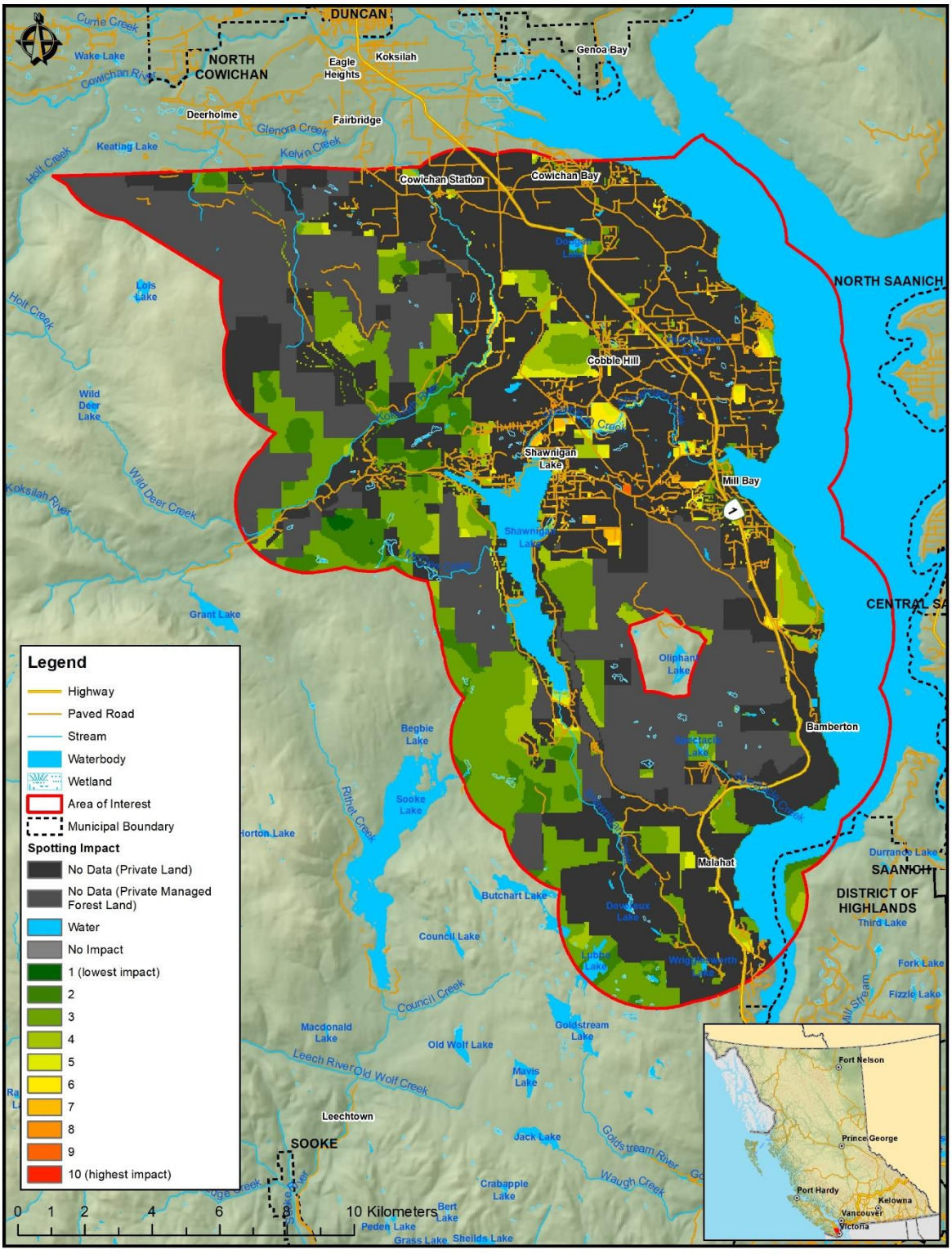
For example, an investigation of home destruction from the 2016 Fort McMurray, Alberta fire found that the vast majority of home ignitions in the interface (outer edges of urban neighbourhoods) were attributable to embers alighting on combustible material (home or adjacent areas).[58] Similarly, reports from the 2010 Fourmile Canyon fire outside Boulder, Colorado, found that only 17% of the 162 homes destroyed were attributed to crown fire.[59,60] Instead of high intensity flames or radiant heat, the majority of homes ignited as a result of firebrands (or embers), which ignited lower-intensity surface fires adjacent to structures or the home directly.[60] Post-fire studies have shown that it is uncommon for homes to be partially damaged by wildfire; survivability is based upon whether or not the structure, or area adjacent to the structure, ignites.

The AOI appears to generally be low in terms of spotting impact with small isolated areas of moderate potential impact near developed areas within Cobble Hill, Mill Bay, north of Shawnigan Lake and around the community of Malahat (Map 7).

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

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

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



Map 7. Spotting Impact within the AOI/Study Area.

4.2.3 Head Fire Intensity

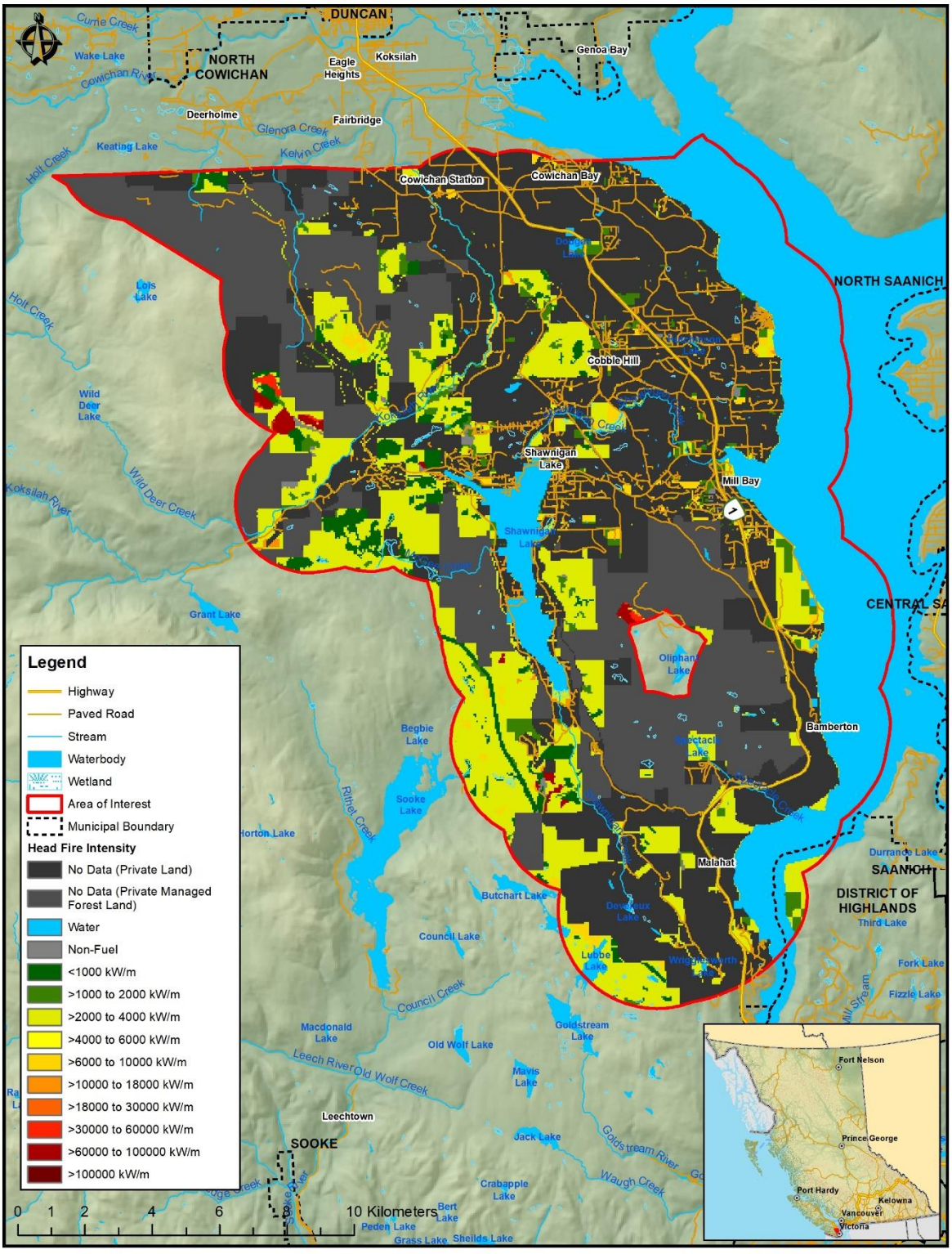
HFI is correlated with flame length and fire behaviour. The greater the fire intensity (kW/m), or HFI and fire intensity class, the more extreme the fire behaviour is likely to be and the more difficult the fire will likely be to suppress (Table 9 and Map 8).

In the AOI, generally speaking, the highest fire intensity class is 5, which represents a vigorous surface fire with intermittent crowning (Table 9). Class 5 is quite uncommon in the AOI (approximately 1% of the area) while classes 3, 2 and 1 dominate throughout (Map 8). Class 3 is described as vigorous surface fire and classes 2 and 1 are described as moderate vigour surface fire and smouldering surface fire, respectively. Class 3 is the most dominant fire intensity class (approximately 16% of the AOI).

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

PSTA - HFI Class	Fire Intensity kW/m	Fire Intensity Class[61]	Percent of AOI	Flame Length (meters)[62]	Likely Fire Behaviour[63]
1	0.01 – 1,000	2	2%	< 1.8	Smouldering surface fire
2	1,000.01 – 2,000	3	3%	1.8 to 2.5	Moderate vigour surface fire
3	2,000.01 – 4.000	4	16%	2.5-3.5	Vigorous surface fire
4	4,000.01 – 6,000	5	<1%	3.5 to 4.2	Vigorous surface fire with occasional torching
5	6,000.01 – 10,000	5	1%	4.2 to 5.3	Vigorous surface fire with intermittent crowning
6	10,000.01 – 18,000	6	<1%	12.3 to 18.2	Highly vigorous surface fire with torching and/or continuous crown fire
7	18,000.01 – 30,000	6	<1%	18.2 to 25.6	Extremely vigorous surface fire and continuous crown fire
8	30,000.01 – 60,000	6	<1%	>25.6[64]	Extremely vigorous surface fire and continuous crown fire, and aggressive fire behaviour
9	60,000.01 – 100,000	6	<1%	>25.6	Blowup or conflagration, extreme and aggressive fire behaviour
10	≥ 100,000	6	0%	>25.6	Blowup or conflagration, extreme and aggressive fire behaviour

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



Map 8. Head Fire Intensity within the AOI.

4.2.4 Fire History

Fire ignition and perimeter data are depicted in Map 4. It was reported from BCWS (personal communication) that most fire activity in the South Zone AOI has occurred after the lifting of fire bans (the fire bans are effective and change human behaviour). Locally, BCWS prevention activity is focused on open fires and mechanical ignition sources, while smoking and lightning caused ignitions are of lower concern.

As shown in Map 4; small to large historical wildfires have burned within the AOI. Fire ignition data for the AOI is available for 1950-2016 and fire perimeter data from 1919-2016. Based on the fire ignition data, from the year 1950 to 2016, there have been 387 fire incidents within the AOI; approximately 263 of these ignitions were human-caused (a conservative estimate not including miscellaneous/undetermined causes).

Based on the fire perimeter data from 1919 to 2016, the top ten fires burning the greatest number of hectares within the AOI occurred between 1922 and 1942 with the largest covering 648 ha and the smallest of the ten covering 68 ha within the AOI (average of 231 ha). Regardless of area burn extent, however, the majority (79%) of the fire events occurred in the two decades between 1919 and 1939, with the remainder occurring in the 1940s-1970s (8 fires), 2008 (1 fire), 2015 (1 fire, 0.5 ha is size) and most recently, in 2016 (2 fires, 2.7 ha and 0.9 ha in size). All were defined as human-caused. The majority (86%) of the fires that either overlapped or occurred exclusively within the AOI were under 100 ha in total fire size and 50% were under 20 ha in size.

4.3 LOCAL WILDFIRE THREAT ASSESSMENT

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

Field assessment locations were prioritized based upon:

- PSTA WTA class - Field assessments were clustered in those areas with WTA classes of 6 or higher.
- Proximity to values at risk – Field assessments were clustered in the intermix and interface, as well as around critical infrastructure.
- Prevailing fire season winds – More field time was spent assessing areas upwind of values at risk.
- Slope position of value – More field time was spent assessing areas downslope of values at risk. Similarly, values at top of slope or upper third of the slope were identified as particularly vulnerable.

- Land ownership – Crown and municipal land was the main focus of field assessments.
- Previous mitigation efforts – Those areas which had previously had fuel reduction or modification were field assessed.
- Local knowledge – Areas identified as hazardous, potentially hazardous, with limited access / egress, or otherwise of particular concern as vulnerable to wildfire, as communicated by local fire officials and BCWS zone staff.
- Observations – Additional areas potentially not recognized prior to field work were visually identified as hazardous and assessed during the week.

A total of 30 WUI threat plots were completed and over 300 other field stops (e.g., qualitative notes, fuel type verification, and/or photograph documentation) were made across the AOI (see Appendix F for WUI threat plot locations).

4.3.1 Fuel Type Verification

The Canadian Forest Fire Behaviour Prediction (FBP) System outlines five major fuel groups and sixteen fuel types based on characteristic fire behaviour under defined conditions.[65] Fuel typing is recognized as a blend of art and science. Although a subjective process, the most appropriate fuel type was assigned based on research, experience, and practical knowledge; this system has been used within BC, with continual improvement and refinement, for 20 years.[66] It should be noted that there are significant limitations with the fuel typing system which should be recognized. Major limitations include: a fuel typing system designed to describe fuels which do not occur within the study area, fuel types which cannot accurately capture the natural variability within a polygon, and limitations in the data used to create initial fuel types.[66] Details regarding fuel typing methodology and limitations are found in Appendix G. There are several implications of the aforementioned limitations, which include: fuel typing further from the developed areas of the study has a lower confidence, generally; and, fuel typing should be used as a starting point for more detailed assessments and as an indicator of overall wildfire threat, not as an operational, or site-level, assessment.

Table 10 summarizes the fuel types by general fire behaviour (crown fire and spotting potential). In general, the fuel type that may be considered hazardous in terms of fire behaviour and spotting potential in the AOI is C-3, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth. C-5 fuel types have a moderate potential for active crown fire when wind-driven.[66] An M-1/2 fuel type can sometimes be considered hazardous, depending on the proportion of conifers within the forest stand; conifer fuels include those in the overstory, as well as those in the understory. An O-1b fuel type often can support a rapidly spreading grass or surface fire capable of damage or destruction of property, and jeopardizing human life, although it is recognized as a highly variable fuel

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

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

type dependent upon level of curing.[67] The O-1b fuel type was also attributed to sites dominated by invasive shrubs such as Scotch Broom. These fuel types were used to guide the threat assessment.

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

Table 10. Fuel Type Categories and Crown Fire Spot Potential. Only summaries of fuel types encountered within the AOI are provided (as such, other fuel types, i.e., C-1, C-2, C-4 and C-7 are not summarized below).

Fuel Type	FBP / CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type – Crown Fire / Spotting Potential
C-3	Mature jack or lodgepole pine	Fully stocked, late young forest (western red cedar, hemlock, and/or Douglas-fir), with crowns separated from the ground	Surface and crown fire, low to very high fire intensity and rate of spread	High*
C-5	Red and white pine	Well-stocked mature forest, crowns separated from ground. Moderate understory herbs and shrubs. Often accompanied by dead woody fuel accumulations.	Moderate potential for active crown fire in wind-driven conditions. Under drought conditions, fuel consumption and fire intensity can be higher due to dead woody fuels	Low
O-1a/b	Grass	Matted and standing grass communities. Continuous standing grass with sparse or scattered shrubs and down woody debris. Vegetated, non-treed areas dominated by shrubs or herbs in dry ecosystems. Areas of very scattered trees. Hay fields. Areas harvested 7 – 24 years ago (dense or open and >4 m in height). Scotch-Broom dominated right-of-ways.	Rapidly spreading, high- intensity surface fire when cured	Low

[67] Ibid.

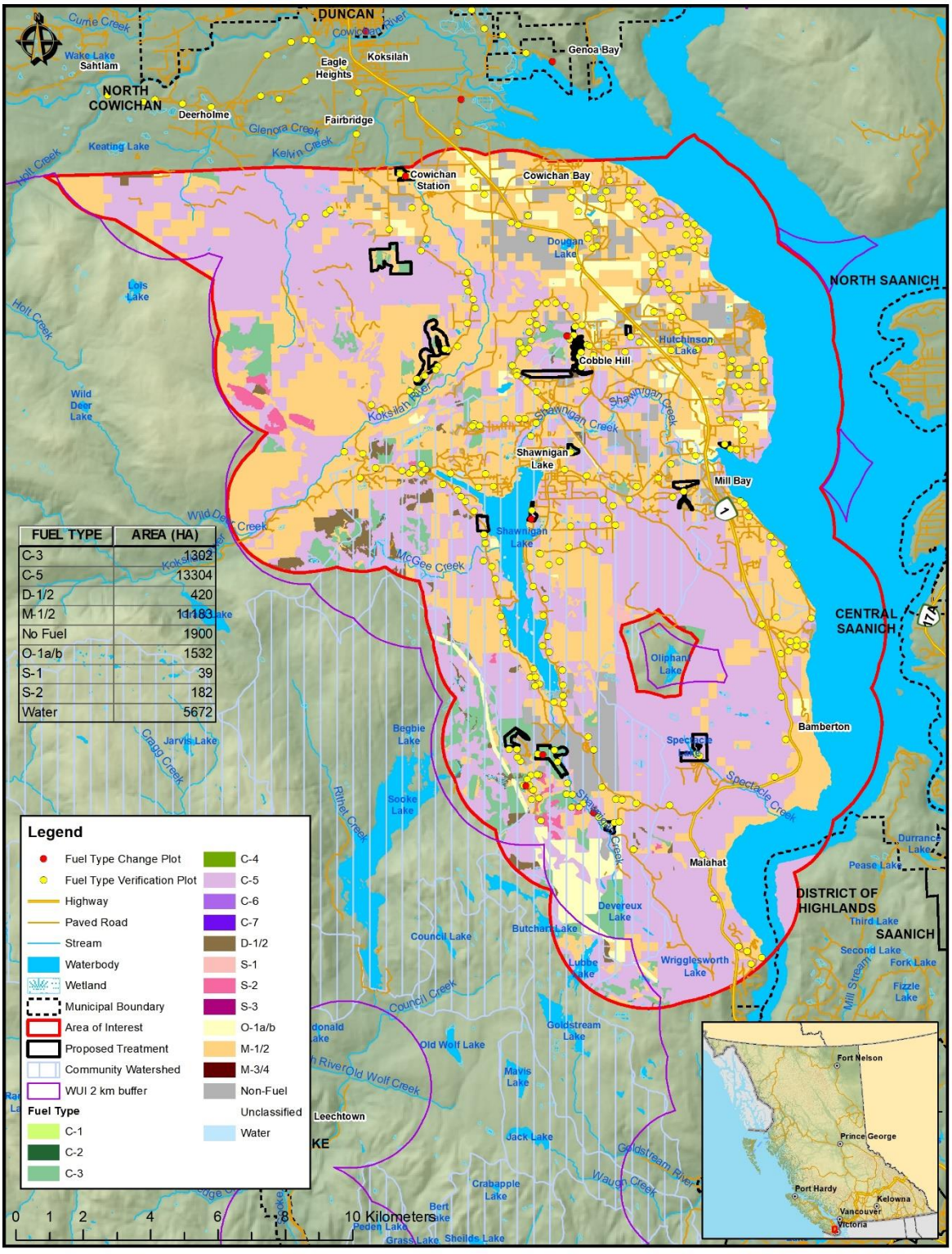
Fuel Type	FBP / CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type – Crown Fire / Spotting Potential
M-1/2	Boreal mixedwood (leafless and green)	Moderately well-stocked mixed stand of conifers and deciduous species, low to moderate dead, down woody fuels.	Surface fire spread, torching of individual trees and intermittent crowning, (depending on slope and percent conifer)	<26% conifer (Very Low); 26-49% Conifer (Low); >50% Conifer (Moderate)
D-1/2	Aspen (leafless and green)	Deciduous stands	Always a surface fire, low to moderate rate of spread and fire intensity	Low
S-1/2	Slash (jack / lodgepole pine, white spruce / balsam, and coastal cedar / hemlock/ Douglas-fir, respectively)	Jack or lodgepole pine slash, white pine/ balsam slash, coastal cedar/ hemlock/ Douglas-fir slash	Moderate to high rate of spread and high to very high intensity surface fire	Low
W	N/A	Water	N/A	N/A
N	N/A	Non-fuel: irrigated agricultural fields, golf courses, alpine areas void or nearly void of vegetation, urban or developed areas void or nearly void of forested vegetation.	N/A	N/A

**C-3 fuel type is considered to have a high crown fire and spotting potential within the study area due to the presence of moderate to high fuel loading (dead standing and partially or fully down woody material), and continuous conifer ladder fuels (i.e., western redcedar, Cw, and/or Douglas-fir, Fd).*

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

- C-5 fuel types being incorrectly identified by the PSTA as C-2,
- M-1/2 fuel types identified as C-3,
- M-1/2 fuel types identified as C-5,
- C-3 fuel types identified D-1/2,
- S-2 fuel types identified as C-5,
- C-3 fuel types identified as D-1/2, and
- D-1/2 fuel types identified as M-1/2.

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



Map 9. Updated Fuel Type.

4.3.2 Proximity of Fuel to the Community

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

Table 11. Proximity to the Interface.

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

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

4.3.3 Fire Spread Patterns

Wind speed, wind direction, and fine fuel moisture condition influence wildfire trajectory and rate of spread. The influence of topography on fire spread patterns is discussed in Section 4.3.4. Wind plays a predominant role in fire behaviour and direction of fire spread and is summarized in the Initial Spread Index (ISI) Rose(s) from the local representative BCWS weather station - Malahat (EC). The wind rose data is compiled hourly and provides an estimate of prevailing wind directions and wind speed in the area of the weather station.

During the fire season (April – October) predominant winds originate from the east (approximately 40-60% of the time) and from the northeast (approximately 10-25% of the time). Winds also occur to a lesser degree from the west to southeast in most months (<5-15% of the time) and also from the north

in October (with approximately 7% frequency). Wind speeds over 20 km/hour occur more frequently (at a 1-6% frequency) in April, May, June and particularly in October (Figure 3). An average of hourly wind readings for the fire season also shows that winds are predominantly from the east and to a lesser degree from the northeast; predominantly at windspeeds up to 10 km/hr (approximately 80% of the time) and gusting upwards of 20 km/hr (Figure 4). Potential treatment areas were identified and prioritized with the predominant wind direction in mind; wildfire that occurs upwind of a value poses a more significant threat to that value than one which occurs downwind.

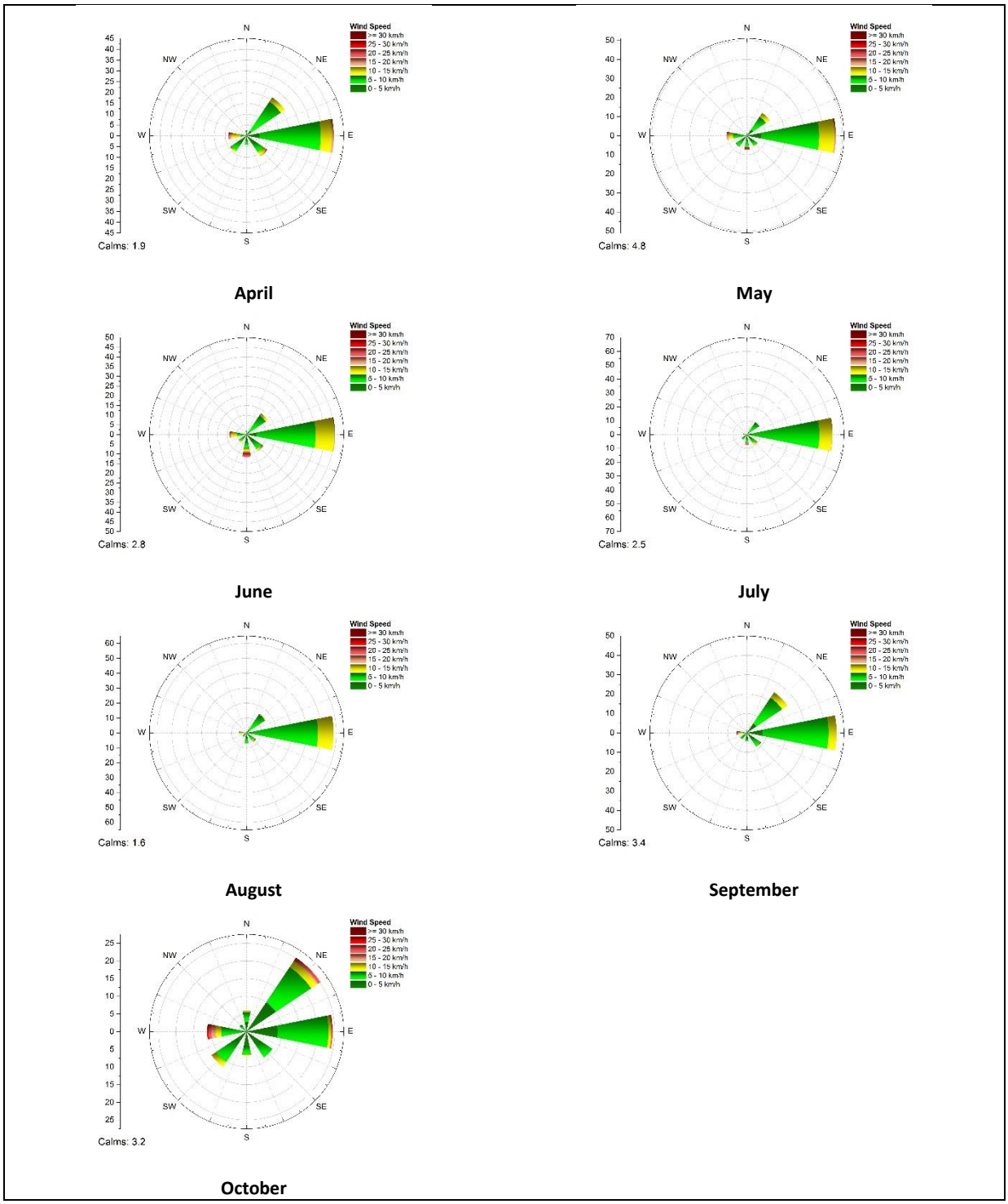


Figure 3. Wind roses depicting average hourly wind speed for the fire season April – October. Left scale represents the frequency of readings in %, while calms represent the frequency of no wind events.

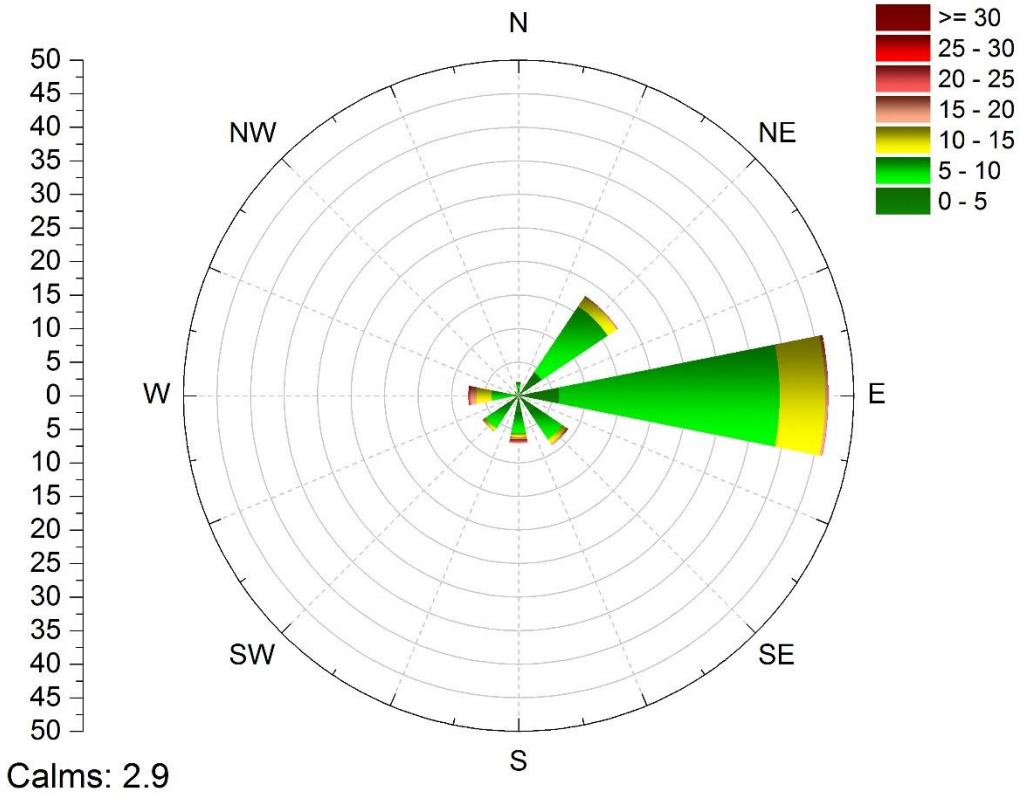


Figure 4. Windrose showing average hourly wind readings during the fire season (April 1 – October 31) 1994 – 2004. Data taken from the Malahat (EC) weather station.

4.3.4 Topography

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

Slope Class and Position

Slope steepness affects solar radiation intensity, fuel moisture (influenced by radiation intensity) and influences flame length and rate of spread of surface fires. Table 12 summarizes the fire behaviour implications for slope percentage (the steeper the slope the faster the spread). In addition, Slope position affects temperature and relative humidity as summarized in Table 13. A value placed at the bottom of the slope is equivalent to a value on flat ground (see Table 12). A value on the upper 1/3 of the slope would be impacted by preheating and faster rates of spread (Table 13). The majority of the

AOI (74%) is on less than 20% slope and will likely not experience accelerated rates of spread due to slope class. Approximately 21% percent of the study area is likely to experience an increased or high rate of spread. On the larger topographic scale, the communities in the South Zone AOI and surrounding agricultural, industrial, commercial, recreational and residential developments would be considered bottom of the slope or valley bottom.

Table 12. Slope Percentage and Fire Behaviour Implications.

Slope	Percent of AOI	Fire Behaviour Implications
<20%	74%	Very little flame and fuel interaction caused by slope, normal rate of spread.
21-30%	13%	Flame tilt begins to preheat fuel, increase rate of spread.
31-45%	8%	Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread.
46-60%	3%	Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread.
>60%	2%	Flame tilt preheats fuel and bathes flames into fuel well upslope, extreme rate of spread.

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

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

4.3.5 Local Wildfire Threat Classification

Using the verified and updated fuel types combined with field wildfire threat assessments, local wildfire threat for the study area was updated. Using the 2016 methodology, there are two main components of the threat rating system: the wildfire behaviour threat class (fuels, weather and topography sub-components) and the WUI threat class (structural sub-component).

The result of the analysis shows that the study area is composed of a mosaic of very low, low, moderate and high threat class stands; the variability in wildfire threat is dictated primarily by the level of natural and anthropogenic disturbances that have historically occurred and persist on the landbase. The study

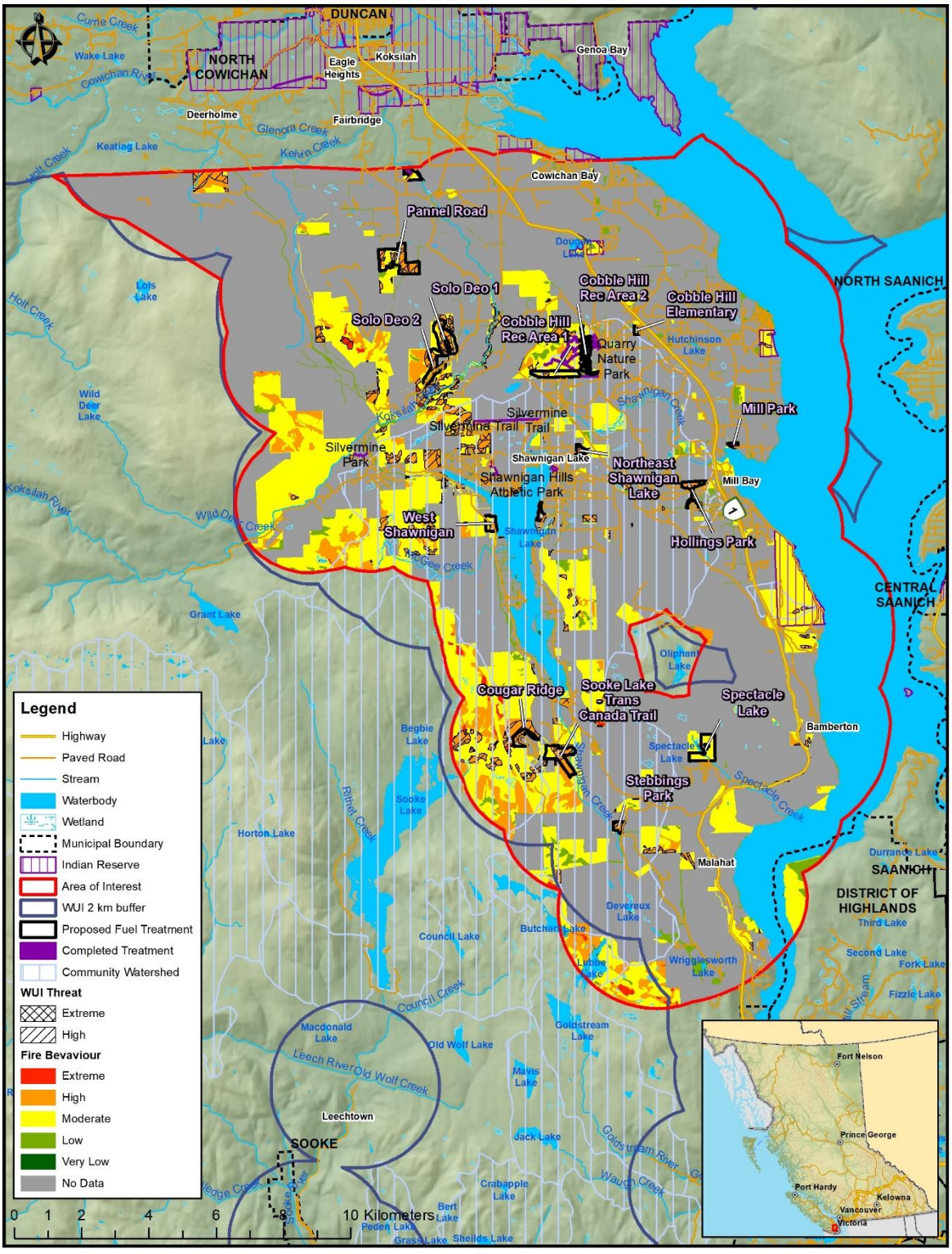
area is less than 1% extreme threat class rating, 5% high, 15% moderate, 4% low and 16% very low/water (Table 14). The remaining 60% of the AOI is classified as private land and private managed forest land and as such has not been allocated fire threat data. Assessment of fire threat on private land is not funded by SWPI and is therefore outside the scope of this CWPP Update. Table 14 also indicates the differences between the original PSTA threat rating and this CWPP's corrected fire behaviour threat.

The areas that represent the highest wildfire behavior potential and greatest risk to values within the CVRD South Zone are areas of high threat class surrounding the development of Cougar Ridge; north / northwest of the Village of Shawnigan Lake; and south of Cowichan Station.

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

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

Wildfire Behaviour Threat Class	2017 PSTA Data	2017-2018 CWPP
	Percent of AOI	Percent of AOI
Extreme	<1%	0%
High	4%	5%
Moderate	15%	15%
Low	2%	4%
Very Low/ No Threat (Water)	17%	16%
No Data (Private Land and Private Managed Forest Land)	62%	60%



Map 10. Local Fire Behaviour Threat Rating and WUI Threat Rating.

SECTION 5: RISK MANAGEMENT AND MITIGATION FACTORS

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

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

5.1 FUEL MANAGEMENT

Fuel management, also referred to as vegetation management or fuel treatment, is a key element of wildfire risk reduction. For the purpose of this discussion, fuel management generally refers to native vegetation/fuel modifications in forested areas greater than 30 m from homes and structures (priority Zone 3 and beyond). The principles of fuel management are outlined in detail in Appendix I.

Fuel treatments have been completed on approximately 26 ha within the AOI since development of the 2005 CWPP. These fuel treatments occurred on CVRD-owned and/or crown land and consisted largely of linear FireSmart treatments along popular trails and in parks (CVRD parks initiative and BC Parks) or adjacent to values at risk such as subdivision developments (as in the case of one linear treatment along a CVRD-owned right-of-way between private developments). Treatments consisted largely of brushing; pruning and removal of fine fuel, coarse woody debris and invasive species. To complement the work completed to date and to further reduce the wildfire risk in the AOI, the objectives for fuel management are to:

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

Ideally, these objectives will enhance protection to homes and critical infrastructure. Caveats associated with the statement include: 1) wildfire behaviour will only be reduced if the fire burns in the same location as treatments occurred, and 2) protection of homes and critical infrastructure is highly

dependent upon the vulnerability to ignition by embers (ignition potential) directly around the value at risk. In summary, fuel treatments alone should not be expected to protect a community from the effects of wildfire, namely structure loss.

Fuel treatments are designed to reduce the possibility of uncontrollable crown fire through the reduction of surface fuels, ladder fuels and crown fuels. However, the degree of fire behaviour reduction achieved by fuel management varies by ecosystem type, current fuel type, fire weather, slope and other variables and it is important to note that it does not stop wildfire.

Historically, funds from public sources, such as the Forest Enhancement Society of BC (FESBC) and the Union of British Columbia Municipalities (UBCM), were only eligible to be used on Crown lands and could not be used to treat private land. While this is still the case for the FESBC program, the new Community Resiliency Investment (CRI) Program (formerly SWPI) provides funding for selected FireSmart activities and planning on private land (subject to program requirements and limits).[68] It is important to recognize that the majority of the AOI (62%) is located on private land or private managed forest land, which increases some of the challenges encountered in mitigation of fuels on private lands. The best approach to mitigate fuels on private lands is to urge private landowners to comply with FireSmart guidelines (as described below in Section 5.2) and to conduct appropriate fuel modifications using their own resources (CRI program funding may be available). In general, when considering fuel management to reduce fire risk, the following steps should be followed:

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

The fuel treatment opportunities identified in this document include the use of interface fuel breaks and interface fuel treatment as defined in Section 5.1.1, to reduce the wildfire potential around the AOI. Potential treatment activities include fuel removal, thinning, stand conversion, pruning, and chipping,

[68] 2019 CRI FireSmart Community Funding & Supports – Program & Application Guide. Retrieved online on Sept 20, 2018. https://www.ubcm.ca/assets/Funding~Programs/LGPS/CRI/cri-2019-program-guide.pdf

or a combination of two or more of these activities. Stand conversion has been shown to be effective at reducing wildfire potential in mixed-wood or conifer dominated stands and is recommended as a BMP to encourage a higher deciduous component. This approach generally involves a thin-from-below to reduce ladder fuels and crown fuels continuity, targeting the removal of conifer species and the retention of broadleaf species. Stand conversion fuel treatments are intricately linked to the establishment and enactment of fire management stocking standards within the WUI 2km buffer. The implementation of modified stocking standards plays a pivotal role in ensuring the success and effectiveness of stand conversion fuel treatments and associated reduction of fire hazard.[69]

In addition to the treatment units proposed in the following section, it is recommended that the CVRD recognize important fuel treatment opportunities to improve emergency access and public safety along the Malahat Highway in the event of evacuation through reduction of hazardous fuels and landscape level fuel treatment.

RECOMMENDATION #12: The CVRD should work with the Ministry of Transportation and Infrastructure (MOTI), to assess the entirety of Hwy 1 and reduce hazardous fuels within 100 m of either side of the road, where possible, and with consideration of private land overlap. This is to increase public safety / improve emergency access in the event of an evacuation or wildfire event.

5.1.1 Proposed Treatment Units

Funding opportunities from UBCM under the SWPI Program have historically been limited to Crown Provincial, Regional District, or Municipal land. The UBCM SWPI funding stream (in place at the time this CWPP Update was developed) has transitioned, as of September 2018, into a new provincial program, the Community Resiliency Investment (CRI) Program, that will consider fire prevention activities on provincial Crown land and private land, in addition to local government and reserve land[70]. Fire prevention activities on private land that may be funded under this program are related to FireSmart activities (including FireSmart planning and assessments, local rebate programs for completion of eligible FireSmart activities, and provision of off-site disposal of vegetation management debris), subject to program requirements. This does not preclude other current and future funding opportunities or potential industrial partnerships and changes to existing programs.

The potential treatment areas represent moderate, high or extreme fire hazard areas which are close to values at risk (structures or infrastructure) and are located on Crown Provincial, Regional District, or Municipal land. Recommendation for treatment in areas of moderate fire hazard areas were limited to

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

[70] This new funding program (up to $50 million over three years) was initiated as per recommendations from the 2017 BC Flood and Wildfire Review Report by Abbott and Chapman (https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/emergency-preparedness-response-recovery/embc/bc-flood-and-wildfire-review-addressing-the-new-normal-21st-century-disaster-management-in-bc-web.pdf). Program details are available on the UBCM's website: https://www.ubcm.ca/EN/main/funding/lgps/community-resiliency-investment.html

areas which would increase efficacy of, and / or create continuity between, previously treated areas (link treatment areas to each other or to low / no fuel areas). All polygons identified for potential treatment have been prioritized based on fire hazard, operational feasibility, estimated project cost, type and number of values at risk, common fire weather (wind direction), and expected efficacy of treatment. Although potential treatment areas have been ground-truthed during field work, additional refinement of the polygons will be required at the time of prescription development. Polygons will require detailed site-level assessment to stratify treatment areas (and areas of no treatment), identify values and constraints, and identify and engage all appropriate Provincial agencies, First Nations, and stakeholders.

Recommended potential treatment areas within the AOI are outlined in Table 15 and displayed in Map 11. These fuel treatment opportunities include the use of interface fuel treatments (the treatment of both patches of fuels and linear interface fuel breaks) and primary fuel breaks as defined below.

Fuel Treatment Types

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

Interface Fuel Breaks/Treatments

Fuel breaks on Crown Land immediately adjacent to private land and in close proximity to the wildland urban interface and/or intermix areas, are termed 'interface fuel treatments'. These are designed to modify fire behaviour, create fire suppression options, and improve suppression outcomes. Interface fuel treatments are relatively small (approximately 100 meters wide) and when treated with appropriate fuel reduction measures, can break the crown fire threshold and reduce the risk of a crown fire reaching values at risk. Treatment widths can be varied to allow for alignment and to take advantage of natural and man-made fire resilient features that enhance effectiveness. Surface fire spread across the fuel treatment and spotting across the fuel treatment, are both concerns and rely on suppression actions to be effective. In order to reduce potential fire intensity and spotting, fuel on private land between the interface fuel treatment and structures should be treated according to FireSmart vegetation

management standards. Structures in interface areas should be constructed or retrofitted to FireSmart design standards.

Primary Fuel Break

Primary Fuel Breaks are located on Crown Land (at times with portions on private land) in strategic locations beyond the interface fuel treatments. Private land may be included in a primary fuel break so that the break represents a continuous fuel reduced area. Primary Fuel Breaks are designed to modify fire behaviour and create fire suppression options that reduce the risk of a crown fire reaching a community and/or adjacent private lands. Primary Fuel Breaks may be located to completely surround a community or be strategically placed upwind of communities and perpendicular to fire season winds. Primary Fuel Breaks have sufficient width and appropriate fuel reduction measures to break the crown fire threshold and reduce fire intensity such that overstory fire moves to the ground surface and spread rates are reduced. While there are no absolute standards for fuel break width or fuel manipulation in the literature and fuel break width will vary based on fuel type, topography, and expected fire behaviour[71], a 300-metre fuel break width is generally recommended. Fuel breaks should be designed to take advantage of natural and man-made fire resilient features and topography to enhance effectiveness. Surface fire spread across, and spotting over the fuel break are both concerns, and depend on the application of suppression resources to be effective.

RECOMMENDATION #13: Proceed with detailed assessment, prescription development and treatment of hazardous fuel units and FireSmart fuel treatment demonstration treatment areas identified and prioritized in this CWPP.

RECOMMENDATION #14: Consider developing a rationale for reduced stocking standards applicable to the CVRD, by employing a qualified wildfire management professional, and in consultation with the Fuel Management Specialist (Coastal Fire Centre) and MFLNRORD. Engage partners such as woodlot and/or Community Forest License Owners, and all other licensees to apply the MFLNRORD approved reduced fire management stocking standards in the wildland urban interface AOI to reduce interface wildfire threat.

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

Table 15. Proposed Treatment Area Summary Table.

FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
2	Spectacle Lake	Moderate	39.4	Interface Fuel Break	2.2	37.2	0.0	This proposed treatment unit (PTU) lies almost entirely within Spectacle Lake Provincial Park. Occurring species at risk include the CDC red-listed Dun Skipper (*Euphyes vestris*) and blue-listed Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*). There is overlap with 5 sensitive ecosystem inventory polygons, and Spectacle Creek flows southeast through and out of the PTU. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Treatment area is located immediately adjacent (<200m) from private residences. This area has been recommended for treatment due to its high recreational use and the presence of hazardous fuels. The stands characteristic of this area are primarily typed as C-5 fuel type with moderate stand densities, moderate fine and medium woody fuel levels present throughout, and scattered/patchy ladder fuels. The combination of these factors lends to potential for crown fire behavior. Additionally, the proposed area was strategically selected given its location at 270 degrees offset to prevailing wind conditions in relation to nearby private residences.
4	Stebbings Park	Moderate	8.4	Interface Fuel Break	8.3	0.1	0.0	This PTU lies entirely within the Shawnigan Community Watershed. Species and ecological communities at risk include the CDC red-listed Edward's Beach Moth (*Anarta edwardsii*) and red-listed Grand-fir/Oregon dull-grape ecological community (*Abies grandis/Berberis nervosa*). Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	The proposed treatment area is located northwest and immediately adjacent (200-300m) from private residences. The stands characteristic of this area are immature conifer stands typed as M-1/2 with high percent conifer. Conifer ladder fuel continuity within the proposed treatment area is uniform. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger.
6	Hollings Park	High	16.7	Interface Fuel Break	16.6	0.0	0.1	This proposed treatment unit lies entirely within the Shawnigan Community Watershed and overlaps significantly with the red-listed Edward's Beach Moth (*Anarta edwardsii*) and the red-listed Grand-fir/Oregon dull-grape ecological community (*Abies grandis/Berberis nervosa*). Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	The proposed treatment area is located <100 m from private residences within Hollings Creek Park Community. This area has been recommended for treatment due to its high recreational use and the presence of hazardous ladder fuels. The stands present within this area are characterized as mature M-1/2 (conifer and deciduous mix), with high percent conifer composition both in the understorey and overstorey of upland areas. A trailside treatment and assessment of all upland areas within this proposed treatment area are necessary to reduce ignition potential (avoid the ravine and lowland deciduous areas near the creek).

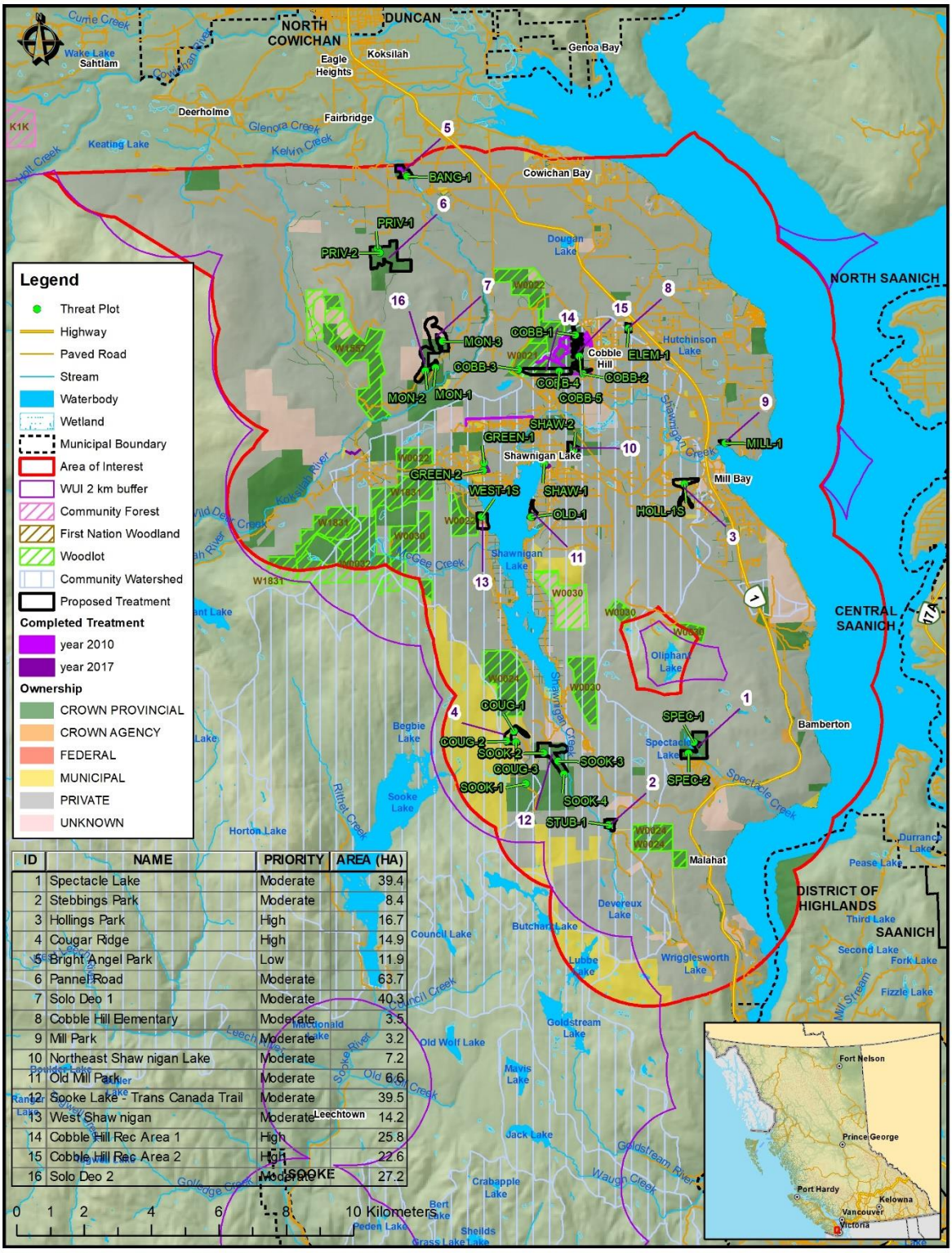
FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
7	Cougar Ridge	High	14.9	Interface Fuel Break	13.5	0.9	0.5	The Shawnigan Community Watershed has considerable overlap with this PTU, with an additional smaller PTU area to the west overlapping with the Sooke Lake Community Watershed. Also present are the CDC red-listed Howell's Violet (*Viola howellii*) and blue-listed Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*). Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	The proposed treatment area is located <200 m from private residences in the newly developed Cougar Ridge Community. The stands characteristic of this area are classified as C-3 fuel type, with patchy to uniform ladder fuels throughout, and low-moderate fine and medium fuel levels. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger. The proposed area was strategically selected given its location at 270 degrees offset to prevailing wind conditions in relation to nearby private residences.
10	Bright Angel Park	Low	11.9	Interface Fuel Treatment	0.0	11.9	0.0	This unit is located within the buffer zone of a masked CDC SAR occurrence, in addition to overlapping with two CDC blue-listed species, Moss' Elfin, *Mossii* subspecies (*Callophrys mossii mossii*) and the Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*) also occur. Two sensitive ecosystem areas lie on the eastern edge of PTU, and a stream passes through the eastern area. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located within 200-300m of private residences. This area has been recommended for treatment due to its high recreational use and the presence of hazardous ladder fuels. The stands characteristic of this area are classified as M-1/2 fuel type (conifer and deciduous mix), with high percent conifer composition. Ladder fuels are scattered throughout the proposed treatment area but are generally clumpier near trails and/or adjacent to roadsides. This type of stand is likely to exhibit potential for crown fire behavior during periods of high or extreme fire danger. The proposed area was strategically selected given its location upwind of private residences.
11	Pannel Road	Moderate	63.7	Interface Fuel Break	45.0	18.4	0.2	This treatment unit is located within the buffer zone of a masked CDC SAR occurrence, in addition to one sensitive ecosystem area. There is overlap in the eastern extent with two growth and yield plots. Consultation with the ecosystem biologist and Forest Inventory MFLNRORD department must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located south of and adjacent to private residences (200-500m). The stands characteristic of this area are classified as a mix of fuel types (C-3 and M-1/2 with high conifer composition). Low to moderate fine and medium fuel levels are present throughout, and ladder fuels are patchy to uniform. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger. The proposed area was strategically selected given its location upwind of private residences.

FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
13	Solo Deo 1	Moderate	40.3	Primary Fuel Break	25.3	15.0	0.0	There is minor overlap with a non-legal old growth management area (internal ID 41232) in the northeastern arm of this proposed treatment unit. Otherwise, this PTU lies entirely within the Koksilah FDU, per the BCTS East and Southwest Coast FSP 2007. Consultation with BCTS, Snaw-Naw-As Forest Services Ltd., and Otter Point Timber Ltd., and other relevant parties must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located south of and adjacent to private residences (200-500m). The stands characteristic of this area are classified as a mix of fuel types (primarily M-1/2 with high conifer composition, with minor components of C-3 and C-5 fuel types). Low to moderate fine and medium fuel levels are present throughout, and ladder fuels are patchy to uniform. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger. The proposed area was strategically selected given its location at 270 degrees offset to prevailing wind conditions in relation to nearby intermixed private residences.
18	Cobble Hill Elementary	Moderate	3.5	Interface Fuel Break	0.0	3.5	0.0	This treatment unit overlaps with the Shawnigan Community Watershed in its southwestern corner. There is also overlap with the Edward's Beach Moth (*Anarta edwardsii*), a CDC red-listed species. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located south of an Elementary School and is surrounded by private residences (<100m). The stands characteristic of this area are primarily typed as C-5 fuel type with moderate stand densities, moderate fine and medium woody fuel levels present throughout, and scattered/patchy ladder fuels. This type of stand is likely to exhibit potential for crown fire behavior during periods of high or extreme fire danger.
20	Mill Park	Moderate	3.2	Interface Fuel Break	0.0	3.2	0.0	The Mill Park treatment unit overlaps in its western areas with agricultural land reserve 1839151. The CDC red-listed species Edward's Beach Moth (*Anarta edwardsii*) and the red-listed Grand-fir/Oregon dull-grape ecological community (*Abies grandis/Berberis nervosa*) are also present. Otherwise, analysis returned overlap with one sensitive ecosystem area. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to private residences (<100m). The stand is characterized as C-5 fuel type with moderate stand densities, low fine and medium woody fuel levels present throughout, and scattered/patchy ladder fuels. The proposed area was strategically selected given its location upwind of private residences.

FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
24	Northeast Shawnigan Lake	Moderate	7.2	Interface Fuel Break	6.0	1.2	0.0	This proposed treatment unit is entirely contained within the Shawnigan Community Watershed. There is also overlap with the CDC red-listed Howell's Violet (*Viola howellii*). Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to private residences (<100m). The stand is characterized as a mix of C-3 and C-5 fuel types, with low to moderate fine and medium fuels. Ladder fuels are sparse/scattered throughout and are primarily western redcedar and Douglas-fir. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger.
26	Old Mill Park	Moderate	6.6	Interface Fuel Break	2.6	4.0	0.0	This proposed treatment unit is entirely contained within the Shawnigan Community Watershed. There is also overlap with the CDC red-listed Howell's Violet (*Viola howellii*). A stream passes through this PTU. Observations of cutthroat and rainbow trout have been recorded in Shawnigan Lake immediately adjacent to the PTU. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to private residences (100-300m). The stand is characterized as a mix of fuel types (primarily C-5 with a minor component of M-1/2, with high conifer percent). Low to moderate fine and medium fuel levels are present throughout, and ladder fuels are scattered and/or patchy throughout the area. The proposed area was strategically selected given its location upwind of private residences.
29	Sooke Lake – Trans Canada Trail	Moderate	39.5	Interface Fuel Break	28.8	10.7	0.0	There is significant overlap in southern area of proposed polygon with recreation polygon REC28220. Approximately 75% of the PTU also overlaps with an FDU managed by Malahat Forestry Services, Inc. The entirety of the polygon lies within Shawnigan Community Watershed. The CDC blue-listed Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*) is present within the PTU. Shawnigan Creek Recreation Reserve lies in the south, and there is a small area with one sensitive ecosystem area. Shawnigan Creek passes through the eastern arm of the PTU, flowing south. Consultation with the ecosystem biologist and all appropriate licencees and/or clients must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to and upwind of private residences (100-300m) near Cougar Ridge Community. The stand is characterized as C-3 fuel type with high conifer density. Low to moderate fine and medium fuel levels are present throughout, and ladder fuels are patchy to uniform throughout the area. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger. The proposed area was strategically selected given its location upwind of private residences.

FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
31	West Shawnigan	Moderate	14.2	Interface Fuel Break	5.0	9.2	0.0	There is minor overlap on western edge of polygon with a non-legal old growth management area (internal ID 41241). West Shawnigan Lake Provincial Park significantly overlaps with the PTU. The PTU lies entirely within Shawnigan Community Watershed and West Shawnigan Lake Provincial Park, and there is overlap with the CDC red-listed Howell's Violet (*Viola howellii*) and the blue-listed Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*). A small sensitive ecosystem area is present, and a stream passes through this PTU. Cutthroat trout, rainbow trout, and yellow perch have recorded occurrences in Shawnigan Lake, immediately adjacent to the PTU. Consultation with the ecosystem biologist and all appropriate licencees and/or clients must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to private residences (100-300m) and near a critical infrastructure. The stand is characterized as a mix of fuel types (primarily C-5 with a minor component of M-1/2, with high conifer percent). Low to moderate fine, medium, and coarse fuel levels are present throughout, and ladder fuels are scattered and/or patchy throughout the area. The proposed area was strategically selected given its location upwind of a critical infrastructure.
32	Cobble Hill Rec Area 1	High	25.8	Interface Fuel Break	4.7	21.0	0.1	This proposed treatment unit completely overlaps with the Cobble Hill Mountain Regional Recreation Area, significantly overlaps with Shawnigan Community Watershed, and has modest overlap in its eastern half with a non-legal old growth management area (internal ID 41235) and a woodlot FFID W0021. CDC red-listed Douglas-fir/Oregon dull-grape ecological community (*Pseudotsuga menziesii/Berberis nervosa*) is present. The PTU's western extent intersects three sensitive ecosystem areas. Consultation with the ecosystem biologist and the woodlot client must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located adjacent to private residences (100-300m) The stand is characterized as a mix of fuel types (primarily C-5 with a minor component of M-1/2, with high conifer percent). Low to moderate fine, medium fuel levels are present throughout, and ladder fuels are scattered and/or patchy throughout the area. The proposed area was strategically selected given its location at 270 degrees offset to prevailing wind conditions in relation to nearby intermixed private residences.

FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values / Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
33	Cobble Hill Rec Area 2	High	22.6	Interface Fuel Break	0.0	22.2	0.4	The PTU completely overlaps with Cobble Hill Mountain Regional Recreation Area. There is significant overlap in the northern half of the PTU with one sensitive ecosystem area, and nearly complete overlap with Shawnigan Community Watershed. The CDC red-listed Douglas-fir/Oregon dull-grape ecological community (*Pseudotsuga menziesii/Berberis nervosa*) is present. Consultation with the ecosystem biologist must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located within 500m of private residences. The stand is characterized as a mix of fuel types (primarily C-5 with a minor component of M-1/2, with low conifer percent). Low to moderate fine, medium fuel levels are present throughout, and ladder fuels are scattered and/or patchy throughout the area. This area has been recommended for treatment due to its high recreational use and the presence of hazardous fuels near mountain bike trails.
37	Solo Deo 2	Moderate	27.2	Interface Fuel Break	16.7	10.4	0.0	This PTU completely overlaps with Koksilah FDU, per the BCTS East and Southwest Coast FSP 2007 (clients: BCTS, Snaw-Naw-As Forest Services Ltd., Otter Point Timber Ltd.). Consultation with the licencees and/or clients must occur during the prescription development phase and prior to implementation to ensure all concerns are addressed.	Proposed treatment area is located south of and adjacent to private residences (200-500m). The stands characteristic of this area are classified as M-1/2 fuel type with high conifer composition. Low to moderate fine and medium fuel levels are present throughout, and ladder fuels are patchy to uniform. This type of stand is likely to exhibit high potential for crown fire behavior during periods of high or extreme fire danger.



ID	NAME	PRIORITY	AREA (HA)
1	Spectacle Lake	Moderate	39.4
2	Stebbings Park	Moderate	8.4
3	Hollings Park	High	16.7
4	Cougar Ridge	High	14.9
5	Bright Angel Park	Low	11.9
6	Pannel Road	Moderate	63.7
7	Solo Deo 1	Moderate	40.3
8	Cobble Hill Elementary	Moderate	3.5
9	Mill Park	Moderate	3.2
10	Northeast Shaw nigan Lake	Moderate	7.2
11	Old Mill Park	Moderate	6.6
12	Sooke Lake - Trans Canada Trail	Moderate	39.5
13	West Shaw nigan	Moderate	14.2
14	Cobble Hill Rec Area 1	High	25.8
15	Cobble Hill Rec Area 2	High	22.6
16	Solo Deo 2	Moderate	27.2

Map 11. Proposed and Past Fuel Treatments.

5.1.2 Maintenance of Previously Treated Areas

The CVRD has shown leadership in completing fuel management projects within the AOI to reduce associated wildfire hazard. These activities have been implemented as a demonstration/pilot treatment in 2008 and operationally in 2010 for a combined total treated area of 26 ha (Map 11). These are primarily linear fuel treatments and trailside treatments focused in the Cobble Hill Recreation area, Bright Angel Park, Koksilah River Park and the Shawnigan Creek/North Shawnigan Lake area. The latter treatment was completed on municipal land adjacent to residential properties. These polygons are in various states of hazard, some of which require additional fuel management activities (maintenance) in order to maintain or re-attain moderate or lower threat class ratings. Maintenance activities may include additional thinning, conifer regeneration reduction, or surface fuel continuity reduction (removal of excess woody debris).

Maintenance of previously treated polygons should be a priority for the CVRD. All polygons that were previously treated were assessed during field visits; polygons were prioritized for maintenance activities, such as reducing and/or removing standing dead, reducing surface fuels, or additional thinning (overstorey reduction and thinning suppressed conifers or conifer regeneration, see Table 16). The return interval for maintenance activities depends upon site productivity and type and intensity of treatment. Less productive areas can likely withstand a longer frequency between maintenance activities, while more productive areas would require treatments more often.

RECOMMENDATION #15: Apply for funding for maintenance activities prioritized and scheduled in this CWPP Update.

RECOMMENDATION #16: Treatment monitoring to be completed by a qualified professional to schedule next set of maintenance activities (5 – 10 years out). This can be completed with a CWPP update, as it was for this document, or as a stand-alone exercise.

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

Treatment Year	Polygon Name/ Treatment Unit	Location	Area (Ha)	Plot Name and Threat Rating	Priority	Target timeline for return (years from 2018)	Comment
2010	AP3327-5	Mill Bay Nature Park	2.1	MILL-1 (Moderate)	1	1-2	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality, surface fuel removal, and hazard tree removal.
2008	AP2369-3	Dougan Park	1.0	SHAW-1 (High)	1	1-2	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality and surface fuel removal. Polygon is adjacent to school and community centre and has high priority for retreatment.
2010	AP3327-7	Silvermine Trail	1.7	Walkthrough	2	1-2	Additional pruning and/or thinning of small diameter stems should be complete to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing dead and surface fuel removal.
2008	AP2369-1	Shawnigan Hills Athletic Park	0.6	GREEN-1 (Moderate) GREEN-2 (High)	2	3-5	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality and surface fuel removal.
2008	AP2369-4	Silvermine Park	0.3	Walkthrough	2	3-5	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality and surface fuel removal.
2010	AP3327-2	Cobble Hill Mountain Regional Recreation Area	14.1	COBB-1 (Moderate), COBB-2 (Moderate), COBB-3 (Moderate), COBB-4 (Moderate), COBB-5 (Moderate)	2	3-5	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality, surface fuel removal, and hazard tree removal.
2010	AP3327-1	Bright Angel Park	1.2	BANG-1 (Moderate)	3	3-5	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include removal of small diameter standing mortality and surface fuel removal.
2010	AP3327-6	Quarry Nature Park	4.4	COBB-1 (Moderate)	3	3-5	No maintenance activities are anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2023 – 2028.
2008	AP2369-2	Old Mill Park	0.9	OLD-1 (Moderate)	4	5-10	No maintenance activities are anticipated in the next five years. Walk-through to assess for and recommend future maintenance needs should be completed 2023 – 2028.

5.2 FIRESMART PLANNING AND ACTIVITIES

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

5.2.1 FireSmart Goals and Objectives

FireSmart® is the comprehensive nationally accepted set of principles, practices and programs for reducing losses from wildfire.[72] FireSmart spans the disciplines of hazard/threat assessment; regional planning and collaboration; policy and regulations; public communication and education; vegetation/fuel management; training and equipment; and, emergency preparedness and response. FireSmart concepts provide a sound framework for advancing the goal of wildfire loss reduction, as it is a common goal shared with CWPPs.

The FireSmart approach and concepts, including recommended FireSmart guidelines[73], have been formally adopted by almost all Canadian provinces and territories, including British Columbia in 2000; FireSmart has become the de facto Canadian standard. FireSmart is founded in standards published by the National Fire Protection Association (NFPA). The objective of FireSmart is to help homeowners, neighbourhoods, whole communities and agencies with fire protection and public safety mandates to work together to prepare for the threat of wildfire in the WUI. Coordinated efforts between all levels of planning and action are integral to effectively and efficiently reducing the risk to communities.

The following are key principles of FireSmart:

- Wildland fires are a natural process and critical to the health of Canadian ecosystems.
- Mitigation and response efforts must be carefully coordinated through all stages of planning and implementation.
- Threats and losses due to wildfires can be reduced by working together. Responsibility for effectively mitigating hazards must be shared between many entities including homeowners, industry, businesses and governments.[74]
- There are seven broad disciplines to help address the threat of wildfire: education, vegetation management, legislation and planning, development considerations, interagency cooperation, emergency planning, and cross training.[74]
- Solutions are required at all scales from individual backyards, to communities and the wider landscape. In order to succeed, these efforts must be integrated across the mosaic of land ownership (Figure 5).

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

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

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

- The ultimate root of the WUI interface problem is the vulnerability of structures and homes to ignition during wildfire events, in particular vulnerability to embers. This leads to an emphasis on risk mitigations on private properties.

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

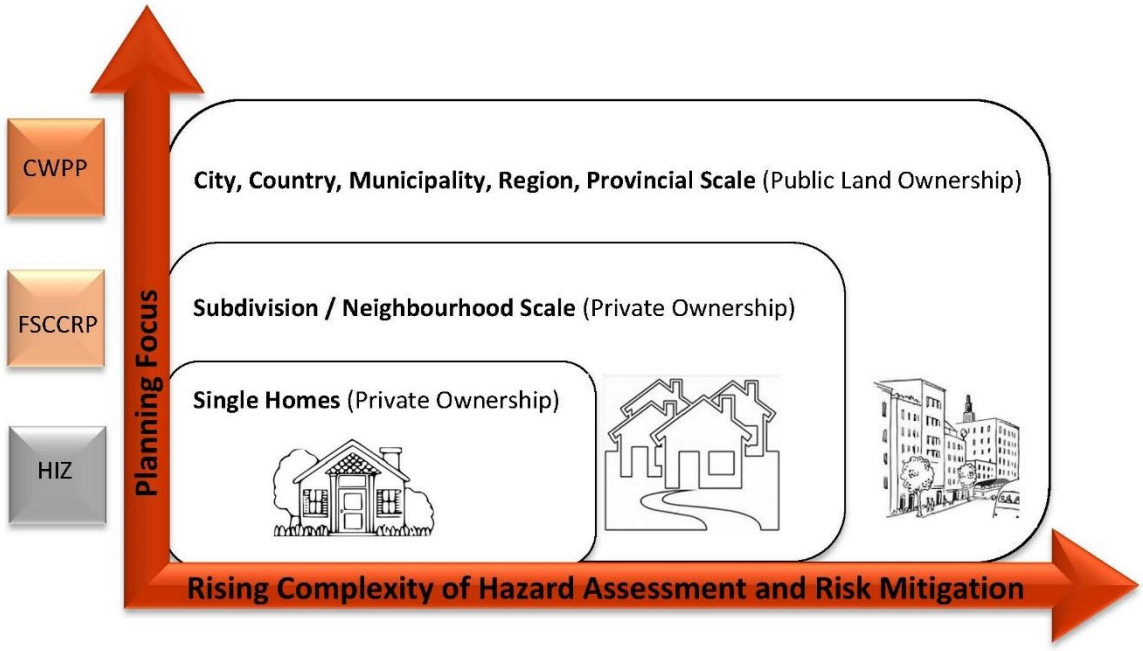


Figure 5. Diagram of the various, coordinated levels of the FireSmart program.[75] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.

Home Ignition Zone

Multiple studies have shown that the principal factors regarding home loss to wildfire are the structure's characteristics and immediate surroundings; the area that determines the ignition potential is referred to as the Home Ignition Zone (HIZ).[76,77] The HIZ includes the structure itself and three concentric, progressively wider Priority Zones. HIZ Priority Zones are based upon distance from structure: 0 – 10 m (Priority Zone 1), 10 – 30 m (Priority Zone 2), and 30 – 100 m (Priority Zone 3). These zones help to guide risk reduction activities, with Recommended FireSmart Guidelines being most stringent closest to the structure. The likelihood of home ignition is mostly determined by the area within 30 m of the structure (Priority Zones 1 and 2). Recommended FireSmart guidelines address a multitude of hazard factors within

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

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

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

the HIZ: building materials and design; vegetation (native or landscaped materials); and the presence of flammable objects, debris, and vulnerable ignition sites. More detail on priority zones can be found in Appendix J.

It has been found that, during extreme wildfire events, most home destruction has been a result of low-intensity surface fire flame exposures, usually ignited by embers. Firebrands can be transported long distances ahead of the wildfire, across fire guards and fuel breaks, and accumulate within the HIZ in densities that can exceed 600 embers per square meter. Combustible materials found within the HIZ combine to provide fire pathways allowing spot surface fires ignited by embers to spread and carry flames or smoldering fire into contact with structures.

Because ignitability of the HIZ is the main factor driving structure loss, the intensity and rate of spread of wildland fires beyond the community has not been found to necessarily correspond to loss potential. For example, FireSmart homes with low ignitability may survive high-intensity fires, whereas highly ignitable homes may be destroyed during lower intensity surface fire events.[77] Increasing ignition resistance would reduce the number of homes simultaneously on fire; extreme wildfire conditions do not necessarily result in WUI fire disasters.[78] It is for this reason that the key to reducing WUI fire structure loss is to reduce home ignitability; mitigation responsibility must be centered on homeowners. Risk communication, education on the range of available activities, and prioritization of activities should help homeowners to feel empowered to complete simple risk reduction activities on their property.

FireSmart Canada Community Recognition Program

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

WUI Disaster Sequence

Calkin et al (2014) coined the 'WUI disaster sequence', a six-step sequence which has been used to describe the situation in which the firefighting capacity of a community is overwhelmed by wildland / interface fires in highly ignitable communities: 1) extreme wildfire behaviour weather combined with, 2) a fire start, which 3) exposes numerous homes with high ignition potential, and results in numerous

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

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

Once multiple homes are ignited in an urban area, there is increasing potential for fire to spread from structure to structure, independently of the wildland vegetation. This is known as an urban conflagration. Effective fire protection depends on ignition resistant homes and properties during extreme wildfire events.[79] More than two simultaneous structure fires could overwhelm the resources and capacity of a fire department.

Overall, FireSmart leads to communities that are better adapted to wildfire, more resilient and able to recover following wildfires by sustaining fewer losses and disruption, and safer places to live and recreate. Action by homeowners is the number one priority for reducing structure loss in the event of a WUI fire, but the overall adaptation of the community to wildfire is multi-pronged and the landscape should not be ignored.[79]

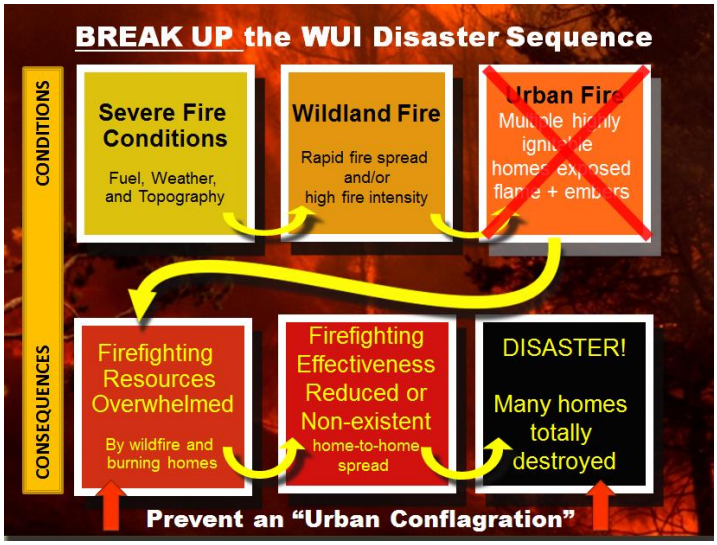


Figure 6. Wildland/urban interface disaster sequence.[80] It is possible to break up the disaster sequence by decreasing the number of highly ignitable homes exposed to embers, therefore reducing the number of homes ignited and removing the consequences of multiple structures lost.

5.2.2 Key Aspects of FireSmart for Local Governments

Reducing the fire risk profile of a community through FireSmart implementation requires coordinated action from elected officials, local government planners, developers, private land owners and industrial managers. This Section presents various options of FireSmart practices, which when enacted, provide avenues for reducing fire risk within the community. An evaluation of the current level of FireSmart implementation within the CVRD South Zone is also presented in this Section.

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

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

Communication, Education and Partnerships

Communicating effectively is a key aspect of any education strategy. Communication materials must be audience specific and delivered in a format and through mediums that reach the target audience. Audiences should include home and landowners, students, local businesses, elected officials, CVRD and municipal staff, and local utilities providers. Education and communication messages should be simple yet comprehensive. A basic level of background information is required to enable a solid understanding of fire risk issues and the level of complexity and detail of the message should be specific to the target audience.

FireSmart information material is readily available and simple for municipalities to disseminate. It provides concise and easy-to-use guidance that allows homeowners to evaluate their homes and take measures to reduce fire risk. However, the information needs to be supported by locally relevant information that illustrates the vulnerability of individual houses to wildfire.

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

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

FireSmart Vegetation Management

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

Since the 2005 CWPP, the CVRD has engaged in proactive vegetation management strategy, specifically targeting high-use areas near values at risk, primarily linear treatments along trails within forested public spaces and CVRD parks. Radio towers in the AOI on Bald Mountain and Mount Wood have also been subject to FireSmart vegetation management. A recommended maintenance schedule for previously treated areas is provided in Section 5.1.2. The CVRD does not currently enforce FireSmart landscaping requirements within development permits. More detailed recommendations regarding municipal policies and bylaws are provided below in Planning and Development.

Planning and Development

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

The planning and development objectives for the CVRD are:

- To include wildfire considerations in the planning and acquisition strategy for parks and recreational areas.
- To utilize regulatory and administrative tools to reduce wildfire hazard on private land and increase number of homes compliant with FireSmart guidelines (with low ignition potential).

The OCP does not explicitly consider the establishment of a development permit area (DPA) to address wildfire risk mitigation. Building upon recommendations from the 2005 CWPP, it is recommended that the CVRD review the OCP, with consideration towards establishing a wildfire development permit area. Other jurisdictions' wildfire development permit areas can serve as models for various components. [81] The first step should be to establish development permit (DP) objectives (for example, minimize risk to property and people from wildland fires; minimize risk to forested area surrounding communities and development in the AOI; conserve the visual and ecological assets of the forest surrounding these areas; reduce the risk of post-fire landslides, debris follows and erosion, etc.). The following components should be considered during the OCP review and DP development process in order to help meet the established objectives:

- Use of fire resistant exterior construction materials within the established development permit area, based on recognized standards such as NFPA 1144 or FireSmart.
- Inclusion of minimum setbacks from forested edge and top of slope based on FireSmart principles.
- Use of FireSmart landscaping (low flammability plants, appropriate spacing and low flammability aggregates/ ground cover based on FireSmart principles).
- Underground servicing.
- Mitigation of fire hazard through fuel management activities based upon qualified professional recommendations (prescriptions and oversight). This is generally most applicable in the subdivision phase.
- Prompt removal of combustible construction materials, thinning/ fuel management debris, or clearing debris during the fire season.
- Coordinating QPs to ensure that requirements for overlapping, and potentially conflicting, development permit areas such as Streamside Protection and Enhancement are met.
- Review and approval process for submitted applications.

[81] The District of North Vancouver has a robust and well-documented Wildfire Hazard Development Permit process. Another jurisdiction which may be worth reviewing is Maple Ridge.

- Post-development inspections and sign-offs.
- Outline of responsibilities for staff and applicants.
- Enforcement and regulation (consequences of non-compliance).

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

In 2015, the province passed the *Building Act* as the new legislation to guide building and construction in the province (Spring 2015). This Act establishes the province as the sole authority to set building requirements and limits local government authority to set building requirements in their bylaws. Section 5 of the *Building Act* provides an exception to the above limitation to local governments by giving them the authority to set local building bylaws for unrestricted and temporarily unrestricted matters, such as exterior design and finish of buildings in relation to wildfire hazard and within a development permit area. The British Columbia Building Code does not have any wildfire-specific fire-resistant design components. Until revisions of the Building Code to include requirements specific to prevention of wildfire spread are completed, local governments can set exterior requirements within an established development permit area for wildfire risk mitigation.[82]

RECOMMENDATION #17: Review the Official Community Plan (OCP); consider including wildfire as a natural hazard development permit area (DPA). A recommended development permit area for the CVRD would include all areas within the South Zone that are located within 200 m of moderate, high or extreme wildfire behaviour threat class areas. This is a suggested distance which should be validated and defined through a more comprehensive GIS analysis of hazardous fuels and their proximity to the interface. Review similar wildfire hazard DPAs established in other jurisdictions and use as models for various aspects of the DP process. The following aspects should be considered in the OCP review and wildfire DPA development: 1) Establish DPA objectives (e.g. minimize risk to property and people from wildland fires; minimize risk to forested area surrounding the AOI; and conserve the visual and ecological assets of the forests surrounding communities; etc.; and 2) Where possible, it is recommended to mandate FireSmart construction materials, some of which may be beyond BC Building Code within the established wildfire hazard development permit area. In order to meet objectives, consider including the following elements: 1) minimum setbacks from forested edge based on FireSmart, 2) fuel management based upon qualified professional recommendations, 3) landscaping to FireSmart guidelines, 4) building materials and design based on NFPA 1144 or FireSmart standards, 5) underground servicing, 6) prompt removal of combustible construction materials or thinning/ fuel management waste.

RECOMMENDATION #18: Ensure that wildfire hazard development permit applications are provided to fire departments for opportunity for input prior to approval. As more development permit applications are received, the importance of communication and integration between fire departments and the Development Services Division will increase.

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

RECOMMENDATION #19: Develop a landscaping standard which lists flammable non-compliant vegetation and landscaping materials, non-flammable drought and pest resistant alternatives, and tips on landscape design to reduce maintenance, watering requirements, avoid wildlife attractants, and reduce wildfire hazard. Consider including the landscaping standard as a development permit requirement within the applicable area, as well as making it publicly available for residents and homeowners outside of the DPA (can be provided at issue of building permit and made available at Municipal Office or other strategic locations).

RECOMMENDATION #20: Consider engaging the development/building community (may include developers, builders, landscapers, and architects) in DP development process. This can be accomplished through a series of workshops/informational sessions to: 1) increase awareness of wildfire risk, 2) demonstrate that there are a variety of actions which can be undertaken to immediately and measurable reduce the risk to the homeowner and community, 3) discuss various strategies and actions which could be implemented to meet DP objectives, 4) educate and inform regarding the DP process and expectations.

Additional recommendations for amendments to policies and bylaws were discussed fully in Section 2.5.3.

Subdivision Design

Subdivision design should include consideration to decrease the overall threat of wildfire. Aspects of subdivision design that influence wildfire risk are access, water pressure and hydrant locations. The number of access points and the width of streets and cul-de-sacs determine the safety and efficiency of evacuation and emergency response. In the communities and/or developed areas within the South Zone, on-street parking can contribute hazards on narrow or dead-end roads, which are already unlikely to have a high capacity under heavy smoke conditions.[83] When the time for evacuation is limited, poor access has contributed to deaths associated with entrapments and vehicle collisions during wildfires.[84] Methodologies for access design at the subdivision level can provide tools that help manage the volume of cars that need to egress an area within a given period of time.[83]

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

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

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

Increasing Local Capacity

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

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

A detailed account of current local capacity for the CVRD South Zone and recommendations to address gaps is provided in SECTION 6:.

FireSmart Compliance within the Area of Interest

As could be expected, there is a wide range of FireSmart compliance on private properties in the AOI. There are large differences in the degree to which FireSmart best practices are visible within individual HIZs, and in neighbourhoods throughout the South Zone communities. Landscaping in the AOI is also in a range of FireSmart compliance. Generally speaking, most homes in interface areas such as, the Village of Shawnigan Lake, Kerry Village, Fern Ridge, Arbutus Mountain Estates, Lambourn Estates, Cobble Hill, Cherry Point Neighbourhood, Cougar Ridge and Douglas Hill Neighbourhood, respectively, do not maintain 10 m defensible space. The main concern in the aforementioned areas is the ubiquity of flammable landscaping options (i.e., cedar hedging) in proximity to residences, as well as the lack of defensible space between property footprints and adjacent forested areas. Bark mulch is commonly used as a landscaping material within the HIZ. Accumulations of conifer foliage in roof corners and gutters was not uncommon. Storage of combustible items under decks, carports, and other horizontal surfaces was common. On the other hand, many residences are surrounded by lawn, agricultural fields, 10 m defensible space, and/or hardscaping (rocks), all of which are FireSmart compliant. The Village of Cowichan Bay displays the highest FireSmart compliance rate.

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

Neighbourhoods in the CVRD South Zone AOI were unofficially surveyed during field work. The following observations were made:

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

RECOMMENDATION #21: The CVRD should hire a qualified professional (QP) or consider training local fire services staff members as Local FireSmart Representatives to assist the various communities in complying with FireSmart principles at the neighbourhood and individual home-level.

5.2.3 Priority Areas within the AOI for FireSmart

This section identifies priority areas within the AOI that would benefit from FireSmart planning and activities.

These priorities are based on general field observations and input from the CVRD and are not based on a scientific sample or formal data collection. Recommended FireSmart activities are essentially the same for each neighbourhood or area; however, it is recommended that the CVRD prioritize the neighbourhoods in Table 17. In addition, every neighbourhood within the AOI should continue to improve upon existing FireSmart activities and equally participate in the CVRD's FireSmart program.

Table 17. Summary of FireSmart Priority Areas.

Area	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Priority Area #1: Cougar Ridge	N	N	The following is a non-extensive list of FireSmart activities for which the CVRD can engage suggested neighbourhood residents: 1) Provide guidance to ensure landscaping is to an established FireSmart standard; 2) Incentivise private landowners to engage in retrofitting homes with building materials and design based on NFPA 1144 or FireSmart standards;
Priority Area #2: Village of Shawnigan Lake and surroundings	N	N	
Priority Area #3: Trestle Estates and north of Koksilah River Provincial Park	N	N	

Area	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Priority Area #4: Rebecca Road	N	N	3) Encourage prompt removal of combustible construction materials or yard waste from private properties; and 4) Coordinate monthly or bi-monthly yard waste removal days prior to and during the fire season to reduce WUI fire hazard.
Priority Area #5: Arbutus Mountain Estates	N	N	
Priority Area #6: Community of Mill Bay	N	N	
Priority Area #7: Carlton and Fern Ridge	N	N	
Priority Area #8: Kerry Village	N	N	
Priority Area #9: Community of Cobble Hill	N	N	
Priority Area #10: Critical infrastructure	Y (partially)	N/A	Based on field observations, most critical infrastructure has had some level of FireSmart setback from forested areas. Consider conducting frequent (2-3 years) maintenance treatments to ensure the wildfire risk does not reach higher than moderate. It is recommended that fuel treatments be considered for areas adjacent to critical infrastructure in order to bolster the effect of previous FireSmart treatments. FireSmart treatments may include thinning from below to reduce ladder fuels and crown fire potential, pruning of retained trees to 3 m, and reducing surface fuels. Additionally, consider adding regular brushing activities to the maintenance treatment schedule to control weeds and grasses around critical infrastructure.

5.3 COMMUNICATION AND EDUCATION

Establishing effective communications and actively engaging key stakeholders in risk reduction activities are keystones to building a FireSmart community. Without the support and involvement of residents, businesses, public officials, industry, and other forest tenure holders, the efforts of public officials, fire departments, and others to reduce wildfire losses will be hindered. In many communities, there is a general lack of understanding about interface fire, the relationship between ignition potential and loss of homes, and the simple steps that can be taken to minimize risk on private land. In addition, public perceptions regarding responsibility for risk reduction and the ability of firefighters to safely intervene to protect homes during a wildfire are often underdeveloped or inaccurate.

Based on the consultation completed during the development of this Plan, it is evident that CVRD staff and some residents have a good level of awareness of interface fire risk and a strong level of commitment

to continue to grow their awareness and understanding. However, field observations highlighted the need to further educate the community at large on what private land owners can do to build a FireSmart community and take personal responsibility for the ignition potential of their homes, businesses, lands, and neighbourhoods. Often, the risk of wildfire is at the forefront of public awareness during or after major wildfire events, whether close to home or further afield. The challenge is to retain this level of awareness outside these times. The Communication and Education objectives for the AOI are:

- To improve public understanding of fire risk and personal responsibility by increasing resident and property owner awareness of the wildfire threat in their community, to establish a sense of responsibility for risk mitigation among property owners, and to empower them to act;
- To enhance the awareness of, and participation by, elected officials and all WUI stakeholders regarding proactive WUI risk mitigation activities; and,
- To reduce or avoid ignitions from industrial sources.

Bringing organizations together to address wildfire issues that overlap physical, jurisdictional or organizational boundaries is a good way to help develop interagency structures and mechanisms to reduce wildfire risk. Engagement of various stakeholders can help with identifying valuable information about the landscape and help provide unique and local solutions to reducing wildfire risk. The CVRD should consider creating/formalizing an Interface Steering Committee to coordinate wildfire risk reduction efforts. The steering committee could include key stakeholders such as CVRD staff, Municipal/Village staff, BCWS, BC Parks, recreational groups/representatives, industrial operators, woodlot owner, and forest tenure license holders.

Moving from the CWPP to implementation of specific activities requires that the community is well informed of the reasons for, and the benefits of specific mitigation activities. In order to have successful implementation, the following communication and public education recommendations are made:

RECOMMENDATION #22: This report and associated maps to be made publicly available through webpage, social media, and public FireSmart meetings. In addition, this Update should be shared with local industry partners; in particular industrial forest companies who may be interested in collaborating on direct fuel management treatments or with other sections of this CWPP Update document.

RECOMMENDATION #23: Complete or schedule periodic updates of the CWPP to gauge progress and update the threat assessment (hazard mapping) for changes in fuels, forest health, land planning, stand structure or changes to infrastructure in the interface. The frequency of updates is highly dependent upon major changes which would impact the CVRD's wildfire threat assessment or the rate at which wildfire risk reduction efforts are implemented. An evaluation of major changes (including funding program changes that may lead to new opportunities) and the potential need for a CWPP update should be initiated every 5 - 7 years.

RECOMMENDATION #24: Develop a social media strategy and ensure that its full power is leveraged to communicate fire bans, high Fire Danger days, wildfire prevention initiatives and programs, easily implementable FireSmart activities, updates on current fires and associated air quality, road closures, and other real-time information in an accurate and timely manner. [85]

RECOMMENDATION #25: Consider promoting FireSmart approaches for wildfire risk reduction to CVRD residents through Town Hall meetings, workshops and/or presentations. Aim to conduct the engagement/promotion campaign prior and during the fire season. Consider supplying FireSmart materials to homeowners in the interface during these engagement campaigns.

RECOMMENDATION #26: Work towards FireSmart community recognition, at the neighbourhood level and facilitate uptake into the FireSmart Canada Community Recognition Program (FSCCRP). This will help reduce fire risk and aid in further funding applications.

RECOMMENDATION #27: Facilitate the FSCCRP uptake within the South Zone AOI and enhance its applications by including the following: 1) inviting BCWS crews to participate in and support the annual FireSmart events set up by participating neighbourhoods. 2) Encourage individual homeowner participants to complete the self-administered FireSmart home assessment tool. 3) Include within the FireSmart Canada Community Assessment Report the standard recommendation that participating neighbourhoods hold a home hazard assessment workshop as one of their FireSmart events.

RECOMMENDATION #28: Promote the use of the FireSmart Home Partners Program offered by the Partners in Protection Association, which facilitates voluntary FireSmart assessments on private property. Use the opportunity to educate the home or business owner about the hazards which exist on their property and provide easy improvements to reduce their risk.

RECOMMENDATION #29: Encourage schools to adopt and deploy existing school education programs to engage youth in wildfire management and risk reduction. There is emergency preparedness curriculum available provincially, which includes preparedness for a variety of natural hazards, including wildfire (Master of Disaster). Other options/value-added activities include consulting with Association of BC Forest Professionals (ABCFP) and British Columbia Wildfire Service (BCWS) (South Island Fire Zone), as well as local fire department and FireSmart representatives to facilitate and recruit volunteer teachers and experts to help with curriculum development to be delivered in elementary and/or secondary schools (field trips, guest speakers, etc.).

[85] Appendix L has general communication and social media information.

RECOMMENDATION #30: Develop and work with all key stakeholders (Industrial operators, MFLNRORD, BCWS, recreational groups/representatives, CVRD staff) to formalize an Interface Steering Committee. The purpose of the steering committee would be to identify wildfire related issues in the area and to develop collaborative solutions to minimize wildfire risks. The following subject areas are recommended for the group to explore: 1) Development of large, landscape level fuel breaks; 2) Public education and awareness needs; 3) Multi-disciplinary, multi-jurisdictional fuel treatment projects/ hazard abatement projects; 4) Development of a funding strategy; and 5) Reduction of human-caused fires, fire prevention and right of way management.

RECOMMENDATION #31: Work towards educating homeowners within unprotected areas (i.e., outside of fire service areas). It is common, especially in the case of second homeowners/ vacation owners, for them to be unaware of the lack of fire services in their area (in the event they call 911).

RECOMMENDATION #32: Continue promoting and providing information to private landowners related to residential sprinklers as a FireSmart prevention measure.

5.4 OTHER PREVENTION MEASURES

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

Risk of human-caused ignition within the study area is not limited to private property owners and individual residents. Power lines and industrial activities pose a risk of ignition, particularly in areas where cured fuels or fuel accumulations exist. Tree failures adjacent to power lines (transmission and distribution) are common occurrences and represent significant risks to ignition within the study area. A cooperative approach for addressing the industrial area concerns must be undertaken by the CVRD and pertinent industrial partners.

RECOMMENDATION #33 Work with industrial operators such as BC Hydro and Fortis BC to ensure that high risk activities, such as grubbing/brushing work are restricted during high fire danger times to reduce chance of ignitions as per the Wildfire Act.

RECOMMENDATION #34: Work with industrial operators (i.e., BC Hydro) to ensure that rights-of-way do not contain fine fuel accumulations (easily cured) prior to and during the fire season and are maintained in a low hazard state (to serve as fuel breaks). Work with industrial operators to ensure that high risk activities, such as right-of-way mowing, do not occur during high or extreme fire danger times to reduce chance of ignitions as per the Wildfire Act.

SECTION 6: WILDFIRE RESPONSE RESOURCES

This section provides a high-level overview of the local government resources accessible for emergency response and preparedness use. Accordingly, in emergency situations when multiple fires are burning in different areas of the Province, resource availability may be scarce. Therefore, local government preparedness and resource availability are critical components of efficient wildfire prevention and planning. Deployment of provincial resources occurs as per the process detailed in the *Provincial Coordination Plan for Wildland Urban Interface Fires* document[86]. The aforementioned document establishes a protocol for collaborative and integrated emergency management in the event of WUI fires within British Columbia.

6.1 LOCAL GOVERNMENT AND FIRST NATION FIREFIGHTING RESOURCES

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

Formal mutual aid agreements are in effect between the primary four fire departments within the AOI and will be updated in 2018 (more detail is provided in Section 6.1.1). In the event of a WUI fire emergency, mutual aid in the CVRD South AOI is activated, as required, between the principal four fire departments. WUI fire events may also lead to aid requests with BCWS.

6.1.1 Fire Department and Equipment

Fire protection with the AOI is primarily the responsibility of four volunteer fire departments (VFD) within four Improvement Districts (IDs) or Fire Service Areas (FSAs). These include the Cowichan Bay VFD, Mill Bay VFD, Shawnigan Lake VFD, and Malahat VFD. Additionally, fire services are under contract to the Capital Regional District by the Malahat VFD at the southern extent of the AOI. At the northern extent of the AOI, fire protection services are provided in the Eagle Heights FSA (567 ha) under contract by the Duncan Fire Department. Table 18 provides an overview of the fire services capacity in the AOI, including fire department personnel and equipment. In total, the various fire protection services cover 15,766 ha (44% of the total AOI area, inclusive of water bodies) and all major communities including First Nations

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

Indian Reserves but excluding large tracts of largely undeveloped and forested lands in the northwest and south of the AOI. Areas not in fire protection include Sooke Lake Road Community Forest and Stebbings Road Community Forest. These areas are under BCWS jurisdiction, and response resources would be supplied via the South Island Fire Zone.

Fire protection equipment includes both land and marine equipment and personnel are largely volunteer. The greatest personnel deficiencies reported by fire departments are the lack of daytime responders (available prior to 5 pm) due to other employment commitments. In consultation with fire departments it was determined that there are no structural firefighting equipment deficiencies, but that some departments are lacking in wildland firefighting equipment.

Table 18. Fire department capacity and equipment within the AOI.

Fire Protection Zones	Fire Department	Number of Stations	Number of Members	Apparatus type and number
Cowichan Bay ID	Cowichan Bay Volunteer Fire Rescue	1	35 (volunteer)	2 engines, 2 tenders, 1 utility truck, 1 command unit, 1 marine
Eagle Heights FSA (Contract Area)	Duncan Volunteer Fire Department	1 (outside of the AOI)	Fire Chief, 25 firefighters, 8 Line Officers, 3 Command Officers	2 pumper trucks, 100' platform, 3,500 US gallon tender, rescue truck, command vehicle and a utility truck.
Mill Bay ID	Mill Bay FD	2 (Mill Bay and Cobble Hill)	2 paid full time 27 volunteer/paid on-call	1 rescue truck, 2 engines, 1 ladder truck, 1 3,500 US gallon tender, 1 F550 Compressed Air Foam System (CAFS), 3 portable pumps.
Shawnigan Lake ID	Shawnigan Lake VFD	2 (and fire/rescue boathouse)	38 (volunteer)	3 engines, 3 tenders with pumps, 1 ladder truck, 1 rescue truck, 1 wildland CAFS pickup, 2000' 4" high volume trailer, 1 jet boat with 2000 gallons/min pumping ability, 1 command unit.
Malahat FSA and Capital Regional District (CRD) – Malahat Contract Area	Malahat VFD	1	18 (volunteer)	1 rescue trucks, 2 engines, 1 tender, 1 CAFS, 1 command unit.

Within the AOI, the Cowichan Bay, Shawnigan Lake, Mill Bay and Malahat volunteer fire departments have formal mutual aid agreements and can provide mutual aid within relatively short response times. It is anticipated that these agreements will be updated in 2018 to be streamlined and include automatic aid

provisions. Mutual aid agreements also exist with adjacent fire departments outside of the AOI. Malahat VFD has mutual aid agreements with Mill Bay and Shawnigan Lake VFDs and the City of Langford Fire Department. Mill Bay also has mutual aid agreements with Cowichan Bay and Shawnigan Lake VFDs. These mutual aid agreements are typically utilized twice a year for structure fires, and in some cases more frequently. For example, in 2017, Mill Bay VFD responded to 12 mutual aid calls and received approximately 8 to 10 mutual aid assists from other departments. Fire departments conduct mutual aid training approximately one to two times per year. Members of the primary fire departments within the AOI undergo significant training focused on structural firefighting and variable levels of training (at least once per year) related to wildfire, including annual wildfire interface training, structure protection program wildland firefighter level 1 (SPP-WFF1) or SPP-115 training. The Shawnigan Lake VFD has four in-house SPP-115 train-the-trainers and Mill Bay has two SPP-WFF1 train-the-trainers. In addition, both Mill Bay and Malahat VFDs have junior firefighter work experience programs, which is particularly popular in Mill Bay. It is recommended that all fire services members within the CVRD South Zone AOI have at a minimum S100 and/or SPP-WFF1 (or equivalent), and that the fire department members engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. The aforementioned cross-training opportunity could include, for example, a joint wildfire simulation exercise. This level of training would improve the local fire departments' commitment to wildfire preparedness.

The level of cross-training and working relationship with MFLNRORD's BCWS is also variable by fire department, and generally not well established within the South Zone. Within recent years the Shawnigan Lake VFD has had no exposure to practical cross-training with the BCWS while the Mill Bay VFD undertakes at least twice annual cross-training with the BCWS. Any cross-training that occurs with the BCWS is generally in the form of table top exercises. In consultation with the BCWS, it was noted that the needs for cross-training vary from department to department and also between volunteer and career staff. Cross-training with the BCWS would enable local fire departments to prepare their responders with technical and practical firefighting training in order to action both structural and wildland fires.

Over the previous 7 years (2011-2017), the five South Zone fire departments responded to an average of 224 calls per year (averaged over all fire departments from 2011 to 2017), of which only approximately 5 per year were wildland (bush) fires. Total calls include alarms, assistance, burning complaints, bush fires, other fires, hydro lines fires, structure fires, hazardous materials, medical aid, mutual aid, motor vehicle accidents, and rescue. Wildland fire calls have ranged from a low of 2 for the Shawnigan Lake VFD in 2011 and 2013, for the Mill Bay VFD in 2015, and for the Malahat VFD in 2016 to a high of 10 for the Duncan Fire Department in 2014. Wildland fires averaged yearly over the period of 2011-2017 for each fire department are as follows: Cowichan Bay – 5, Duncan – 6, Malahat – 3, Mill Bay – 5, Shawnigan Lake – 4.

6.1.2 Water Availability for Wildfire Suppression

Water is the single most important suppression resource. In an emergency response scenario, it is critical that a sufficient water supply be available. The Fire Underwriters Survey summarizes their recommendations regarding water works systems fire protection requirements, in *Water Supply for Public Fire Protection* (1999).[87] Some key points from this document include the need for:

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

Water service within the communities of the CVRD South Zone is an important component of emergency response for a wildland urban interface fire in the event of a large-scale emergency, and in particular for structural fires. As previously noted in Sections 3.2.3 and 3.3.1, water service is provided by a number of distinct CVRD, private and improvement district operated systems, and the majority of the systems rely on groundwater. For suppression within the AOI, hydrant service is provided within the fire services area boundaries at varying levels of coverage, with the exception of the Malahat fire service area, which has no hydrant service. There are significant areas outside of these boundaries with no hydrant service.

Several areas or neighbourhoods that have a lack of hydrants, water supply and/or water pressure were identified and that create suppression challenges in the AOI. The 2017 CVRD Water and Wastewater Utilities Review and Assessment Report (Innova Strategy Group, 2017) indicated a significant number of short and medium-term capital projects required in order to ensure water quality and supply meets acceptable standards. In consultation with the Wildfire Working Group, a lack of hydrants was identified in the following neighbourhoods and developments: Telegraph Road (private system, besides lack of hydrants, also has limited capacity, not sufficient for firefighting), Malahat, and Cobble Hill Road. Water pressure from hydrants creates a challenge for suppression in the Shawnigan Village System (pressure of <500 gal/minute).

In consultation with the Mill Bay Fire Department, it was noted that within the Mill Bay Improvement District, Keparo and Wilkinson Road private water systems have older systems with limited water volume and pumps requiring manual activation. Within the same District, it was estimated that hydrants are available in approximately 50% of the area; three areas have private water systems and the remaining area has no hydrants. The Mill Bay Fire Department stated that Mill Bay is at its population threshold for water and is now experiencing a lack of water for fire protection. Within the Shawnigan Lake

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

Improvement District, hydrants are available in some areas: including two larger systems and four smaller systems. The Shawnigan Lake VFD stated that in the event of prolonged power outage the largest suppression challenge would be depletion of water in the Shawnigan Lake Water reservoir due to a lack of secondary power.

Water supply within the CVRD South Zone is limited in a number of water systems during summer months. According to the 2017 CVRD Water and Waste Water Utilities Review and Assessment Report, various water supply limitations were noted in the following water systems: 1) Carlton water system (system is deteriorating and will require revision/refurbishing in near future); 2) Fern Ridge water system (one hydrant has reduced fire flow pressure); 3) Arbutus Ridge water system (well capacity is low and easily dries out during the summer season); and 4) Shawnigan Lake water system (groundwater well may require to be moved and reservoir will need refurbishing in the future).

The CVRD fire departments can draft from natural water sources such as Shawnigan Lake, other much smaller lakes, ponds, rivers (Shawnigan River and others), and even swimming pools, or the ocean when necessary for fire suppression purposes. Static water sources can be severely impacted by summer drought. The natural water sources are known and mapped. Shawnigan Lake in particular provides a large capacity freshwater reservoir that is not assumed to be immediately vulnerable to drought conditions or climate change. The ocean can be used to draft water, depending upon equipment, as a last resort.

RECOMMENDATION #35: All new rural development outside VCBs should have a water system which meets or exceeds minimum standards of NFPA 1142, Standard on Water Supplies for Suburban and Rural Fire Fighting. Fire services should review the water supply to ensure it provides sufficient placement, flow, and reliability for suppression needs and that secondary power is available in the event of power outages.

RECOMMENDATION #36: Consider completing a fire flow/water vulnerability assessment to identify where upgrades to systems, flows, hydrant number or location, and water storage, or secondary power is required. Prioritize and rank projects and complete or require upgrades as resources allow.

6.1.3 Access and Evacuation

Road networks in a community serve several purposes including providing access for emergency vehicles, providing escape/evacuation routes for residents, and creating fuel breaks. Access and evacuation during a wildfire emergency often must happen simultaneously and road networks should have the capacity to handle both. In the event of a wildfire emergency, the Malahat Highway (Highway 1) is the only reliable, paved access route north and south to and from the AOI. Paved roads also connect Shawnigan Lake, Cobble Hill, Cowichan Bay, and Cowichan Station to the Malahat Highway. Evacuation would be conducted by First Responders, RCMP, and the Search and Rescue team (tactical). If a wildfire were to block the Malahat Highway, evacuation from the AOI would be difficult. Smoke and poor visibility, car accidents, wildlife, and other unforeseen circumstances can further complicate evacuations and hinder safe passage.

Many developments within the CVRD South Zone are located on single access roads which branch off of the Malahat Highway; this limits the ability of fire crews to respond to fires and safely evacuate residents. A number of single access routes or isolated neighbourhoods that cause suppression or evacuation concerns were identified by the Wildfire Working Group including: Cougar Ridge, Goldstream Heights, Colpman Road, and Stebbings Road. A significant barrier to access and evacuation in the event of wildfire is the complicated and varied road ownership and multitude of locked gates on access roads on private property, including TimberWest private forest land. While the CVRD and Search and Rescue retain master keys to all or most private roads, it is critical for both agencies to have the most recent information on gate locations and ownership. Industrial landowners such as TimberWest also have concerns regarding security and may limit access accordingly.

Within the AOI, some of the critical infrastructure is reached via narrow and/or private, forested roads, which may impede suppression efforts and response times. Furthermore, there is a significant portion of land within the AOI which is inaccessible by roads. As such, a review of the Improvement Districts/Fire Service Areas and the accessibility, the risks and benefits of the current boundaries is recommended.

Emergency access and evacuation planning is of particular importance in the event of a wildfire event or other large-scale emergency. The CVRD has developed an Emergency Response Plan (ERP) in 2015 which includes basic contingencies in the event of a wildland/interface fire (i.e., contacts and roles of local government personnel). However, the ERP does not specify evacuation routes to be used during an emergency situation. In the event of a wildfire emergency within the AOI, the Mill Bay Community League Hall or the Malahat First Nation Council Office can be designated as the EOC. It is recommended that the CVRD develop a detailed evacuation plan that includes the following provisions:

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

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

The creation of a map book or spatial file that displays the trail network available for fire departments to access during an emergency or for fire suppression planning must accompany any fire access trail building activities. In order to effectively use the trails as crew access or as fuel breaks during suppression efforts, it is recommended to develop a Parks Access Plan, or Total Access Plan. This plan should be made available to the South Zone fire departments and the BCWS in the event that they are aiding suppression efforts on an interface fire in the AOI. The plan should include georeferenced maps with associated spatial data and ground-truthed locations of potential optimal firebreaks, identify the type of access available for each

access route, identify those trails that are gated or have barriers, and provide information as to how to unlock / remove barriers. The plan should also identify those natural areas where access is insufficient. Access assessment should consider land ownership, proximity of values at risk, wildfire threat, opportunities for use as fuel break / control lines, trail / road network linkages where fuel-free areas or burn off locations can be created or used as potential sprinkler locations and requirements for future maintenance activities such as operational access for fuel treatments and other hazard reduction activities.

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

RECOMMENDATION #37: Complete and participate in regular testing of, and updates to, the evacuation plan.

RECOMMENDATION #38: Consider developing a community wildfire pre-planning brochure that addresses the following: 1) locations of staging areas; 2) identifies water reservoirs, communications requirements (i.e., radio frequencies), minimum resource requirements for structure protection in the event of an interface fire, and values at risk; and 3) maps of the area of interest.

RECOMMENDATION #39: Develop a Total Access Plan for the CVRD to create, map and inventory trail and road network in natural areas for suppression planning, identification of areas with insufficient access and to aid in strategic planning. Georeferenced maps with ground-truthed locations of potential optimal firebreaks should be developed as part of the Total Access Plan and shared with fire suppression personnel and BCWS to support emergency response in the event of a wildfire. The plan should be updated every five years, or more regularly, as needed to incorporate additions and/or changes.

RECOMMENDATION #40: Include a qualified professional with experience in operational wildland/interface fire suppression in the planning and strategic siting of future trails and parks.

RECOMMENDATION #41: Consider developing a map book or spatial file that displays the trail network available for fire department personnel to access during an emergency or for fire suppression planning (i.e., to accompany any fire access trail building activities).

6.1.4 Training

The fire departments within the CVRD South Zone maintain a current level of structural protection training as described in Section 6.1.1. Additionally, all members have yearly refreshers and/or certification in SPP-WFF1 (Wildland Firefighter Level 1) and/or SPP-115. According to the Office of Fire Commissioner, a new course on Engine Operations in the Wildland Urban Interface is currently being developed and was expected to be released in 2018, which is a 1-day course that combines the SPP-WWF-1, the S115 and S215 (personal communication with Tom Boechler, Structure Protection Specialist). It is recommended

that the fire departments in the South Zone consider providing members with this course upon release, to ensure currency with techniques, applications and procedures for wildland urban interface fire suppression. Provision of training opportunities for structural firefighters in the realm of wildland firefighting is critical to building capacity for suppression and emergency management at the local level. Until these course developments are complete, it is recommended that all fire department members at minimum have S100 and/or SPP-WFF1 (or equivalent), and that the fire departments engage in yearly practical wildland fire training with BCWS. It must be noted that SPP-WFF 1 is a new S100 equivalent course for structure firefighters only, and as such BCWS has phased out instruction of S100 training for fire departments.

The fire departments maintain communication with BCWS throughout the year, as required by the fire season demands; however, the level of engagement with the BCWS is inconsistent between fire departments and has generally not been very strong in recent years. It is recommended that the fire departments work cooperatively with the BCWS (South Island Fire Zone/Cobble Hill Fire Base) to conduct yearly mock exercises, where information and technical/practical knowledge are shared, such as: fireline construction, Mark 3 pump operations, sprinkler protection, skid pack operations, portable water tank deployment, and wildland hose operations. These practices could also provide training to wildland crews on hydrant hookup methods, as well as provide an avenue to discuss working together on inter-agency fires. Additional training options could include engaging adjacent Fire Departments within the AOI and outside the AOI (i.e., City of Duncan, City of Langford, District of North Cowichan) to conduct joint training so as to further strengthen regional emergency response and firefighting training.

Recommendation #42: Fire departments should work with BCWS to initiate and/or maintain an annual structural and interface training program. As part of the training, it is recommended to conduct annual reviews to ensure PPE and wildland equipment resources are complete, in working order, and the crews are well-versed in their set-up and use. Interface training should include completion of a mock wildfire simulation in coordination with BCWS and safety training specific to wildland fire and risks inherent with natural areas. It is recognized that BCWS crew resources are limited and their availability and is highly dependent upon the current fire season and other BCWS priorities.

Recommendation #43: Fire Departments should engage in regular cadence of communication with the BCWS South Island Fire Zone/Cobble Hill Fire Base to foster a strong relationship and identify potential cooperative wildfire risk reduction opportunities.

Recommendation #44: Ensure that the fire departments maintain the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain high level of member education and training specific to interface and wildland fires. The Office of the Fire Commissioner (OFC) offers SPP 115 (formerly S-115) to train structural firefighters on the use of wildfire pumps and hose, and fire service hose and hydrants in the application of structural protection units (SPUs). The OFC is currently developing additional wildfire-specific Officer-level training courses (i.e., Engine Operations in the Wildland Urban Interface); the fire departments should continue the practice of staying up to date on wildfire training opportunities, and to train members in this capacity, as training resources/budgets allow.

Recommendation #45: It is recommended that all South Zone fire department members at minimum have SPP-WFF 1 and that the fire departments engage in yearly practical wildland fire training with BCWS that covers at a minimum: pump, hose, hydrant, air tanker awareness, and employment of SPUs. The aforementioned cross-training opportunity could include, for example, a joint wildfire simulation exercise.

6.2 STRUCTURE PROTECTION

The South Zone fire departments are well resourced in both structural and wildland fire suppression equipment. The fire departments maintain a current level of training in both wildfire and structural firefighting (see Section 6.1.1 for additional detail). The CVRD South Zone Fire Departments are not equipped with a Structural Protection Unit (SPU) The UBCM owns four complete SPUs, each equipped to protect 30 – 35 structures. The kits are deployed by the MFLNRORD / BCWS incident command structure and are placed strategically across the province during the fire season based on fire weather conditions and fire potential. When the kits are not in use, they may be utilized by fire departments for training exercises. SPUs can be useful tools in the protection of rural/ interface homes in the event of a wildfire. An important consideration in protecting the WUI zone from fire is ensuring that homes can withstand an interface fire event. Structure protection is focused on ensuring that building materials and construction standards are appropriate to protect individual homes from interface fire. Materials and construction standards used in roofing, exterior siding, window and door glazing, eaves, vents, openings, balconies, decks, and porches are primary considerations in developing FireSmart neighbourhoods. Housing built using appropriate construction techniques and materials in combination with fire resistant landscaping are less likely to be impacted by interface fires.

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

It is recommended that homeowners take a building envelope – out approach, that is, starting with the home and working their way out. Addressing little projects first can allow for quick, easy, and cost-

effective risk reduction efforts to be completed sooner, while larger, more costly projects can be completed as resources and planning allow. For example, prior to the fire season, clearing roofs and gutters of combustible materials (leaves and needles), clean out any combustible accumulations or stored materials from under decks, moving large potential heat sources such as firewood, spare building materials or vehicles as far from the structure as possible, maintaining a mowed and watered lawn, removing dead vegetation, and pruning trees are actionable steps that residents can start working on immediately. The following link accesses an excellent four-minute video demonstrating the importance of FireSmart building practices during a simulated ember shower: http://www.youtube.com/watch?v=_Vh4cQdH26g.

The structure protection objectives for the CVRD are to:

- Encourage private homeowners to voluntarily adopt FireSmart principles on their properties and to reduce existing barriers to action;
- Enhance protection of critical infrastructure from wildfire (and post-wildfire impacts); and,
- Enhance protection of residential / commercial structures from wildfire.

RECOMMENTATION #46: Consider working with local distributors and homeowners within CVRD South Zone and its communities. The objective is to improve education of homeowners and remove some barriers to FireSmart action. Local distributors can include: hardware stores, garden centers, and aggregate providers. Initiatives may include: 1) Developing and delivery of FireSmart workshop(s) for local distributors on FireSmart issues and solutions/advice for homeowners. These distributors can be educated upon which supplies are FireSmart and in what configuration they can be used (for example, external sprinkler system equipment, aggregates and ground cover, wire mesh for vents, deck skirting); 2) Advocating for a FireSmart branding in the retail stores (could be stickers on shelf pricing or a FireSmart-specific section) to increase public exposure to projects that can be done at a relatively low cost; and/or 3) Compile a database of local service providers and retailers which can help to install or complete FireSmart home improvements. These providers may be able to further partner to flesh out a list of FireSmart options for various home improvements, based upon a range of variables (for example, price, time to deliver, installation costs, and aesthetics).

RECOMMENTATION #47: Consider programs which serve to remove barriers to action for homeowners by providing methods for them to cheaply and easily dispose of wood waste removed from their property. Programs may include scheduled community chipping opportunities, yard waste dumpsters available by month in neighbourhoods, or scheduled burning weekends. Programs should be available during times of greatest resident activity (likely spring and fall).

RECOMMENTATION #48: Complete a vulnerability assessment of all critical infrastructure, secondary power sources, and fuel availability. Review current capability of secondary power sources, identify vulnerabilities, and prioritize needs, in the case of prolonged or extensive power outages. Upgrade or realign resources, as prioritized.

RECOMMENTATION #49: Consider acquiring a Type 2 SPU trailer to improve wildfire response (provides protection for 25-30 residences).

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

Provided separately as PDF package.

APPENDIX B – WILDFIRE THREAT ASSESSMENT WORKSHEETS AND PHOTOS

Provided separately as PDF package.

APPENDIX C – MAPS

Provided separately as PDF package.

APPENDIX D – SUMMARY OF 2005 CWPP RECOMMENDATIONS

The following recommendations were provided as part of the 2005 CWPP for the Cowichan Valley Regional District developed by Strathcona Forestry Consulting.

Education and Community Involvement:

- Strive to involve the public in interface issues through an effective education and public awareness program.
- As recommended in Firestorm 2003, encourage communities in the CVRD to adopt the FireSmart (Partners in Protection 2003) standard for community protection, both for public and private property.
- Focus FireSmart efforts on high-risk neighbourhoods.
- Promote FireSmart and the Community Wildfire Protection Plan at community events: SummerFest, homeshows, fall fairs, Cowichan Forestry Week, National Forest Week, Fire Prevention Week, etc.
- Ensure any regulatory action taken by the CVRD Board to educate residents about interface actions is done in consultation with local fire departments and the Ministry of Forests and Range Protection Branch.
- Collaborate with First Nations Emergency Services (FNES) to improve fire protection and prevention on First Nation lands.
- Showcase Errington Fire Department's video of Firestorm 2003 at community meetings.

Vegetation Management:

Fuel Modification Areas

- Encourage property owners to establish and maintain Fuel Modification Zones around structures (in areas with an elevated interface fire risk).
- Ensure fuel treatment is conducted around strategic communications facilities.
- Encourage local fire departments to set a FireSmart example – establish fuel-free zones around firehalls.
- Establish community firebreaks along edges of new subdivisions bordering areas with significant long-term fuel loading (i.e., Cougar Ridge on the Sooke Road in south Shawnigan).

Fire-resistive Vegetation

- Encourage residents in high hazard areas to landscape with fire-resistive vegetation. See FireSmart Landscaping on Southeastern Vancouver Island (brochure included), Strathcona Forestry Consulting, 2004 http://www.district.langford.bc.ca/document/brochures/FireSmartLandscaping.pdf

Fuel Disposal

- Promote the CVRD's policy of free dumping of organic garden waste and debris piles twice a year – in April, and October, at 3 CVRD transfer stations.
- Extend the timeframe for free drop-off of organic garden waste and debris.
- Investigate the feasibility of a curbside collection for organic garden waste and debris.
- Encourage homeowners to compost deciduous litter and grass clippings.
- Follow Ladysmith's example and develop a community-wide composting program (program operating costs can be defrayed by the sale of high-quality, composted soils to the community).
- Experiment with mechanical chippers and other machinery to process slash.
- Use prescribed burning as a viable tool for reducing on-site fuel loading (under careful supervision, and under optimum weather conditions).

Infrastructure:

Planning Tools

- Designate development permit areas (DPAs) for wildfires in Official Community Plans (OCPs). For areas that are designated for future development in OCPs (that is, not already zoned for development), ensure that the secondary plans or bylaw amendment applications contain development permit areas for interface fire risk mitigation. Consider applying DPAs to existing developed/subdivided areas in or next to high or extreme hazard areas.
- In order to provide consistency with good planning principles, dissuade the CVRD Board from approving isolated development in areas the OCP does not suggest as candidate future development sites, especially if development is proposed in high or extreme interface zones outside fire protection boundaries.
- Issue FireSmart pamphlets to development applicants.
- Prior to the issuance of a development permit, require the applicant to submit a Wildland Urban Interface Assessment, conducted by a qualified RPF or RFT with relevant applicable experience.
- Utilise Sec. 219 covenants to address interface fire protection measures (i.e., Fuel-Free Zones around structures, on-going vegetation maintenance, building materials and design, and installation of sprinklers).
  Regulate by bylaw the provision of works and services to lands that are being subdivided in order to provide consistent standards for access and water service.
- Use local Building Bylaws to mandate preventative measures in new developments in high risk areas.
- Develop consistent regional burning bylaws using science-based methodology.
- Investigate the feasibility of a bylaw to license the disposal of land clearing debris in machine stacked piles (to be taken to a licensed disposal facility, or burned onsite using air curtain burners, or chipped onsite).

Parks

- Reduce fuel buildup in parks (possibly through UBCM fuel treatment pilot projects).

- Reduce fuels along high-use recreational trail corridors.
- Encourage park staff to take basic fire suppression training.
- Allocate a budget for fire management activities in parks.
- Provide regular patrols of all at-risk parks during fire season.
- Continue to conduct annual cleanup of downed woody debris, hazardous tree removal, and litter accumulations in parks.
- Collaborate with various agencies involved in the Trans Canada Trail to minimise the threat of fire along the trail.

Forest Watch

- Encourage residents in high-risk park- interface neighbourhoods to institute "Forest Watch" patrols during fire season.

Access

- Require new roads and driveways to meet minimum FireSmart guidelines, in accordance with the latest edition of the "Manual on Geometric Design Standards for Canadian Roads and Streets" (Roads and Transportation Association of Canada).

Firefighting

- Encourage fire departments to utilise and /or acquire equipment with bush capabilities.
- Discuss incentives to recruit and retain new volunteer fire fighters.

Water Supply for Firefighting

- Collaborate with UBCM (and the Ministry of Municipal Affairs) to develop consistent standards for fireflow and water storage for fire fighting purposes in rural areas, especially in areas lacking community piped water.
- Encourage existing property owners in high to extreme interface areas to install on-site water supply for firefighting purposes.
- Investigate the feasibility of implementing FUS Superior Tanker Shuttle rating in rural areas lacking community piped water.

Strategic Planning

- Follow North Cowichan's lead – identify and liaise with logging companies operating within and adjacent to CVRD; develop an emergency fire plan (in collaboration with the MoFR Wildland Fire Services).
- Develop an approved Fire Management Plan (based on North Cowichan's Forest Fire Protection Plan for its Forest Reserve) for Regional and Community Parks.
- Collaborate with BC Parks to develop a strategic fire management plan for provincial parks in the CVRD.

APPENDIX E – WILDLAND URBAN INTERFACE DEFINED

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

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

Two situations are differentiated. Locations where there is a clean/abrupt transition from urban development to forest lands are usually specified as the "interface" whereas locations where structures are embedded or mingled within a matrix of dense wildland vegetation are known as the "intermix". An example of interface and intermixed areas is illustrated in Figure 7.

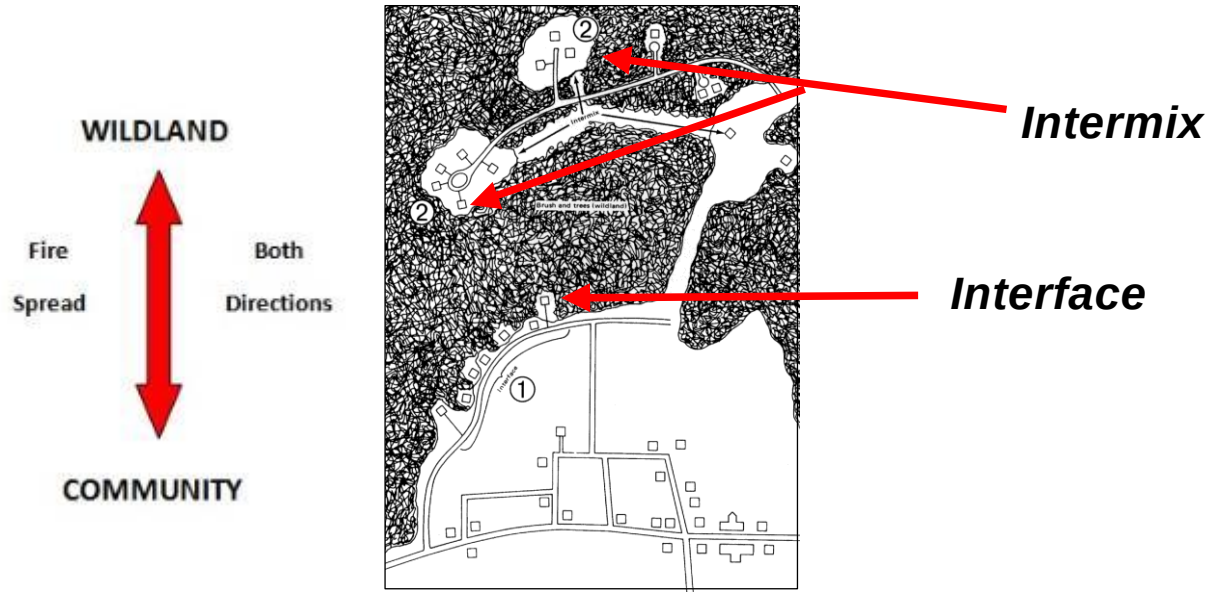

Figure 7. Illustration of intermix and interface situations.

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

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

1. From sparks or burning embers carried by the wind, or convection that starts new fires beyond the zone of direct ignition (main advancing fire front), that alight on vulnerable construction materials or adjacent flammable landscaping (roofing, siding, decks, cedar hedges, bark mulch, etc.) (Figure 8).

2. From direct flame contact, convective heating, conductive heating or radiant heating along the edge of a burning fire front (burning forest), or through structure-to-structure contact. Fire can ignite a vulnerable structure when the structure is in close proximity (within 10 meters of the flame) to either the forest edge or a burning house (Figure 9).

Figure 8. Firebrand caused ignitions: burning embers are carried ahead of the fire front and alight on vulnerable building surfaces.

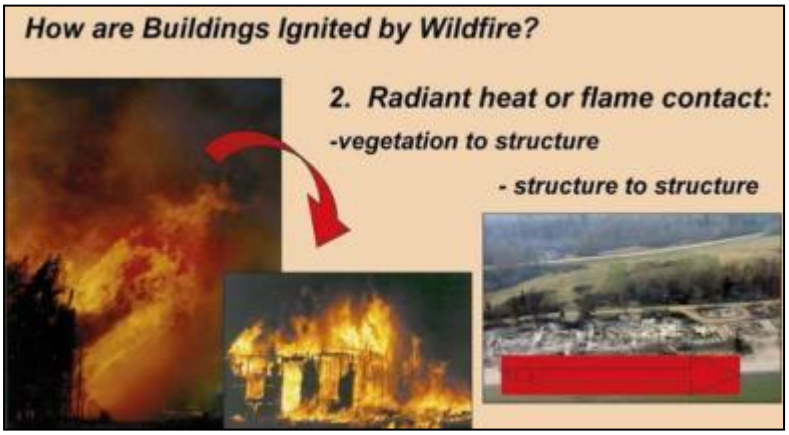

Figure 9. Radiant heat and flame contact allows fire to spread from vegetation to structure or from structure to structure.

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

APPENDIX F – WUI THREAT PLOT LOCATIONS

Table 19 displays a summary of all WUI threat plots completed during CWPP field work. The original WUI threat plot forms and photos will be submitted as a separate document. The following ratings are applied to applicable point ranges:

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

Table 19. Summary of WUI Threat Assessment Worksheets.

WUI Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class*
BANG1	Bright Angel Park	Moderate	N/A
COBB1	Cobble Hill Mountain Regional Recreation Area	Moderate	Low
COBB2	Cobble Hill Mountain Regional Recreation Area	Moderate	N/A
COBB3	Cobble Hill Mountain Regional Recreation Area	Moderate	N/A
COBB4	Cobble Hill Mountain Regional Recreation Area	Moderate	N/A
COBB5	Cobble Hill Mountain Regional Recreation Area	Moderate	N/A
COUG1	Near Cougar Ridge Road	High	High
COUG2	Near Cougar Ridge Road	High	Moderate
COUG3	Near Cougar Ridge Road	High	Extreme
ELEM1	Ecole Cobble Hill	Moderate	N/A
GREEN1	Shawnigan Hills Athletic Park	Moderate	High
GREEN2	Shawnigan Hills Athletic Park	High	Extreme
HOLL1S	Hollings Creek Park	High	High
MILL1	Mill Bay Nature Park	Moderate	Moderate
MON1	Near Solo Deo Monastery	Moderate	N/A

WUI Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class*
MON2	Near Solo Deo Monastery	High	High
MON3	Near Solo Deo Monastery	High	High
OLD1	Old Mill Park	Moderate	High
PRIV1	Near private residences south of Pannell Road and Howe Road	Moderate	N/A
PRIV2	Near private residences south of Pannell Road and Howe Road	Moderate	N/A
SHAW1	Near Shawnigan Lake Community Centre	High	Extreme
SHAW2	At the end of Wooden Road near Briarlea Road	Moderate	N/A
SOOK1	Near right-of-way south of Sooke Lake Road	Moderate	N/A
SOOK2	South of Sooke Lake Road	Moderate	N/A
SOOK3	South of Sooke Lake Road	High	Moderate
SOOK4	South of Sooke Lake Road	Moderate	N/A
SPEC1	Spectacle Lake Provincial Park	High	Moderate
SPEC2	Spectacle Lake Provincial Park	Moderate	N/A
STUB1	Immediately west of Stebbings Road	High	Moderate
WEST1S	West Shawnigan Lake Provincial Park	Moderate	N/A

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

APPENDIX G – FUEL TYPING METHODOLOGY AND LIMITATIONS

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

It should be noted that fuel typing is intended to represent a fire behaviour pattern; a locally observed fuel type may have no exact analog within the FBP system. The FBP system was almost entirely developed for boreal and sub-boreal forest types, which do not occur within the study area. As a result, the AOI fuel typing is a best approximation of the Canadian Forest Fire Danger Rating System (CFFDRS) classification, based on the fire behaviour potential of the fuel type during periods of high and extreme fire danger within the South Coast region. Additionally, provincial fuel typing depends heavily on Vegetation Resource Inventory (VRI) data, which is gathered and maintained in order to inform timber management objectives, not fire behaviour prediction. For this reason, VRI data often does not include important attributes which impact fuel type and hazard, but which are not integral to timber management objectives. Examples include: surface fuels and understory vegetation.

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

For information on the provincial fuel typing process used for PSTA data as well as aiding in fuel type updates made in this document, please refer to Perrakis and Eade, 2015.[88]

[88] Ibid.

APPENDIX H – WUI THREAT ASSESSMENT METHODOLOGY

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

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

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

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

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

Field Data Collection

The primary goals of field data collection are to confirm or correct the provincial fuel type, complete WUI Threat Assessment Plots, and assess other features of interest to the development of the CWPP update. This is accomplished by traversing as much of the study area as possible (within time, budget and access constraints). Threat Assessment plots are completed on the 2012 version form, and as per the Wildland Urban Interface Threat Assessment Guide.

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

1. Update fuel-typing using orthophotography provided by the client and field verification.
2. Update structural data using critical infrastructure information provided by the client, field visits to confirm structure additions or deletions, and orthophotography
3. Complete field work to ground-truth fuel typing and threat ratings (completed 30 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 300+ field stops with qualitative notes, fuel type verification, and/or photographs)
4. Threat assessment analysis using field data collected and rating results of WUI threat plots – see next section.

Spatial Analysis

Not all attributes on the WUI Threat Assessment form can be determined using a GIS analysis on a landscape/polygon level. To emulate as closely as possible the threat categorization that would be determined using the Threat Assessment form, the variables in Table 20 were used as the basis for building the analytical model. The features chosen are those that are spatially explicit, available from existing and reliable spatial data or field data, and able to be confidently extrapolated to large polygons.

Table 20. Description of variables used in spatial analysis for WUI wildfire threat assessment.

WUI Threat Sheet Attribute	Used in Analysis?	Comment
FUEL SUBCOMPONENT		
Duff depth and Moisture Regime	No	Many of these attributes assumed by using 'fuel type' as a component of the Fire Threat analysis. Most of these components are not easily extrapolated to a landscape or polygon scale, or the data available to estimate over large areas (VRI) is unreliable.
Surface Fuel continuity	No	
Vegetation Fuel Composition	No	
Fine Woody Debris Continuity	No	
Large Woody Debris Continuity	No	
Live and Dead Coniferous Crown Closure	No	
Live and Dead Conifer Crown Base height	No	
Live and Dead suppressed and Understory Conifers	No	
Forest health	No	
Continuous forest/slash cover within 2 km	No	
WEATHER SUBCOMPONENT		
BEC zone	Yes	
Historical weather fire occurrence	Yes	
TOPOGRAPHY SUBCOMPONENT		
Aspect	Yes	

WUI Threat Sheet Attribute	Used in Analysis?	Comment
Slope	Yes	Elevation model was used to determine slope.
Terrain	No	
Landscape/ topographic limitations to wildfire spread	No	
STRUCTURAL SUBCOMPONENT		
Position of structure/ community on slope	No	
Type of development	No	
Position of assessment area relative to values	Yes	Distance to structure is used in analysis; position on slope relative to values at risk is too difficult to analyze spatially.

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

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

There are obvious limitations in this method, most notably that not all components of the threat assessment worksheet are scalable to a GIS model, generalizing the Fire Behaviour Threat score. The WUI Threat Score is greatly simplified, as determining the position of structures on a slope, the type of development and the relative position are difficult in an automated GIS process. This method uses the best available information to produce the initial threat assessment across the study area in a format which is required by the UBCM SWPI program.

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

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

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

Limitations

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

The threat assessment is based largely on fuel typing, therefore the limitations with fuel typing accuracy (as detailed in Section 4.3.1) impacts the threat assessment, as well.

APPENDIX I – PRINCIPLES OF FUEL MANAGEMENT

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

What is Fuel Management?

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

Fire Triangle:

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

Forest Fuels:

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

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

Surface Fuels:

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

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

Aerial Fuels:

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

Two measures that describe crown fire potential of aerial fuels are the height to live crown and crown closure (Figure 10 and Figure 11). The height to live crown describes fuel continuity between the ground surface and the lower limit of the upper tree canopy. Crown closure describes the inter-tree crown continuity and reflects how easily fire can be propagated from tree to tree. In addition to crown closure, tree density is an important measure of the distribution of aerial fuels and has significant influence on the overall crown and surface fire conditions (Figure 12). Higher stand density is associated with lower inter tree spacing, which increases overall crown continuity. While high density stands may increase the potential for fire spread in the upper canopy, a combination of high crown closure and high stand density usually results in a reduction in light levels associated with these stand types. Reduced light levels accelerate self-tree pruning, inhibit the growth of lower branches, and decrease the cover and biomass of understory vegetation.

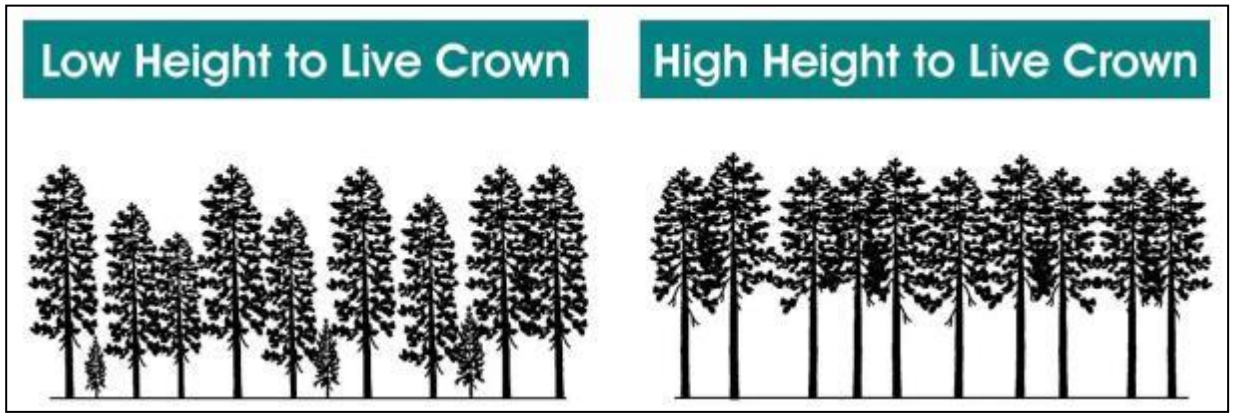

Figure 10. Comparison of stand level differences in height-to-live crown in an interior forest, where low height to live crown is more hazardous than high height to live crown.

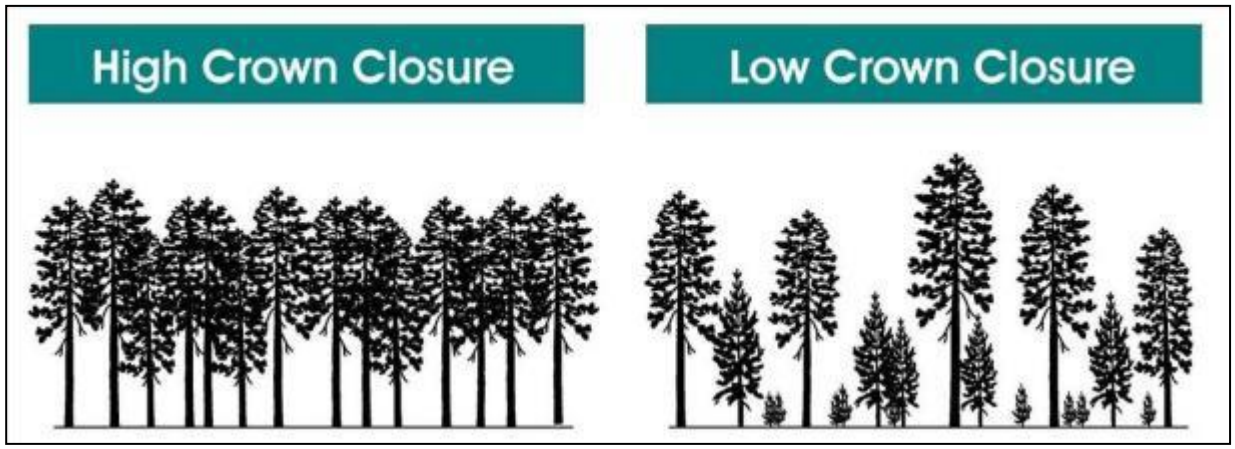

Figure 11. Comparison of stand level differences in crown closure, where high crown closure/continuity contributes to crown fire spread, while low crown closure reduces crown fire potential.

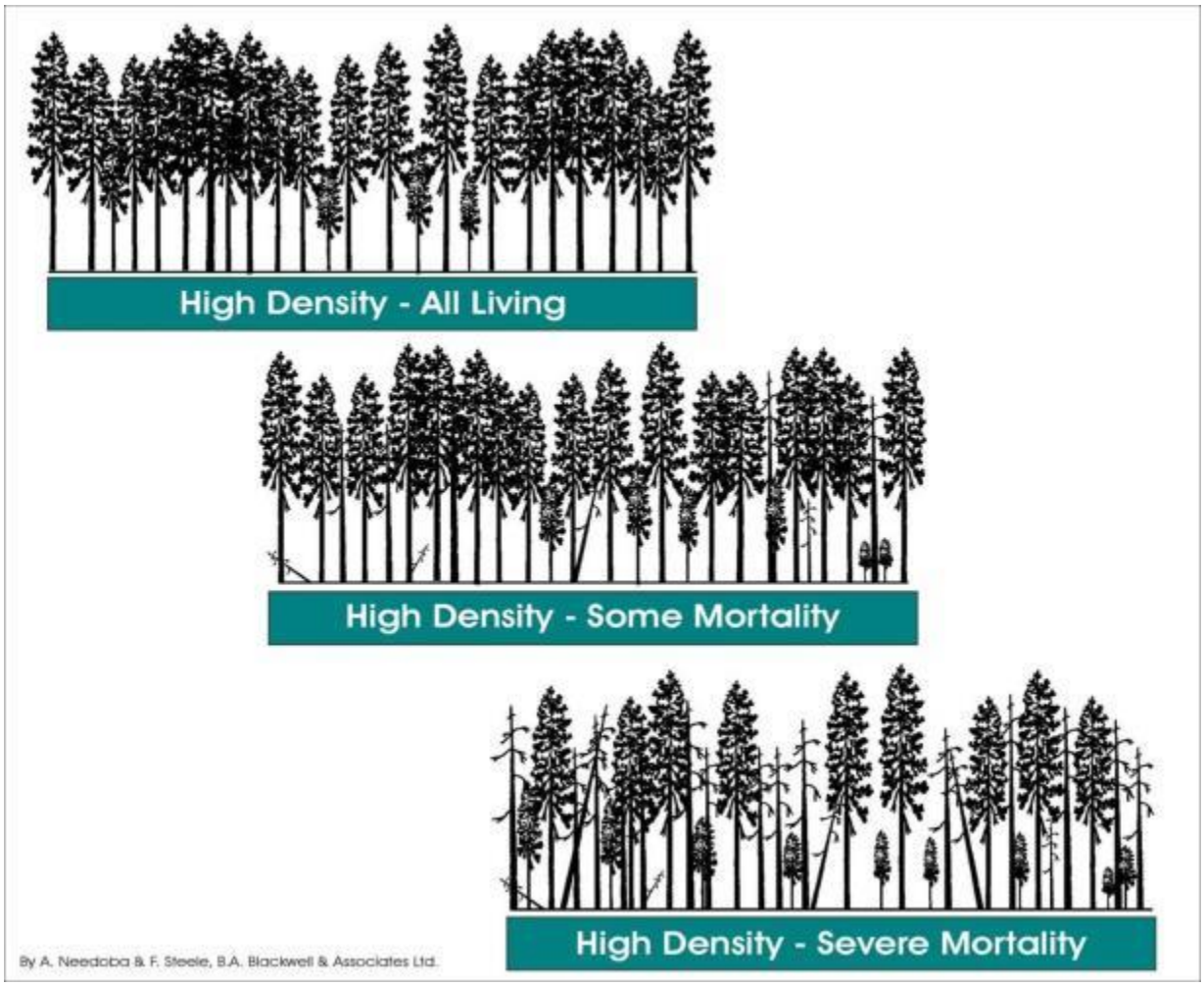

Figure 12. Comparison of stand level differences in density and mortality, and the distribution of live and dead fuels in these types of stands.

Thinning is a preferred approach to fuel treatment (Figure 13.) and offers several advantages compared to other methods:

- Thinning provides the most control over stand level attributes such as species composition, vertical structure, tree density, and spatial pattern, as well as the retention of snags and coarse woody debris for maintenance of wildlife habitat and biodiversity.
- Unlike prescribed fire treatments, thinning is comparatively low risk, and is less constrained by fire weather windows.
- Thinning may provide marketable materials that can be utilized by the local economy.
- Thinning can be carried out using sensitive methods that limit soil disturbance, minimize damage to leave trees, and provide benefits to other values such as wildlife.

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

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

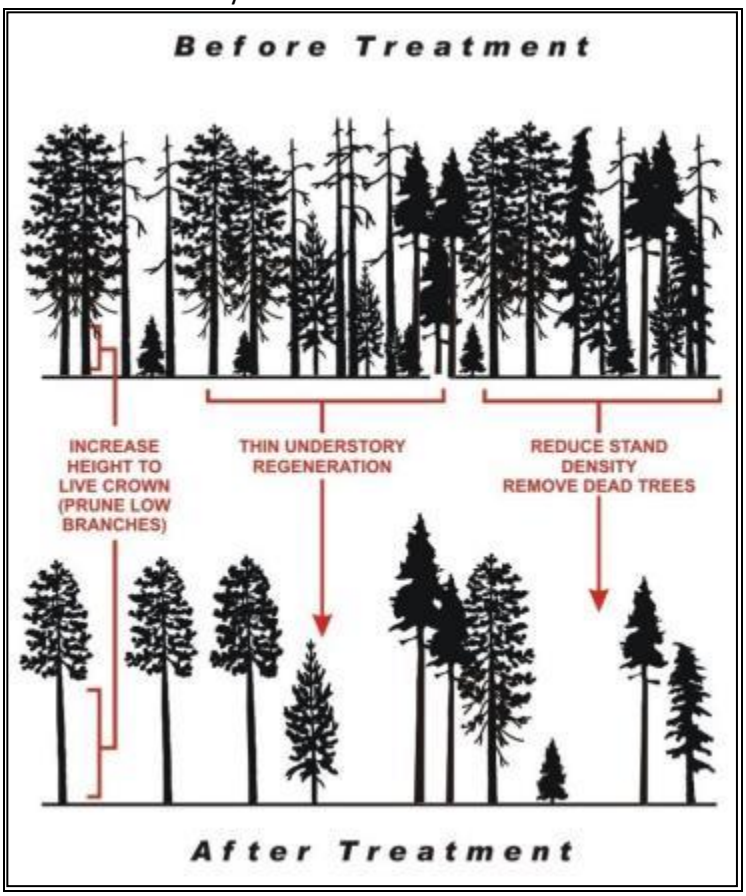

Figure 13. Illustration of the principles of thinning to reduce the stand level wildfire hazard.

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

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

APPENDIX J – FIRESMART FUEL TREATMENTS

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

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

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

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

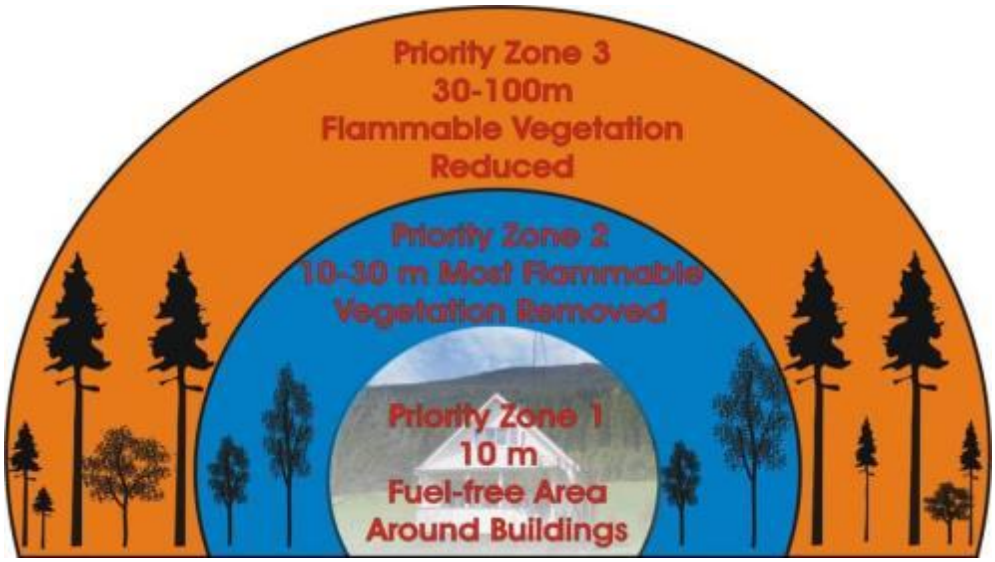

Figure 14. Illustration of FireSmart zones. (Figure adapted from FireSmart)

APPENDIX K – FIRESMART CONSTRUCTION AND LANDSCAPING

Two recent studies by Westhaver (2015, 2017) found that certain "fatal flaws", such as high-flammability landscaping like bulky ornamental junipers and large, easily ignited fuel sources (e.g. motorized vehicles, firewood, construction materials, *etc*.) were sufficiently influential to result in structure ignition of homes otherwise assessed as "Low" hazard by overwhelming the advantages provided by highly fire resistant structures[89].

In the 2017 Fort McMurray investigations (Westhaver) it was found that the most notable observed attributes of the surviving interface homes were: vegetation and fuels within the HIZ which were compliant with FireSmart practices, HIZs with relatively few combustible objects and ignition sites (examples of ignition sites include: combustible accumulations on roofs, gutters, *etc*.) , and Low to Moderate structural hazard ratings.[90,91] This investigation, and other similar investigations, indicate that the FireSmart principles can be effective at reducing structure loss, particularly in the urban perimeter where fire initially spreads from the forest to structures. .

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

FireSmart Construction

Roofing Material:

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

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

Soffits and Eaves

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

Building Exterior - Siding Material:

Building exteriors constructed of vinyl or wood are considered the second highest contributor to structural hazard after roofing material. These materials are vulnerable to direct flame or may ignite when sufficiently heated by nearby burning fuels. The smoke column will transport burning embers, which may

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

[90] Ibid.

[91] Using the FireSmart hazard assessment system.

lodge against siding materials. Brick, stucco, or heavy timber materials offer much better resistance to fire. While wood may not be the best choice for use in the WUI, other values from economic and environmental perspectives must also be considered. It is significantly less expensive than many other materials, supplies a great deal of employment in BC, and is a renewable resource. New treatments and paints are now available for wood that increase its resistance to fire and they should be considered for use.

Balconies and Decking:

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

Combustible Materials:

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

FireSmart Landscaping

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

Decorative bark mulch, often used in home landscapes is easily ignitable from wildfire embers or errant cigarettes and can convey fire to the home. Alternatives to bark mulch include gravel, decorative rock, or a combination of wood bark and decorative rock.[92]

Landscaping Alternatives

The landscaping challenges faced by many homeowners pertain to limited space, privacy and the desire to create visually explicit edge treatments to demarcate property ownership from adjacent lots with evergreen vegetation screens. Ornamental plant characteristics fulfilling these criteria have an upright branching habit, compact form, dense foliage, as well as a moderate growth rate. Dwarf and ornamental conifers such as Arborvitae hedging are popular choices, yet conifers such as these which have needle or scale-like foliage are highly flammable and not compliant with FireSmart principles and should be omitted from the 10 m Fire Priority Zone of the planned home footprint.

There are a number of broadleaved deciduous and evergreen plants with low flammability which can be used for landscaping within FireSmart PZ 1 (within 10 m of structures). Landscaping should be selected

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

for the appropriate Canadian Plant Hardiness Zone (see www.planthardiness.gc.ca for the Hardiness Zone specific to the various study area). The majority of the areas would be within Zone 3b.

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

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

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

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

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

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

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

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

APPENDIX L – COMMUNICATION AND EDUCATION

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

Websites and social media are some of the most cost-effective methods of communication available. Pew Research Center recently found that approximately 60% of Americans get their news from social media; 44% get their news from Facebook.[93] Twitter, LinkedIn, and Instagram are other social media platforms which can be used to provide real-time information to a large audience and are used, albeit to a lesser extent, by users as their primary news source.[94]

The challenge of all social media is to ensure that your message reaches the intended audience, accomplished by having users 'like' the page, engage with the posts, or re-share information to an even larger audience. There are communication experts who specialize in social media who can evaluate an organization's goals and offer tips to increase engagement and create compelling content to communicate the message. Likewise, it is important to be aware of the demographic of the community; a younger, more digitally connected community is more likely to use social media to get updates on 'newsworthy items'.[95]

[93] Pew Research Center Journalism and Media. Social media news use: Facebook leads the pack. May 25, 2016. Accessed December 17, 2017 from http://www.journalism.org/2016/05/26/news-use-across-social-media-platforms-2016/pj_2016-05-26_social-media-and-news_0-03/.

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

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