Cowichan Valley Regional District
Central Zone
Community Wildfire Protection Plan
2017 Update

Submitted by:

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ACKNOWLEDGEMENTS

The authors would like to thank the following Cowichan Valley Regional District (CVRD) staff: Jason deJong (CFO, Fire Rescue Services Coordinator); Rob Grant (GIS/Mapping Supervisor); Richenda Woods (GIS/Mapping Technician); Keir Gervais (Manager, Public Safety); Tanya Soroka (Parks & Trails Planner); Ryan Dias (Parks Operations Superintendent); Austin Tokarek (Asset Coordinator); Rob Conway (Manager Building Inspections and Bylaw Enforcement) and Keith Batstone (Development Services Manager). The authors would also like to express their appreciation to Central Zone fire department personnel including: Fire Chief Randy Busch (Sahtlam Volunteer Fire Rescue). The input provided by Pat Hayes (fire management specialist) is also acknowledged and appreciated. These individuals invested substantial time in meetings, and/or answering questions, reviewing and commenting on the contents of this document.

In addition, the authors would like to thank staff from the BC Wildfire Service, including: Jessica Duncan (Wildfire Prevention Officer, Coastal Fire Centre); Tony Botica (Wildfire Prevention Officer, Coastal Fire Centre); Gene Drew (Forest Protection Technician, South Island Fire Zone); Dimitri Vaisius (Wildfire Officer, South Island Fire Zone); staff from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development including: Mark Palmer (Stewardship Forester) and Jessica McKierahan (Sunshine - South Island Recreation Officer); and staff from BC Parks including: Andy Macdonald (Haida Gwaii/South Island Section Head), Erica McClaren (Conservation Specialist, Black Creek).

Appreciation is extended to the Cowichan Tribes for their review of this document.

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

REGISTERED PROFESSIONAL SIGN AND SEAL

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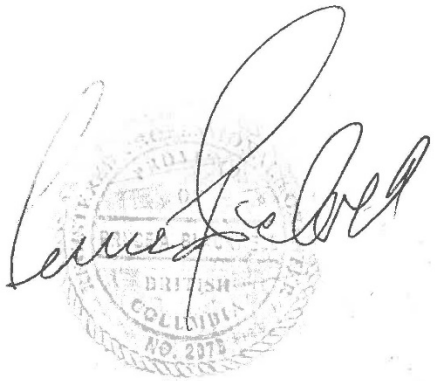
Bruce A. Blackwell	RPF 2073
DATE SIGNED (ORIGINAL DOCUMENT)	
November 20, 2018	
DATE SIGNED (AMENDED DOCUMENT)	
June 25, 2019	
I certify that the work described herein fulfills the standards expected of a member of the Association of British Columbia Forest Professionals and that I did personally supervise 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.

The CWPP Update will provide the Cowichan Valley Regional District (the CVRD) with a framework that can be used to review and assess areas of identified high fire risk within the CVRD Central 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 60 strategic recommendations are summarized in Table 1 below. These recommendations are more thoroughly discussed in their corresponding sections within the document. Because the area of interest (i.e., study area) extends outside the CVRD boundary onto private land—and therefore outside CVRD jurisdiction—the CVRD's role may be limited in some instances to that of an influencer, while in others, recommendations can be directly implemented by the CVRD. Ultimately, the recommendations within this strategy should be viewed as a toolbox of options to help reduce the wildfire threat to the community. There is not one combination or singular course of action which is the answer; the CVRD will have to further prioritize based on resources, strengths, and constraints, while regularly updating and reviewing the prioritization and courses of action as variables change over 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	11	Moderate	Review the Cowichan Bay Official Community Plan (OCP) and individual bylaws, specific to burning and tree retention, with consideration for limitations and constraints to wildfire mitigation activities on private property. In circumstances where fuel reduction and debris management are limited by the OCP and bylaws, consider additional clauses which allow for tree removal and/or burning in defined circumstances (i.e., for the purpose of wildfire mitigation) and when meeting specific criteria. Any open burning should be done in adherence to the provincial Open Burning Smoke Control Regulation (OBSCR).	~20-25 in-house hours (Local Government Funding)
2	12	High	Review the Cowichan Bay OCP, Section 6.5 and explicitly define the natural hazards most likely to impact community safety, including wildfire and interface fire.	Negligible cost ~5 in-house hours (Local Government Funding)
3	12	Moderate	Review the Cowichan Bay OCP Section 6.6 (Parks & Trails) and associated Cowichan Bay Community Parks & Trails Master Plan (2013) and any supporting bylaws and consider parks acquisition and maintenance through a wildfire lens, to ensure wildfire risk, mitigation, liability and future maintenance are considered as priorities in development of the parks and trails inventory, including consideration for long-term maintenance costs and access.	~15-20 in-house hours (Local Government Funding
4	13	High	Implement a bylaw that requires private water purveyors to maintain and flow-test water hydrants at the same frequency and to the same standard as municipally owned and maintained hydrants.	~5-15 hours (Consultant). Cost dependent on type of assessment
5	13	Moderate	Reviewing and update the Cowichan Bay OCP, Section 9.6 - Fire Protection to include reference to updated fire threat mapping and expanding the policies to include FireSmart recommendations 35 and 36 contained in this 2017 CWPP Update.	Negligible cost ~ 5-10 in-house hours (Local Government Funding)
6	14	High	Review the Cowichan Bay OCP, Part 2 - Sensitive Lands Development Permit Area (DPA) and update the areas of high and moderate risk of wildfire with threat mapping from the 2017 CWPP Update.	15-20 in-house hours (Local Government Funding)

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	15	Moderate	Assess the Forest Industrial Development Permit Area and update its extent to include areas of high and extreme wildfire threat, as identified in Section 4.3.5 of this 2017 CWPP Update.	~10 in-house hours (Local Government funding)
8	16	Moderate	Review the Duncan OCP growth management policies (Section 5.1) through a wildfire lens, including considerations for preventing further development in the wildland urban interface due to the potential for increased wildfire threat.	~10-15 in house hours (Local Government funding)
9	16	Moderate	Review the Duncan OCP climate protection policies (Section 7.2) in relation to tree preservation and enhancement of canopy cover through a wildfire lens. Tree preservation and planting should consider wildfire-related risk and encourage planting of deciduous or fire-resistant species as well as implementing a density/spacing requirement that follows FireSmart standards within the wildland urban interface.	~10 in house hours (Local Government funding)
10	16	High	Review and expand the Duncan OCP Section 9.3 - Fire Protection policies to include FireSmart standards and practices and FireSmart recommendations 35 and 36 contained in the 2017 CWPP Update.	~10-15 in house hours (Local Government funding)
11	17	High	Develop an All Hazards Plan for the City of Duncan to explicitly identify the potential natural and anthropogenic disasters that the area may be susceptible to, including wildfires. This document should be supplementary to and compliment the broader-scale CVRD Local Authority Emergency Plan.	~10,000-$15,000 (consultant) to build plan (Local Government funding/UBCM CRI Funding[1])
12	17	Moderate	Review the Duncan OCP Section 9.6 and acknowledge the importance of emergency access through parks in the event of wildfire as well as the potential increased risk of wildfire associated with public use in parks and recreation areas (lighting of fires, discarded cigarettes, etc.).	Negligible cost ~5-10 in house hours (Local Government funding)
13	17	High	Review the Duncan OCP Section 10.2 – Water Supply and Distribution and consider including an objective regarding adequate water supply and distribution for the purposes of wildfire protection/firefighting.	Negligible cost ~5-10 in house hours (Local Government funding)

[1] 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 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**
14	17	High	Review the Duncan OCP Section 10.2 – Water Supply and Distribution and consider adopting a policy which recommends the creation of a map book or database of natural surface water sources available for use during fire suppression.	~24 in house hours for GIS staff (Local Government Funding)
15	18	Moderate	Review the Duncan OCP Sections 12.2, 12.3, 12.4 and 12.5 and consider including policies which encourage the use of deciduous and fire-resistant plant, shrub, and tree species in the respective landscaping sections.	Negligible cost 5-10 in house hours (Local Government funding)
16	18	Moderate	Review the Duncan OCP Sections 12.2 and 12.5 and consider including a requirement to consult a qualified professional when retaining significant stands of trees to ensure that they do not contribute to an increased risk of wildfire adjacent to structures and values.	Negligible cost <5 in house hours (Local Government funding)
17	18	Moderate	Review the Cowichan-Koskilah OCP Technical Background Report Section 2.4 – Hazards and consider updating to include reference to updated fire threat mapping.	Negligible cost 5-10 in house hours (Local Government funding)
18	19	High	Review and amend the Cowichan-Koksilah OCP to include a growth management policy which considers wildfire risk and other natural hazards during strategy development.	10-15 in house hours (Local Government funding)
19	20	Moderate	Work 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.	~6 CVRD staff hours required for internal work with the DSD. Additional 16 hours for material development and distribution for incentive/engagement campaign)
20	20	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), see Appendix K – FireSmart Construction and Landscaping for more information on combustible materials. 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)

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**
21	20	Moderate	Review and complete updates to the Cowichan Bay Community Parks & Trails Master Plan through a wildfire lens, including consideration for the placement, type, width, and objective of trails.	~5-10 in house hours (Local Government funding)
Document Section 3: Values at Risk Recommendations				
Objective: Protect critical infrastructure				
22	25	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
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Objective: Undertake Fuel Treatments to Improve Emergency Access				
23	69	Moderate	Work with the Ministry of Transportation and Infrastructure (MOTI), to assess the entirety of Hwy 1 and Hwy 18 and reduce hazardous fuels within 150 m of either side of the road, where possible. This is to increase public safety/improve emergency access in the event of an evacuation or wildfire event.	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				
24	71	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 Funding/Local Government Funding
25	71	Low	Develop 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

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				
26	82	High	Apply for funding for maintenance activities prioritized and scheduled in this CWPP Update.	UBCM CRI Funding/Local Government Funding
27	82	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				
28	88	Moderate	Apply for a FireSmart demonstration grant through the CRI program. This type of fuel treatment can display the practices and principles of FireSmart activities to the public in the form of demonstration treatments. These small projects are not necessarily completed to reduce fire behaviour or increase stand resiliency in any measurable way, but instead are prioritized more by their visibility to the public and combining the treatment with elements of public education (signage, community work days, public tours, active demonstrations of operations, etc.).	5-10 CVRD staff hours
29	89	Moderate	Develop and implement a community chipper program with the help of neighbourhood representatives. As a demonstration, this program can begin twice per year in two separate neighbourhoods. This program can also be implemented in conjunction with community clean up days.	Emergency/CVRD Fire Department staff hours may vary based on uptake. ~$10,000 for two neighbourhoods/ year
30	91	Moderate	Review the Official Community Plan (OCP) and include wildfire as a natural hazard development permit area (DPA). A recommended development permit area for the CVRD would include all areas within the Central 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, such as Cowichan Bay, 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)

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Estimated Cost ($) or Person hours**
31	91	Moderate	Ensure that wildfire hazard development permit applications are provided to fire departments for opportunity for input prior to approval. As more wildfire 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
32	91	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 DPA.	$2,000 - $3,000 to outsource. Alternatively, general FireSmart landscaping information is available free of charge, but is not climate/plant hardiness zone specific
33	91	Moderate	Engage the development/building community (may include developers, builders, landscapers, and architects) in the DPA development process. This can be accomplished through a series of workshops/ informational sessions.	~40 hours
34	93	Moderate	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				
35	95	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
36	95	Moderate	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. 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

Document Section 5: Risk Management and Mitigation Factors Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Estimated Cost ($) or Person hours**
37	95	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. [2]	~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
38	96	High	Promote 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
39	96	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)
40	96	Moderate	Facilitate the FSCCRP uptake within the Central Zone AOI and enhance its applications by including the following: 1) inviting BC Wildfire Service (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

[2] 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**
41	96	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
42	96	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 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
43	96	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
44	96	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

Item	Page No.	Priority	Recommendation/Next Steps	Estimated Cost ($) or Person hours
Document Section 5: Risk Management and Mitigation Factors Recommendations				
Objective: Reduce Wildfire Risk from Industrial Sources				
45	97	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
46	97	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				
Objective: Improve Water Availability for Emergency Response				
47	101	High	All new rural development 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
48	101	High	Complete 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				
49	103	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
50	103	Moderate	Develop 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)

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Estimated Cost ($) or Person hours**
Objective: Include Wildfire Considerations when Trail Planning				
51	103	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)
52	103	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
53	103	Moderate	Develop 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				
54	104	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 joint wildfire simulation 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.)
55	104	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

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Estimated Cost ($) or Person hours**
56	104	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; it is recommended that all Central Zone fire department members at minimum have S-100 or SPP-WFF 1 (or equivalent) and consider expanding training. 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 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-WFF 1 and SPP-115 currently implemented)
Objective: Encourage FireSmart Initiatives				
57	106	Low	Work with local distributors and homeowners within CVRD Central 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) Development 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. 4) Develop general cost implications of improvements so property owners can prioritize replacements	~60 hours

Document Section 6: Wildfire Response Resources Recommendations				
Item	**Page No.**	**Priority**	**Recommendation/Next Steps**	**Estimated Cost ($) or Person hours**
58	106	High	Develop 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 (in 2018 the CRI program has made available funding for FireSmart activities on private land). 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 Program Funding Additional time for advertisement of program availability will be required.
Objective: Enhance Protection of Municipal Infrastructure from Wildfire				
59	106	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
60	106	Moderate	Acquire 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
CBVFR	Cowichan Bay Volunteer Fire Rescue
CDC	Conservation Data Centre
CFFDRS	Canadian Forest Fire Danger Rating System
CRI	Community Resiliency Investment Program
CVRD	Cowichan Valley Regional District
CWPP	Community Wildfire Protection Plan
DP	Development Permit
DPA	Development Permit Area
DVFD	Duncan Volunteer Fire Department
FBP	Fire Behaviour Prediction System
FDU	Forest Development Unit
FESBC	Forest Enhancement Society of British Columbia
FMP	Fire Management Plan
FRS	Fire Rescue Services
FSCCRP	FireSmart Canada Community Recognition Program
FSP	Forest Stewardship Plan
GAR	Government Actions Regulation
HIZ	Home Ignition Zone
LRMP	Land and Resource Management Plan
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations & Rural Development
MOTI	Ministry of Transportation and Infrastructure
NCFD	North Cowichan Fire Department
NFPA	National Fire Protection Agency
OBSCR	Open Burning Smoke Control Regulation
OCP	Official Community Plan
OFC	Office of the Fire Commissioner
PSTA	Provincial Strategic Threat Analysis
PTU	Proposed Treatment Unit
QP	Qualified Professional
SPU	Structural Protection Unit
SVFR	Sahtlam Volunteer Fire Rescue
SWPI	Strategic Wildfire Prevention Initiative
TSA	Timber Supply Area
UBCM	Union of British Columbian Municipalities
VFD	Volunteer Fire Department
WUI	Wildland Urban Interface

SECTION 1: INTRODUCTION

The staff of the Cowichan Valley Regional District (CVRD) have recognized wildfire mitigation and planning to be a foundational component of emergency planning and preparedness for the communities in the CVRD Central Zone. In 2017, B.A. Blackwell and Associates Ltd. was retained to assist the CVRD in developing an updated Community Wildfire Protection Plan (CWPP); hereinafter referred to as the CWPP, for the CVRD Central 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 with a focus on integrating the updated Provincial Strategic Threat Analysis (PSTA), 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 development and planning bylaws; completion of fuel treatments; and changes in fuels surrounding the community.

Although forest fires are both inevitable and essential to the health of forested ecosystems, the 2003, 2004, 2009, 2010, 2015, 2017 and 2018 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 demonstrate the vulnerability of communities and potential toll of wildfires on families, neighbourhoods and regional economies. 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[3] (WUI).

1.1 PURPOSE

The purpose of this CWPP Update is to identify and update the wildfire risks within and surrounding the CVRD Central Zone, to describe the potential consequences if a wildfire was to impact the community, and to examine options and strategies to reduce wildfire risks. Each community has a unique risk profile. This CWPP Update provides a reassessment of the level of risk with respect to changes in the area that have occurred recently and gives the CVRD a current and accurate understanding of the threats to human life, property and critical infrastructure from wildfires. The goal of this CWPP Update, 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 Update is intended to serve as a framework to inform the implementation of specific actions and

[3] 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).

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 Central Zone. The CWPP process consists of four general phases:

1) **Consultation involving key local government representatives, structural and wildfire specialists, First Nations, and stakeholders**. Consultation and information sharing at various stages of the CWPP 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), 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 Update 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. This CWPP Update provides recommendations for ongoing community education and engagement to support successful implementation of the CWPP.

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 Update.

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, GIS/Mapping Supervisor, GIS/Mapping technician, Asset Management Coordinator, Manager of Building Inspections and Bylaw Enforcement, and Parks and Trails Planner and Parks Operations Superintendent. Non-CVRD staff included in the Working Group were: Fire Chief for Sahtlam Volunteer Fire Rescue and a local fire management specialist. During the initial meeting of the Wildfire Working Group, the objectives were to obtain information on wildfire risk mitigation initiatives currently in place or completed, existing plans and policies, current resources; to identify areas of concern and CVRD vulnerabilities; and finally, to determine priorities and potential mitigation

strategies. Members of the Wildfire Working Group were consulted on an ongoing basis throughout development of the CWPP and were integral in providing CWPP review and approval.

BCWS representatives from the Coastal Fire Centre and South Island Fire Zone – Cobble Hill (Fuel Management Specialist, Wildfire Officer and Forest Protection Specialist) were consulted as follows: 1) at the onset of the project planning phase; 2) throughout the CWPP 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) to provide review and revision of the draft document upon plan completion.

Information sharing took place with the Cowichan Tribes as identified through the Consultative Areas Database and in consultation with MFLNRORD and the CVRD, regarding the CWPP and locations of existing or potential 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 (i.e., maps, explanation of the CWPP, and CWPP draft document). The Cowichan Tribes were provided the Plan for review and feedback

Additional stakeholders were contacted 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 Resource Manager; and Khowutzun Forest Services Ltd.

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 Central 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 can be demonstrated in the following example. If a fire (the hazard) ignites and spreads towards a community, the wildfire can become a threat to life and property, with an associated risk of loss, where:

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

and:

- 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 (e.g., fuel type, climate, probability of ignition); 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 plan implementation. A community engagement and education strategy is described in Section 5.3.

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

SECTION 2: LOCAL AREA DESCRIPTION

This section describes the communities within the CVRD Central 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

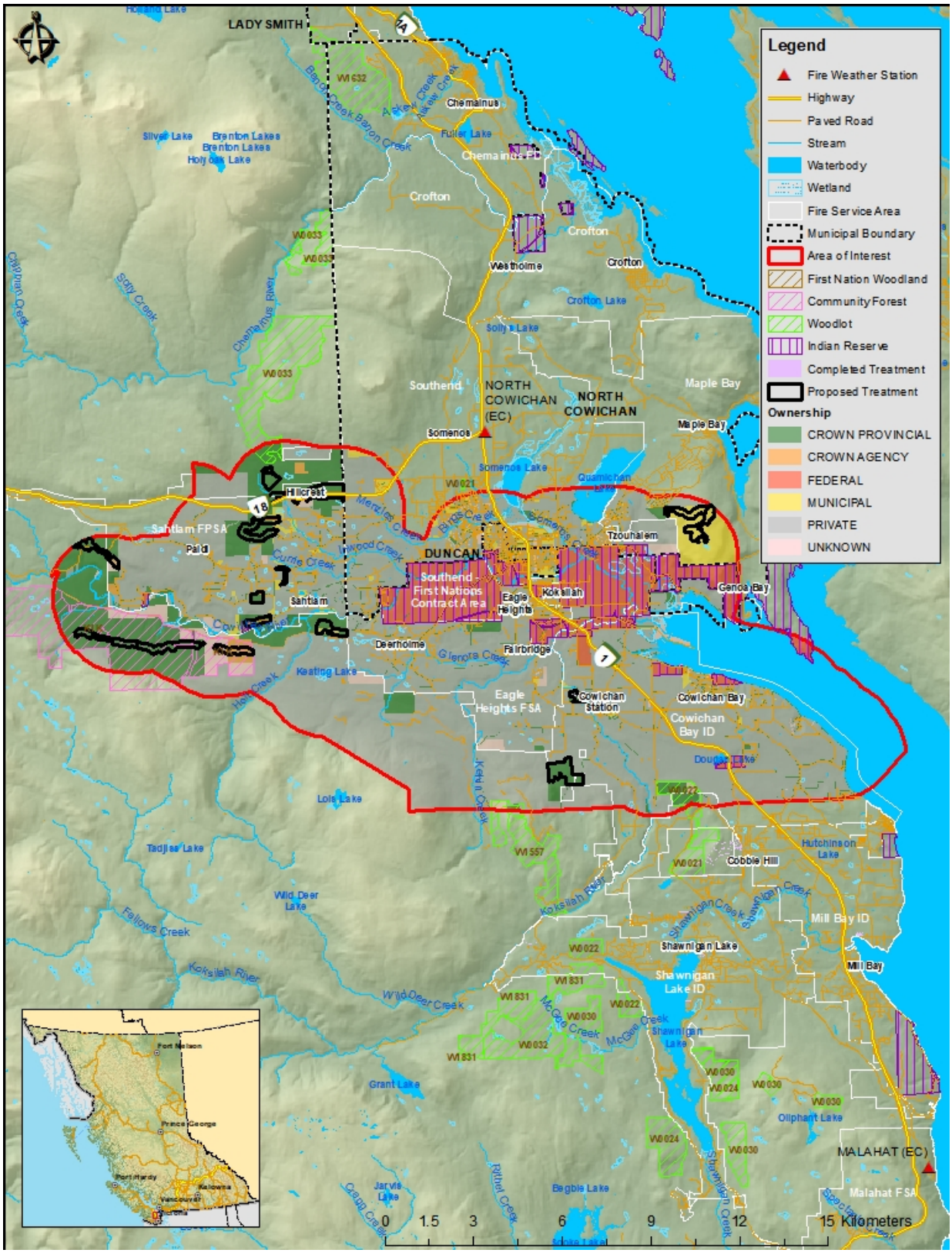
The Cowichan Valley Regional District Central Zone is located in southern Vancouver Island, approximately 45km northwest of Victoria. The Central Zone encompasses a number of communities of varying sizes, including the City of Duncan and the southernmost extent of the Municipality of North Cowichan. Other communities include Glenora, Paldi, Cowichan Station, Koksilah Village, Cowichan Bay Village, and Sahtlam. Due to buffering around values at risk (described below), there is overlap of the Central Zone AOI with the AOIs for both the CVRD South and CVRD West Zone CWPPs. Specifically, Cowichan Station and Cowichan Bay Village overlap with the South Zone AOI, and Paldi overlaps with the West Zone AOI.

The AOI for the Central Zone CWPP is illustrated below in Map 1. The AOI represents a two-kilometer (km) spotting buffer around values at risk (i.e., structures) within the Central Zone. The current AOI

differs significantly from the previous 2005 CWPP AOI which included all developed areas within the entire CVRD plus a 2km buffer. The current AOI roughly follows the Cowichan River from east to west, from the Cowichan Bay approximately 25km inland to the area surrounding the community of Paldi in its westernmost extent. The AOI is approximately 10km north to south. In total, the AOI encompasses 23,092 ha, a breakdown of the AOI's land ownership is provided in Table 2.

Table 2. Summary of AOI by land ownership.

Land Ownership	Hectares
Crown Agency	193
Crown Provincial	5,159
Federal*	2,152
Municipal	732
Private	13,778
Unknown	1,077
Total	**23,092**


Legend
Fire Weather Station
Highway
Paved Road
Stream
Waterbody
Wetland
Fire Service Area
Municipal Boundary
Area of Interest
First Nation Woodland
Community Forest
Woodlot
Indian Reserve
Completed Treatment
Proposed Treatment
Ownership
CROWN PROVINCIAL
CROWN AGENCY
FEDERAL
MUNICIPAL
PRIVATE
UNKNOWN
LADY SMITH
Chemainus
Crofton
Westholme
Somenos
NORTH COWICHAN (EC)
NORTH COWICHAN
Maple Bay
Hillcrest
DUNCAN
Tzouhalem
Genoa Bay
Southend First Nations Contract Area
Eagle Heights
Koksilah
Fairbridge
Deerholme
Cowichan Station
Cowichan Bay
Cowichan Bay ID
Eagle Heights FSA
Sahtlam FPSA
Sahtlam
Paldi
Keating Lake
Lois Lake
Tadjiae Lake
Wild Deer Lake
Cobble Hill
Hutchinson Lake
Mill Bay ID
Mill Bay
Shawnigan Lake
Shawnigan Lake ID
Grant Lake
Oliphant Lake
MALAHAT (EC)
Malahat FSA
Begbie Lake
Jarvis Lake
0 1.5 3 6 9 12 15 Kilometers

Map 1. Area of Interest (AOI).

2.2 COMMUNITY DESCRIPTION

The South Island region has been inhabited by Coast Salish Aboriginal Peoples since time immemorial. The largest of these groups within the AOI, and the largest single First Nation in British Columbia, is the Cowichan First Nation Band. This is not to the exclusion of other Coast Salish nations who historically lived on and managed their traditional territory in the area, including the Tzart-Lam First Nation, Theik First Nation, Kil-Pah-Las First Nation, Est-Patrolas First Nation, and Kakalatza First Nation, who together form the extended indigenous community within the Central Zone. In total, the Central Zone AOI contains six First Nation reservations, with the largest being Cowichan Indian Reserve 1. These include Est-Patrolas Indian Reserve 4, Theik Indian Reserve 2, Kil-pay-las Indian Reserve 3, Kakalotza Indian Reserve 6 and Tzart-lam Indian Reserve 5. At least six traditional villages remain occupied today, including Quamichan, Comeakin, Khenipsen, Clemclemaluts, Theik, and Kil-Pah-Las[4].

The Central Zone AOI encompasses a portion of several electoral areas. The majority of Electoral Area D including the communities of Cowichan Bay and Koksilah is contained within the AOI. A large swath of Electoral Area E is also contained within the AOI, comprising the communities of Cowichan Station, Sahtlam, Hillcrest, Deerholme, Eagle Heights, Fairbridge and Glenora. In the far west of the AOI, a small section of Electoral Area F covers the area around Paldi. Against the southern boundary of the AOI there is overlap with Electoral Areas B and C. The City of Duncan and the southern extent of the Municipality of North Cowichan cover a sizeable area in proximity to the northern boundary of the AOI. The CVRD in its entirety has a population of 80,000 and covers approximately 3,473 km^2.[5] Services to residents of the CVRD Central Zone are provided both at the regional and electoral levels. 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 head offices of the Cowichan Valley Regional District are located in Duncan, which is the economic hub of the valley. Duncan was not officially incorporated until 1912 after petitioning the Province of British Columbia to secede from the Municipality of North Cowichan. However, settlement of the area began long before that. It was bolstered by the northward rush of gold seekers in the 1850s, and what was once a small village grew with the advent of the first railway tracks being laid in 1886. Initially, it was the development of copper mining on Mt. Sicker that was the main driver of the regional economy. Today, the foundation of Duncan's, and to a large degree the CVRD's, economy comprises fishing, farming, forestry, and tourism interests. The major non-resource based economic drivers are construction and retail trades and services which are responsible for more than 15% of employment.

Fire protection within the AOI is the responsibility of the Sahtlam Volunteer Fire Rescue, Duncan Volunteer Fire Department (VFD), Cowichan Bay VFD, and the North Cowichan FD's Southend and

[4] CVRD Bylaw 3605: Electoral Area D - Cowichan Bay Official Community Plan Schedule A

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

Maple Bay Fire Halls. Mutual aid agreements exist between all fire departments. 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. Highway 1, which runs north and south from the AOI, is the only reliable, paved access route to large urban centres in the event of an evacuation of the AOI. Highway 18 is a paved route which provides access to communities along Cowichan Lake and the west coast of Vancouver Island. Paved roads also connect the communities to Highway 1 and Highway 18. Many developments within the CVRD Central Zone are located on single access roads which branch off of Highway 1 or Highway 18, limiting 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 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 largest fire to burn within and adjacent to the CVRD Central Zone AOI occurred in 1924 and encompassed an area of over 3,750 ha. The most significant fire to occur in recent years was in 2012, was 5.2 ha in size, and occurred north of Paldi and Highway 18. Since 1950, fire ignitions have occurred throughout the entire Central Zone AOI; however, the most significant fires have been in the western part of the AOI, between Duncan and Skutz Falls. In early August of 2018, 34 new fires were ignited on Vancouver Island, primarily due to lightning events.[6] 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 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 BCWS historical ignition dataset demonstrates that the proportion of human-caused fires within the CVRD Central AOI is substantially greater than that of the province as a whole.[7] This ignition data shows that within the CVRD Central AOI, 73% of ignitions since 1950 have been human-caused (a conservative estimate not including miscellaneous or undetermined causes), versus 40% in the province of BC.[8] This statistic may be explained by the high recreational use, specifically for camping, and the prevalence of forestry activities, railways, and other industrial activities within the AOI.

[6] BC Wildfire Service, Interactive Map

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

[8] BCWS, 2018

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, at the request of 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. There is currently a Sensitive Lands (SL) development permit area within Cowichan Bay, which sets standards based upon FireSmart principles for building material use, landscaping and appropriate setbacks from forested areas in the identified high hazard wildfire interface areas. However, no such regulation applies to other communities within the CVRD Central Zone and the mechanism by which development permit assessments occur in Cowichan Bay is not known. FireSmart brochures and flyers were distributed several years ago, however, 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. 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.

Fire department-initiated education regarding wildfire threat and prevention varies by department. Some fire departments within the AOI provide public information through their websites in the form of information on fire prevention, FireSmart, and open or backyard burning and fire protection bylaws, including links to BC Wildfire Service news.

2.5 LINKAGES TO OTHER PLANS AND POLICIES

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

2.5.1 Local Authority Emergency Plan

Emergency preparedness and response is managed by the CVRD, which has created a comprehensive Emergency Management Plan to serve the Regional District.[9] 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

[9] CVRD Local Authority Emergency Plan – Emergency Operations Centre Response Guidelines. Mid Island Emergency Coordinators & Managers. February 2015.

(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 EOCs 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.[9]

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).[10] 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), Nanaimo Regional District (various, 2005-2009); Lake Cowichan (2017), North Cowichan (2005), Extension (2006), and the District of North Saanich (2011). These documents, as/if available have been 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 South, West, and North Zones. The AOI of the CVRD Central Zone significantly overlaps the CVRD South and West Zones. CWPPs for each of the four CVRD zones are being developed by the same consultant ensuring consistency in recommendations and synergies with proposed fuel treatments.

2.5.3 Local Government/First Nation Policies and Recommendations

The following municipal bylaws, strategies and policies are relevant to wildfire planning in the CVRD.

Bylaw No. 3605, 2013: Electoral Area D –Cowichan Bay Official Community Plan

The Cowichan Bay Official Community Plan (OCP) provides guidance for land use, residential development, and community evolution throughout Electoral Area D over the next 10 years. The following sections contain objectives and policies which are directly relevant to wildfire risk reduction, emergency response, and community resilience post-disaster as described below.

2013 Cowichan Bay OCP Section 1.4: Local Context

This section identifies climate change as an important factor to consider throughout many areas within the OCP. It recognizes a decrease in soil moisture regimes, changes to ground water supply and increased natural disturbances such as forest fires and drought. The expected impact of climate change on natural disturbance regimes, particularly wildfire, is significant and emphasizes the

[10] Emergency Preparedness Workbook. Mid Island Emergency Coordinators & Managers. 2017.

importance of climate change adaptation and mitigation policies to increase community resilience. Further details regarding climate change and the implications on fire can be found in Section 4.1.3 of the CWPP document.

2013 Cowichan Bay OCP Section 4: Land Use Designations

This section of the OCP covers specific policies and objectives for land use throughout the plan area. Specifically, it covers development of various types of residential areas such as cluster, rural, village, mixed use, etc. For the majority of these land use designations it notes that the development must be serviced by community water and sewer systems, in which both systems must have the capacity to meet each respective designation as well as be able to be expanded for further development if applicable. Water meters will also be installed in such case where the CVRD may implement a water metering program.

2013 Cowichan Bay OCP Section 5.2: Ecosystems & Biodiversity

This section of the OCP outlines the policies associated with the protection, restoration and enhancement of ecosystems within the plan area. Subsection (h) covers the prevention of invasive species spread through implementing bylaws and development guidelines as well as by supporting the Invasive Plant Council of BC. Invasive plant species such as scotch broom which are highly flammable, increase fuel loads and wildfire hazard. Scotch broom is a highly competitive evergreen shrub which out-competes native species to create impenetrable thickets. On Vancouver Island, Scotch broom is, in some cases, displacing less flammable plant and tree species. By controlling invasive species, not only is the forest health improved, but fire behaviour potential of the area is also reduced.

2013 Cowichan Bay OCP Section 5.5 Air, Noise & Light Pollution

This section of the OCP addresses the reduction of, and methods of mitigation for, multiple pollution types within the Cowichan Bay area. Objective 1 – Policy (a) sees the reduction of open air burning within the plan area in order to minimize air pollution. Policy (b) encourages tree retention on private land in order to help reduce noise pollution, filter air pollutants and sequester carbon. Both of these policies provide many benefits to the CVRD that should not be understated. It is recommended that the unintended potential impacts on wildfire mitigation activities be considered. For example, open air burning of clean wood waste is one method for debris management during fuel reduction activities. Furthermore, on steeper or inaccessible sites, it is sometimes the only feasible option. Policies which constrain tree removal on private land can also limit a homeowners' ability to create defensible space around their home.

RECOMMENDATION #1: Review the Cowichan Bay OCP and individual bylaws, specific to burning and tree retention, with consideration for limitations and constraints to wildfire mitigation activities on private property. In circumstances where fuel reduction and debris management are limited by the OCP and bylaws, consider additional clauses which allow for tree removal and/or burning in defined circumstances (i.e., for the purpose of wildfire mitigation) and when meeting specific criteria. Any open burning should be done in adherence to the provincial Open Burning Smoke Control Regulation (OBSCR).

2013 Cowichan Bay OCP Section 6.5: Community Safety

Objective 2 in Section 6.5 of the OCP overviews the policies relating to emergency response preparedness within the plan area such as buildings of refuge and public education. The CVRD supports sharing natural hazard mapping to support public health and safety. Enhancement of the Cowichan Bay Fire Hall is supported, as well as further redevelopment which increases community capacity for emergency response.

RECOMMENDATION #2: Review the Cowichan Bay OCP, Section 6.5 and explicitly define the natural hazards most likely to impact community safety, including wildfire and interface fire. These have 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 resilience, mitigate potential damages and increase public and official awareness of risk.

2013 Cowichan Bay OCP Section 6.6: Parks & Trails

This section of the OCP outlines Electoral Area D park acquisition objectives and acquisition process through development and other means. During subdivision, the owner of the land being subdivided is to provide Regional District parkland as part of the subdivision approval process. Further, the OCP outlines the objective to ensure a strategic and planned approach to the acquisition and maintenance of parks and trails. The strategic approach is to be ensured through the development and adoption of a Community Parks and Trails Master Plan. Parks and trails provide a multitude of ecosystem, social, and economic benefits to the area, but also have the potential to impact the interface fire risk and increase the liability of the area should they not be maintained in an acceptable range of wildfire threat. New parks should be reviewed by a Qualified Professional (QP) 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 a wildfire. 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.

RECOMMENDATION #3: Review the Cowichan Bay OCP Section 6.6 (Parks & Trails) and associated Cowichan Bay Community Parks & Trails Master Plan (2013) and any supporting bylaws and consider parks acquisition and maintenance through a wildfire lens, to ensure wildfire risk, mitigation, liability and future maintenance are considered as priorities in development of the parks and trails inventory, 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 of this 2017 CWPP Update document for related recommendations specific to access).

An additional recommendation related to trails acquisition and maintenance in the context of wildfire risk management is provided below under the *Cowichan Bay Community Parks & Trails Master Plan*.

2013 Cowichan Bay OCP Section 6.7: Heritage, Arts & Culture

This section of the OCP outlines the CVRD's commitment to identify and protect heritage and archaeological sites and recognize the history and contributions of First Nations to the Cowichan Bay 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 of this 2017 CWPP Update document 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 value identification and First Nations consultation.

2013 Cowichan Bay OCP Section 9.2: Water Supply & Distribution

This section of the OCP summarizes the water systems within the plan area, including the ownership and the number of connections. Within Electoral Area D there are 4 primary owners of the community water system: The CVRD, Cowichan Bay Waterworks, Bench Park Society and the City of Duncan. Objective 1 summarizes the need for independent water purveyors to ensure that water supplies are adequate enough to meet firefighting needs as well as future growth over the long term, however, it is only strongly encouraged and not required.

RECOMMENDATION #4: Implement a bylaw that requires private water purveyors to maintain and flow-test water hydrants at the same frequency and to the same standard as municipally owned and maintained hydrants.

2013 Cowichan Bay OCP Section 9.6: Fire Protection

This section of the OCP overviews the fire protection and fire infrastructure within the area with the objective of ensuring there are sufficient water supplies and fire service infrastructure for fire protection services. This section also references areas of high and moderate risk of wildfire identified by the CVRD 2005 CWPP and acknowledges and supports the CWPP in balance with other community goals (i.e., protection, restoration and enhancement of wooded areas, etc.). Policies within this section state that all land being subdivided fall within a fire protection area and that adequate fire protection standards such as hydrant locations are present for these areas. Water storage systems are also encouraged to be improved as well as road access to water courses such as lakes and the ocean. Education is encouraged, with the CVRD supporting the FireSmart Manual and the development of additional material in order to help reduce the overall fire risk within the area.

RECOMMENDATION #5: Review and update the Cowichan Bay OCP, Section 9.6 - Fire Protection to include reference to updated fire threat mapping and expanding the policies to include FireSmart recommendations 35 and 36 contained in this 2017 CWPP Update.

2013 Cowichan Bay OCP Part 2: Development Permit Areas

Sensitive Lands (SL) Development Permit Area (DPA) – This DPA was designated to provide for the protection of the natural environment as well as the protection of development from hazardous conditions such as flooding, erosion, or wildfire. Objectives are as follows:

- To reduce potential risk to loss of life, property and the environment;
- To promote awareness of potential hazards; and
- To allow development of lands to be assessed by a geotechnical professional.

With regards to fire specifically, there are requirements relating to subdivisions, building design and landscaping that must be met or considered prior to obtaining a development permit for a new construction. Appropriate evacuation routes as well as access for emergency crews must be present, tree thinning and removal of coarse woody debris is suggested in order to follow a more natural ecologic function while also minimizing fire risk, and FireSmart building and landscaping techniques shall be followed.

Agricultural (AG) DPA: In order to minimize land use conflicts, the area between agricultural designations and the adjacent land use should have a 15-30m buffer zone (dependent on surrounding area) of trees and vegetation. This buffer could potentially function as a small fuel break if a fire were to spread to or from the agricultural land. In order for a buffer to function as a fuel break, fire resistant species should be used, following appropriate spacing and thinning practices in order to be the most effective.

Rural Character (RC) DPA: All sites being developed should be designed to reduce the risk of wildfire by placing structures and buildings in such a way to mitigate the impact that surrounding combustible vegetation may have on said development. All internal roadways will be designed to accommodate emergency service vehicles such as fire trucks and ambulances.

RECOMMENDATION #6: Review the Cowichan Bay OCP, Part 2 - Sensitive Lands DPA and update the areas of high and moderate risk of wildfire with threat mapping from the 2017 CWPP Update.

Bylaw No. 1490, 1994: Electoral Area E & F –Cowichan/Koksilah Official Community Plan

The Cowichan - Koksilah Official Community Plan (OCP) provides guidance for land use, residential development, and community evolution throughout Electoral Area E & F over the next 10 years. This plan covers all of Electoral Area E and the northeastern side of Area F. The following sections of the OCP contain objectives and policies which are directly relevant to wildfire risk reduction, emergency response, and community resilience post-disaster.

1994 Cowichan/Koksilah OCP Section 5: Forestry

Policy 5.1.16 identifies the variability surrounding climate change and how wildland urban interface areas may be affected, considering forestry objectives, biodiversity and public safety.

1994 Cowichan/Koksilah OCP Section 7: Residential Development

This section of the OCP covers specific policies and objectives for land use throughout the plan area, specifically for development of various types of residential areas such as suburban, rural, urban, etc. Regardless of type, all residential development shall be reasonably accessible for fire protection services and be located within a fire protection area.

1994 Cowichan/Koksilah OCP Section 12: Utilities, Water, Sewer and Solid Waste Services

Section 12.2 of the OCP covers fire protection within the plan area and lists six main priorities covering water use and storage between each fire protection district. This includes, road access to viable water sources, adequately meeting fire protection standards in new developments, and proper fire hydrant placement in new subdivisions.

1994 Cowichan/Koksilah OCP Section 14: Development Permit Areas

Forestry Industrial Development Permit Area (applicable to "I-2 Heavy Industrial" zoned sites) covers the protection of the natural environment, protection of development from hazardous conditions (i.e. wildfire) and the protection of farming from industrial development impacts.

Development of areas that fall within the Forestry Industrial Development Permit Area shall be developed in such a way to minimize the risk of damage to persons and property, while also addressing environmental issues. Guidelines include that all buildings should have insulation and roofing materials that meet the appropriate fire rating requirements of the BC Building Code, that screening of certain building openings to prevent the accumulation of combustible material should occur, that a fuel reduced buffer of 10m in width will surround buildings to minimize fire risk, and, for developments that only have one access or escape route, that exterior sprinkler systems should be installed for added structure protection.

Depending on the type of development and location of the development, the CVRD may request a report which outlines how the development addresses the aforementioned guidelines, including how the interface fire hazard is minimized and recommendations which the local fire department can review to assist for future planning.

RECOMMENDATION #7: Assess the Forest Industrial Development Permit Area and update its extent to include areas of high and extreme wildfire threat, as identified in Section 4.3.5 of this 2017 CWPP Update.

Bylaw No. 2030, 2007: The Corporation of the City of Duncan Official Community Plan

The City of Duncan Official Community Plan (OCP) outlines stewardship of the environment, enhancement of the community and provides guidance for land use and development within the City over the next few years. The following sections contain objectives and policies which are directly relevant to wildfire risk reduction, emergency response, and community resilience post-disaster.

2007 Duncan OCP Section 5.1: Growth Management

This section of the OCP outlines the growth management objectives and policies adopted by the City of Duncan to direct land use decisions to encourage sustainable, strategic growth and development. The policies encourage compact neighborhoods, sustainable building materials, cross-jurisdictional planning, and local consultation with regard to land use decisions.

RECOMMENDATION #8: Review the Duncan OCP growth management policies (Section 5.1) through a wildfire lens, including considerations for preventing further development in the wildland urban interface due to the potential for increased wildfire threat.

2007 Duncan OCP Section 7.2: Climate Protection

Policy 7.2.1 addresses the natural resources policy as it relates to tree preservation, tree planting on public and private land, and outreach and collaboration with community groups focused on ecological sustainability in the City of Duncan. The City aims to meet these objectives by adopting a comprehensive urban forest strategy and a tree preservation bylaw.

RECOMMENDATION #9: Review the Duncan OCP climate protection policies (Section 7.2) in relation to tree preservation and enhancement of canopy cover through a wildfire lens. Tree preservation and planting should consider wildfire-related risk and encourage planting of deciduous or fire-resistant species as well as implementing a density/spacing requirement that follows FireSmart standards within the wildland urban interface.

2007 Duncan OCP Section 9.3: Fire Protection

This section of the OCP outlines how fire protection is dealt with in the City and surrounding areas, with the overall objective of maintaining adequate fire protection to protect life and property. Policies include providing public education on fire prevention best practices, encouraging property owners to use fire prevention devices on their property (i.e. sprinklers, alarms, non-combustible materials) and allocating paid staff if volunteer personnel resources become stretched too thin.

RECOMMENDATION #10: Review and expand the Duncan OCP Section 9.3 - Fire Protection policies to include FireSmart standards and practices and FireSmart recommendations 35 and 36 contained in the 2017 CWPP Update.

2007 Duncan OCP Section 9.4: Emergency Planning

Overall objectives for this section include improving public awareness of disasters and disaster preparedness planning, minimizing the impacts of potential disasters, and ensuring the City is able to respond to and recover from a major emergency or disaster. Policy 9.4.3 encourages public preparedness for disasters through education and outreach, such as suggesting that the public assemble emergency kits and create plans in order to limit injuries, confusion and logistical issues in the event of a disaster or emergency situation. Policy 9.4.5 requires developers to comply with Development Permit Area rules and regulations, specifically for hazard land areas, in order to reduce the risk associated with these areas.

RECOMMENDATION #11: Develop an All Hazards Plan for the City of Duncan to explicitly identify the potential natural and anthropogenic disasters that the area may be susceptible to, including wildfires. These have 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 resilience, mitigate potential damages and increase public and official awareness of risk. This document should be supplementary to and compliment the broader-scale CVRD Local Authority Emergency Plan.

2007 Duncan OCP Section 9.6: Parks, Open Spaces and Recreation

This section of the OCP outlines the policies intended to provide, improve, and expand the parks and recreational facilities in the City of Duncan, which includes the development of a *Parks, Open Space and Greenway Master Plan*.

RECOMMENDATION #12: Review the Duncan OCP Section 9.6 and acknowledge the importance of emergency access through parks in the event of wildfire as well as the potential increased risk of wildfire associated with public use in parks and recreation areas (lighting of fires, discarded cigarettes, etc.).

2007 Duncan OCP Section 10.2: Water Supply and Distribution

The objectives of this section of the OCP are to ensure that water is sufficiently supplied through the City into the future. The policies relate to recommendations contained in the *Cowichan Basin Water Management Plan,* including the maintenance of the water system, water consumption reduction, and the prohibition of wells in the City for individual residences and new developments.

RECOMMENDATION #13: Review the Duncan OCP Section 10.2 – Water Supply and Distribution and consider including an objective regarding adequate water supply and distribution for the purposes of wildfire protection/firefighting.

RECOMMENDATION #14: Review the Duncan OCP Section 10.2 – Water Supply and Distribution and consider adopting a policy which recommends the creation of a map book or database of natural surface water sources available for use during fire suppression.

2007 Duncan OCP Sections 12.2-12.4: DPA 1 – Multi Family Residential Areas, DPA 2 - Downtown, DPA 3 - Highway 1 Corridor, and DPA 4 - Other Commercial Areas

The landscaping sections of DPAs 1-4 specify the use of native and drought-resistant plant species where planting or retention should occur. Significant tree stands and natural vegetation are to also be maintained where present. The Parking Areas section states that all private parking areas must be designed in order to provide close access to buildings, be clearly marked, be clearly lit when needed and to have appropriate signage in place. This will help emergency response crews access the properties in the event of an emergency.

RECOMMENDATION #15: Review the Duncan OCP Sections 12.2, 12.3, 12.4 and 12.5 and consider including policies which encourage the use of deciduous and fire-resistant plant, shrub, and tree species in the respective landscaping sections.

RECOMMENDATION #16: Review the Duncan OCP Sections 12.2 and 12.5 and consider including a requirement to consult a qualified professional when retaining significant stands of trees to ensure that they do not contribute to an increased risk of wildfire adjacent to structures and values.

Cowichan-Koksilah Official Community Plan: Technical Background Report 2015

The Cowichan-Koksilah Official Community Plan represents the community's vision for the future, providing guidance regarding land development, local government regulations and policies centered around the community's needs and priorities. This OCP 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[11] of the Wildfire Hazard is also provided, in which much of the area falls within the high to extreme wildfire hazard categories.

RECOMMENDATION #17: Review the Cowichan-Koskilah OCP Technical Background Report Section 2.4 – Hazards and consider updating to include reference to updated fire threat mapping.

2015 Cowichan-Koksilah OCP Technical Background Report Section 6.7: Fire Protection

This section outlines the fire protection coverage throughout the OCP area and which fire 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 Technical Background Report Section 7.7: Growth Management Policy

This section identifies a shortcoming of the OCP, the absence of a strategic growth management policy. A growth management policy is a legal requirement for official community plans; they not only serve to meet the housing development needs of the area but also to outline potential interface areas that could be at risk of wildfires.

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

RECOMMENDATION #18: Review and amend the Cowichan-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.

City of Duncan Bylaw No. 3165, 2017: Parks and Public Open Spaces

This bylaw restricts the use and discharge of any fireworks or explosive material of any kind within a park, (unless authorized in writing by the City) as well as restriction of the any burning substance such as a fire, match, cigar, cigarette, etc. being placed on the ground.

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. 2020, 2009: Landclearing Management Regulation Bylaw

This bylaw overviews the use and 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 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. 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. This bylaw also states that the owner or occupier must not have any accumulation of filth, discarded material or garbage of any kind.

RECOMMENDATION #19: Work 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 homeowner participation via a CVRD-wide engagement campaign and providing incentives such as the opportunity to acquire/purchase discounted address signs.

RECOMMENDATION #20: 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), see Appendix K – FireSmart Construction and Landscaping, for more information on combustible materials. 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.

Cowichan Bay Community Parks & Trails Master Plan, 2013.

The Cowichan Bay Parks & Trails Master Plan provides a comprehensive strategy for the maintenance and development of the parks and trails throughout the Cowichan Bay area with priority recommendations targeted for the next 10 years, as well as secondary recommendations for 10 years and beyond.

Trails can have a significant impact on the wildfire risk of a community, with respect to access, detection and suppression. High-use recreational trails can be beneficial when users provide increased early detection and reporting. Alternatively, trails are potentially locations of increased ignitions in the interface. Furthermore, depending upon trail width, clearance, and surfacing, they can provide points of access for suppression efforts, serve as surface fire fuel breaks, and act as control lines for suppression efforts.

RECOMMENDATION #21: Review and complete updates to the Cowichan Bay Community Parks & Trails Master Plan 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)[12]

The Vancouver Island Land Use Plan (VLUP) is the higher-level planning document for all of Vancouver Island, including the CVRD Central 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 VLUP also identifies Land Use Zones, which are used to delineate areas which require specific management.

Relevant Legislation

The presence of a Marbled Murrelet Wildlife Habitat Area (WHA) 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 prescription-level phase. Fuel management within these areas should aim to enhance these values, whenever possible, and the land manager (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)[13] that encompasses the CVRD Central 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 Update (Section 5.1.1). Due to the fact that the CVRD Central Zone has limited access and egress options, improving access and thereby increasing public safety in the event of an emergency evacuation should be a priority. Funding opportunities for establishing fuel breaks on Crown land along Highway 1 and other single-access roads may be available through the Forest Enhancement Society of

[12] The Province of BC, 2000.

[13] Vancouver Island Central Coast Response Fire Management Plan – 2018. MFLNRORD.

British Columbia (FESBC). Communication with the Natural Resource District and Ministry of Transportation and Infrastructure should be initiated to explore potential fuel treatments. These fuel breaks have been recommended in order to protect access and egress routes in the CVRD Central Zone as well as to serve as strategic anchors for fire suppression and to reduce extreme crown fire behaviour.

One approved Forest Development Unit (FDU) and two submitted FDUs are located within the AOI with associated Forest Stewardship Plans (FSPs) which set specific forest practices obligations applicable to specific forest licensees. These should be reviewed and followed during the prescription development phase of planning.

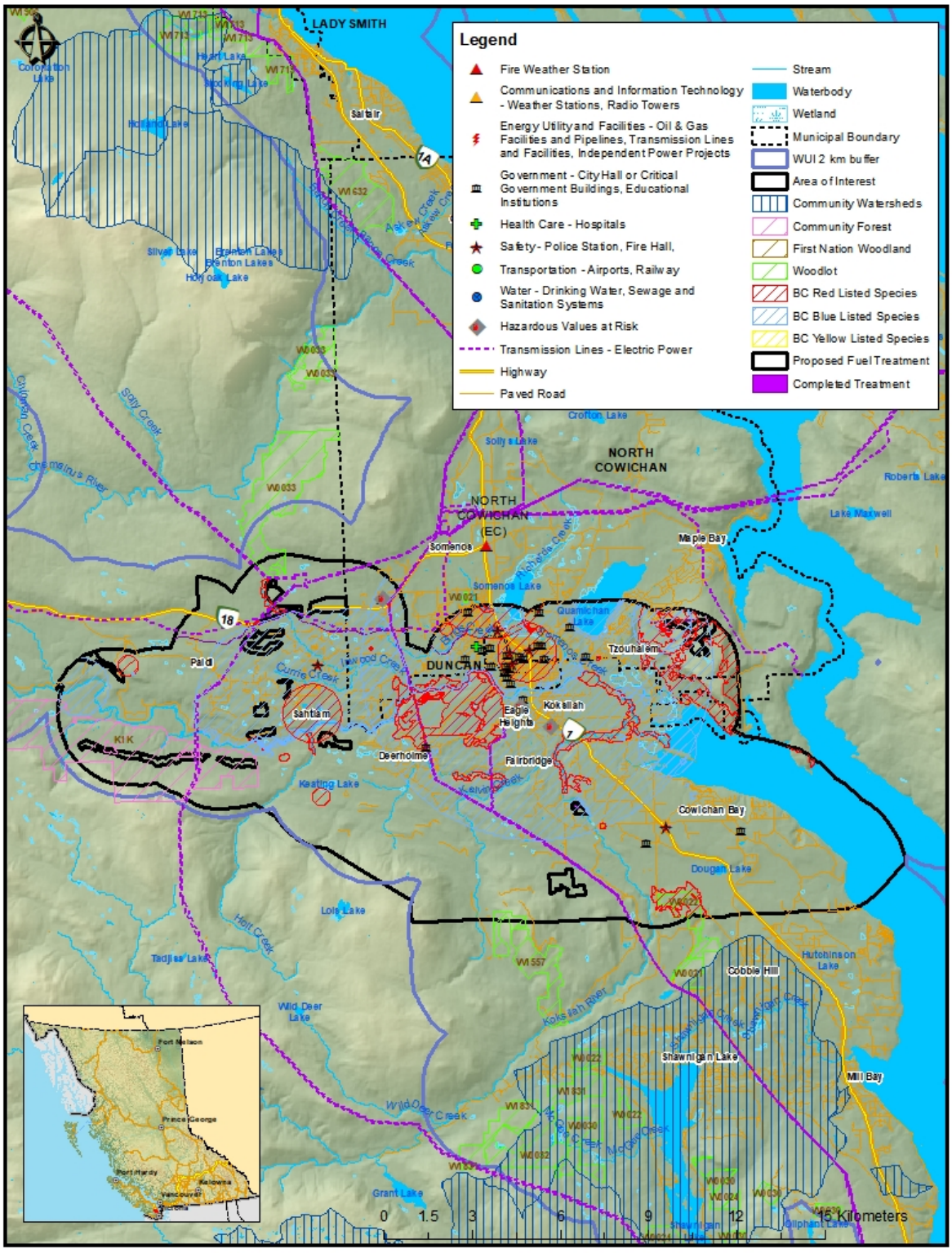
Two provincial parks and protected areas are also located within the AOI, including Mount Tzuhalem Ecological Reserve and Cowichan River Provincial Park. BC Parks is in the process of developing a management plan for Cowichan River Provincial Park and has an approved Purpose Statement and Zoning Plan. Mount Tzuhalem Ecological Reserve currently has an approved Purpose Statement in place which recognizes the risk of fire and potential impacts on the reserve and adjacent community and provides recommended management responses. BC Parks and the CVRD should be consulted and existing management plans reviewed prior to fuel treatment planning or prescription development in these parks.

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[14]. 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 in this 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 Central 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.

[14] Ministry of Forests, Lands and Natural Resource Operations. 2015 https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/TSA_FH_Strategies/2015-Coast%20FH%20Strategy.pdf



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.[15]

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 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 Central Zone has increased moderately in recent years. It was last measured at approximately 12,308 persons in 2016, up 4.7% from 2011.[16] This compares to 4.2% growth in the Cowichan Valley as a whole during the same years. The largest population change has occurred in Area D (9.2% growth), with lower growth rates experienced in Area E (6.9%) and the City of Duncan (0.2%) from 2011 to 2016. According to the 2016 Census, there are approximately 5,708 private dwellings in the Central Zone, approximately 304 of which are occupied on a part-time basis. These figures are calculations based on the Census population statistics of CVRD Electoral Areas D and E and the City of Duncan which overlap with the CVRD Central Zone AOI. Portions of Electoral Areas B, C and F and the Municipality of North Cowichan also partially overlap the AOI, however, these estimates were not included in the calculation. Population density is greatest in the City of Duncan.

The CVRD Central Zone also attracts visitors for outdoor recreation including camping, hiking, kayaking, canoeing, summer camps, and other recreational endeavors, particularly during the fire season (May – October). Several parks and recreation areas in the AOI experience high usage during the summer months, including, but not limited to Mount Tzuhalem Ecological Reserve and hiking trails, Cowichan River Provincial Park, Cobble Hill and Currie Creek MFLNRORD recreation sites, Sandy Pool Regional Park, the Cowichan Valley Trail, Coverdale Watson Park, Hecate Park, Maple Grove Park, Bright Angel Park, Glenora Riverside Park, Glenora Trails Head Park, and Wake Lake Nature Reserve. Furthermore, Highway 1 is frequently used as an access corridor from the central island to Victoria, Sooke, and the Southern Gulf Islands and Highway 18 is used to access the west coast of Vancouver Island, which increases the number of people to evacuate in the event of a wildfire.

Knowledge of and access to updated structure locations is a critical step in efficient and successful emergency response planning and the development of mitigation strategies and recommendations. Field visits to the CVRD Central Zone AOI and access to recent orthophotography and spatial data from

[15] 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

[16] Statistics Canada. 2016 Census.

the CVRD has enabled the development of an updated WUI boundary that accounts for the most recent development.

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 in the AOI can be maintained 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. This dataset was enhanced with additional infrastructure identified and mapped during field visits and is shown in Map 2. Table 3 details an inventory of the critical infrastructure provided by the CVRD and via field visits.

Protection of critical infrastructure is 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 all types of critical infrastructure and are reflected in the outlined recommendations. During field visits, it was observed that generally the CVRD's critical infrastructure is compliant with FireSmart principles. Defensible spaces were in some cases complemented by fences and other barriers to unauthorized access.

RECOMMENDATION #22: 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 Central 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 flammable shrubs be employed to help reduce fire risk, utility pole damage and subsequent outages.

The BC Hydro Sahtlam substation is located within the Central Zone AOI, north of Highway 18. Three major radial transmission lines connect this substation with the Vancouver Island substation, the Dunsmuir substation, and to the Pike Lake substation. The transmission line which connects the Vancouver Island substation (located north of the AOI in Qualicum Bay) and the Goward substation

(located to the south of the AOI, north of Esquimalt) also bisects the Central Zone AOI. This system is well-mapped and BC Hydro provides assurance that staff will work with local fire departments and BCWS to mitigate impacts to this infrastructure in the event of a wildfire.[17]

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 event may cause power outages. Consideration must be given to protecting this critical service and providing power backup (secondary power sources) 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 Duncan City Hall, CVRD Regional Building, the fire halls, emergency operations centre, and RCMP detachment, and most water pumping stations via backup generators. The CVRD also has emergency generators for various infrastructure during the event of a power outage. These emergency generators are powered by either diesel, natural gas, or propane and have sufficient fuel capacity to operate for 4-10 hours. 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 6.1.2 for discussion and recommendations related to backup power and water availability for fire suppression).

3.2.2 Communications, Pipelines and Municipal Buildings

The CVRD Central Zone is serviced by one hospital (Cowichan District Hospital), one regional airport (Duncan Airport), and three municipal and regional buildings (the CVRD Regional Building and Duncan and Glenora City Halls). There is a Fortis BC gas line that supplies the CVRD Central Zone. A map of the FortisBC natural gas distribution system for the CVRD Central Zone is not available to external companies. As such, it is not possible to identify specific areas that may be vulnerable to wildfire. However, a publicly available service area map[18] of British Columbia indicates that a natural gas pipeline transects the AOI. The FortisBC company website states that employees will consult with local authorities and BCWS in the event of a wildfire. The Mt. Hayes Liquified Natural Gas facility stores approximately 1.5 billion cubic feet (Bcf), providing Vancouver Island customers with improved natural gas supply, transmission infrastructure and reliability. This project has allowed the expansion of previous transmission systems to improve capacity for meeting winter load requirements.[19] A full inventory of critical infrastructure for communications, pipelines and municipal buildings with updated locations is presented in Table 3, below.

[17] https://www.bchydro.com/safety-outages/emergency-preparation/natural-disasters.html
[18] https://www.fortisbc.com/About/ServiceAreas/Pages/default.aspx
[19] Terasen Gas. 2007. Mt. Hayes LNG Storage Facility. Retrieved online at: https://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/070506_TGVI%20Mt%20Hayes%20LNG%20CPCN_FF.pdf

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

Critical Infrastructure Type	Location
Electrical service	Service from regionally integrated transmission network. Distribution is combination of wood poles and underground servicing.
Duncan Regional Airport	5100 Langtry Rd, Duncan, BC
RCMP - North Cowichan Duncan Detachment	6060 Canada Avenue North Cowichan/Duncan
Duncan VFD Fire Hall	468 Duncan Street, Duncan
North Cowichan FD South End Fire Hall	5851 Duncan Street, Duncan
Sahtlam Volunteer Fire Rescue Fire Hall	4384 Cowichan Lake Road, Duncan
Cowichan Bay VFD Fire Hall	4461 Trans-Canada Hwy Cowichan Bay
Ambulance - Station 152	2582 Lewis Street, Duncan
Cowichan Community Centre (Primary Reception Centre)	2687 James Street, Duncan
Glenora City Hall (Secondary Reception Centre)	3660 Glenora Rd, Duncan
Trailer at Coverdale Watson Park (Secondary Reception Centre)	Wilmot Road, Cowichan Bay
Siem Lelum Gymnasium (Secondary Reception Centre)	5574 River Road, Duncan
CVRD Office (Emergency Coordination Centre [ECC])	175 Ingram Street, Duncan
Duncan City Hall (ECC)	200 Craig Street, Duncan
Bings Creek Recycling Centre and CVRD Operations Centre for Recycling & Waste Management, Water Management, Parks, Search & Rescue (EOC)	3900 Drinkwater Road, Duncan
Cowichan District Hospital	3045 Gibbins Road, Duncan
Cerwydden Care Centre (Long Term Care)	3243 Cowichan Lake Road, Duncan
Sunridge Place (Long Term Care)	361 Bundock Avenue, Duncan
Cairnsmore (Long Term Care)	250 Cairnsmore Street, Duncan
Wicks Road Group Home (Mental Health Care)	6276 Wicks Road, North Cowichan
Cowichan Lodge (Mental Health Care)	2041 Tzouhalem Road, Duncan V9L 5L6
Elder Residential	1051 College Street, Duncan
Elder Residential	4404 Cowichan Lake Road, Duncan
Elder Residential	256 Government Street, Duncan
Elder Residential	280 Government Street, Duncan
Assisted Living	574 Coronation Avenue, Duncan
Cowichan Tribes Band Office	5760 Allenby Road, Duncan

3.2.3 Water and Sewage

The CVRD operates and maintains 19 water utilities, which provide 3,700 connections to residents and commercial operators within the region.[20] In the CVRD Central Zone, water is supplied through groundwater sources. In the CVRD as a whole, approximately 25 private operators and municipalities, First Nations, and local governments supply water to the Regional District.[21] In 2017, the CVRD released a report titled "Water & Wastewater Utilities Review and Assessment for the Cowichan Valley Regional District"[22], which was developed to address the lack of district-level utilities planning and the inherent challenges the CVRD faces when operating multiple distinct systems with a quickly growing population.

The Central Zone AOI is serviced by a total of 5 CVRD-operated systems. Additional water service is provided by one improvement district (Cowichan Bay Improvement District), two municipal systems (City of Duncan and Municipality of North Cowichan) and one private system (Garnet Creek Water Users). The CVRD tracks surface water storage levels and targets for all its reservoirs and maintains updated maps of all water systems within its jurisdiction.[23] A detailed account of water availability for wildfire suppression is provided in Section 6.1.2.

The CVRD operates and maintains 16 sewer systems.[24] 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. Updated locations for water and sewage infrastructure within the CVRD Central Zone AOI (current as of 2018) are detailed below in Table 4.

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

[21] 2010 State of the Environment Report. Retrieved online at: http://www.12things.ca/uploads/2010S0Ereportsm.pdf

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

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

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

Table 4. Critical Infrastructure Identified in CWPP field visits.

Critical Infrastructure Type	Location
Water supply	Communities including Cowichan Bay, the City of Duncan and Municipality of North Cowichan are served by their respective improvement district or municipal water systems (Cowichan Bay Improvement District, and City of Duncan and North Cowichan municipal water systems). CVRD water systems and associated infrastructure include the following: • Douglas Hill including two pump stations located at 4108 St. Catherines Drive and 1451 Freeman Road, and a reservoir located at 4922 Wilson Road • Lambourn Estates including two reservoirs and a pump station on Chestnut Road and a treatment building on Hurtun Road • Cherry Point including a reservoir located at 1105 Cherry Point Road and a treatment building located at 4361 Brentview Drive • Dogwood Ridge including a reservoir and treatment building located at 4922 Wilson Road • Satellite Park including a pressure reducing valve station located on Satellite Park Drive and a pump station at 3841 Lefran Road Additionally, the Garnet Creek Water Users private water system is located in Area C.
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 in the Central Zone AOI include the following: • Lambourn Estates, including a treatment building and two pump stations and outfall • Cowichan Bay, including a disposal field, pump station and treatment building • Eagle Heights, including a pump station

3.3 HIGH ENVIRONMENTAL AND CULTURAL VALUES

The following section identifies high environmental and cultural values and where they are located. Environmental, cultural and recreational values are high throughout the 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 Central Zone draws its domestic water from groundwater sources. Drinking water availability is a concern in the CVRD due to the dry spells that typically occur during the summer and exacerbated by growing demand and climate change impacts.[21] [25]

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

The CVRD Central Zone AOI does not encompass any Community Watersheds. Due to the reliance on groundwater, as opposed to surface water sources, the drinking water supply and quality in the AOI is not vulnerable to potential hydrological impacts of wildfire related to post-fire debris flows, erosion or mass wasting triggered by precipitation events.

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 13 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, Stz'uminus First Nation, Cowichan Tribes, Lake Cowichan First Nation, Lyackson First Nation, Penelakut Tribe, Malahat First Nation, Te'Mexw Treaty Association, Twawassen First Nation, Tsawout First Nation, Tseycum Indian Band, Pauquachin First Nation, and Tsartlip Indian Band.

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 Pauquachin First Nation, Tsartlip First Nation, Tsawout First Nation, and Tseycum First Nation are Douglas Treaty Nations, granted the rights to hunt over unoccupied lands and carry on their traditional fisheries[26]. The 2009 Tsawwassen First Nation Treaty defines Tsawwassen First Nation's Aboriginal rights throughout their claimed traditional territory which includes the waters of the Salish Sea.

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[27]. 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.[28] Prior to stand modification for fire hazard reduction, and depending on treatment location, preliminary

[26] 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
[27] Snetsinger, 2010.
[28] https://www.for.gov.bc.ca/archaeology/accessing_archaeological_data/obtaining_access.htm

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 should ensure sufficient time for review and input regarding their rights and interests prior to prescription finalization or implementation.

3.3.3 High Environmental Values

Multiple non-legal OGMAs overlap with the northwest extent of the AOI (and these are roughly overlapping with Marbled Murrelet habitat). Any proposed fuel treatment that may overlap these areas requires MFLNRORD oversight at the prescription development phase, and work can only occur following MFLNRORD approval (OGMA amendment policy replacement application and/or detailed rationale must be provided to the District Manager for review).

There is an established legal order for a Marbled Murrelet Wildlife Habitat Area (WHA) on the western edge of the AOI bordering the Cowichan River (WHA #1-034)[29]. This order and associated wildlife measures should be reviewed and adhered to should a fuel treatment be proposed within this area.

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 AOI, 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 21 occurrences of Red-listed species, 7 Red-listed ecological communities and 19 occurrences of Blue-listed species within the AOI (Table 5). There is one overlap 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.

[29] Order – Wildlife Habitat Areas #1-033, 1-034 and 1-040 Marbled Murrelet WHAs in the South Island Forest District. Accessed online from: http://www.env.gov.bc.ca/wld/documents/wha/MAMU_1-033,034,040_ord.pdf

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

Common Name	Scientific Name	Category	BC List	Habitat Type
Barn Owl	*Tyto alba*	Vertebrate Animal	Red	Terrestrial: cropland/hedgerow, suburban/orchard
Black Cottonwood - Red Alder/ Salmonberry	*Populus trichocarpa - Alnus rubra/ Rubus spectabilis*	Ecological Community	Blue	
Blue-grey Taildropper	*Prophysaon coeruleum*	Invertebrate Animal	Blue	Terrestrial: forest broadleaf
California-tea	*Rupertia physodes*	Vascular Plant	Blue	Terrestrial; forest broadleaf; roadside; forest needleleaf
Coastal Scouler's Catchfly	*Silene scouleri ssp. scouleri*	Vascular Plant	Red	Terrestrial: woodland broadleaf
Common Bluecup	*Githopsis specularioides*	Vascular Plant	Red	Terrestrial: grassland/herbaceous; seepage
Common Ringlet, Insulana Subspecies	*Coenonympha tullia insulana*	Invertebrate Animal	Red	Terrestrial: roadside, grassland/herbaceous
Deltoid Balsamroot	*Balsamorhiza deltoidea*	Vascular Plant	Red	Terrestrial: woodland broadleaf, grassland/herbaceous
Dense Spike-primrose	*Epilobium densiflorum*	Vascular Plant	Red	Terrestrial: temporary pool, roadside
Douglas-fir - Arbutus	*Pseudotsuga menziesii - Arbutus menziesii*	Ecological Community	Red	Terrestrial; forest mixed
Douglas-fir/Dull Oregon-grape	*Pseudotsuga menziesii/ Mahonia nervosa*	Ecological Community	Red	
Dun Skipper	*Euphyes vestris*	Invertebrate Animal	Red	Terrestrial: grassland/herbaceous; suburban/orchard, roadside, forest needleleaf; palustrine
Ermine, Anguinae Subspecies	*Mustela erminea anguinae*	Vertebrate Animal	Blue	Terrestrial; forest needleleaf
Fern-leaved Desert-parsley	*Lomatium dissectum var. dissectum*	Vascular Plant	Red	Terrestrial: woodland mixed, grassland/herbaceous
Garry oak/ California brome	*Quercus garryana/Bromus carinatus*	Ecological Community	Red	Terrestrial; woodland broadleaf; grassland/herbaceous

Common Name	Scientific Name	Category	BC List	Habitat Type
Garry Oak/ Oceanspray	*Quercus garryana/ Holodiscus discolor*	Ecological Community	Red	Terrestrial; woodland broadleaf
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
Green-fruited Sedge	*Carex interrupta*	Vascular Plant	Blue	Riparian; riverine; sand/gravel bars
Green Heron	*Butorides virescens*	Vertebrate Animal	Blue	Terrestrial; woodland broadleaf; suburban/orchard; lacustrine; riparian; forest broadleaf
Henderson's Checker-mallow	*Sidalcea hendersonii*	Vascular Plant	Blue	Estuarine; tidal flat; herbaceous wetland
Heterocodon	*Heterocodon rariflorus*	Vascular Plant	Blue	Terrestrial: grassland/herbaceous, seepage, woodland broadleaf
Howell's Quillwort	*Isoetes howellii*	Vascular Plant	Blue	Terrestrial: Seepage
Howell's Triteleia	*Triteleia howellii*	Vascular Plant	Red	Terrestrial; woodland broadleaf; grassland/herbaceous
Howell's Violet	*Viola howellii*	Vascular Plant	Red	Terrestrial: grassland/herbaceous
Labrador-Tea/ Western Bog-laurel/Peat-mosses	*Rhododendron groenlandicum/ Kalmia microphylla/ Sphagnum spp.*	Ecological Community	Blue	
Macoun's Groundsel	*Packera macounii*	Vascular Plant	Blue	Terrestrial: grassland/herbaceous; grassland/herbaceous
Moss' Elfin, Mossii Subspecies	*Callophrys mossii mossii*	Invertebrate Animal	Blue	Terrestrial
Needle-leaved Navarretia	*Navarretia intertexta*	Vascular Plant	Red	Palustrine: temporary pool
Northern Red-legged Frog	*Rana aurora*	Vertebrate Animal	Blue	Terrestrial: forest needleleaf, urban; palustrine: pond
Nuttall's Quillwort	*Isoetes nuttallii*	Vascular Plant	Blue	Palustrine; temporary pool
Oregon Ash	*Fraxinus latifolia*	Vascular Plant	Red	Terrestrial: suburban/orchard, forest mixed
Prairie Lupine	*Lupinus lepidus*	Vascular Plant	Red	Terrestrial; roadside

Common Name	Scientific Name	Category	BC List	Habitat Type
Propertius Duskywing	*Erynnis propertius*	Invertebrate Animal	Red	Terrestrial; woodland mixed; grassland/herbaceous; woodland broadleaf
Purple Martin	*Progne subis*	Vertebrate Animal	Blue	
Purple Sanicle	*Sanicula bipinnatifida*	Vascular Plant	Red	Terrestrial: woodland broadleaf; grassland/herbaceous
Red Alder/Slough Sedge (Black Cottonwood)	*Alnus rubra/Carex obnupta [Populus trichocarpa]*	Ecological Community	Red	
Tall Woolly-heads	*Psilocarphus elatior*	Vascular Plant	Red	Terrestrial: grassland/herbaceous
Threaded Vertigo	*Nearctula sp. 1*	Invertebrate Animal	Blue	Terrestrial
Twisted Oak Moss	*Syntrichia laevipila*	Nonvascular Plant	Blue	Terrestrial: grassland/herbaceous; epiphytic
Vancouver Island Beggarticks	*Bidens amplissima*	Vascular Plant	Blue	Riverine: creek
Warty Jumping-slug	*Hemphillia glandulosa*	Invertebrate Animal	Red	Terrestrial: forest mixed
Western Redcedar/ Common Snowberry	*Thuja plicata/ Symphoricarpos albus*	Ecological Community	Red	
White-top Aster	*Sericocarpus rigidus*	Vascular Plant	Red	Terrestrial: woodland broadleaf, grassland/herbaceous
White Meconella	*Meconella oregana*	Vascular Plant	Red	Terrestrial
Wine-cup Clarkia	*Clarkia purpurea ssp. quadrivulnera*	Vascular Plant	Red	Terrestrial: grassland/herbaceous
Yellow Montane Violet	*Viola praemorsa var. praemorsa*	Vascular Plant	Red	Terrestrial: woodland broadleaf, woodland mixed

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 Timber Supply Area (TSA), which encompasses 1,574,719 hectares. 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.[30] The last Timber Supply Review (TSR) was completed in 2016[31] 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 three Woodlot Licences (see Map 1), Tree Farm License (TFL) 46 operated by Teal Cedar Products Ltd. (minor overlap in northwest corner of the AOI) and multiple Occupant Licenses to Cut. Additionally, a First Nation Community Forest Agreement is held and operated by Khowutzun Forest Service Ltd., a partnership with Cowichan Tribes (limited partner). The opportunity exists to work with local licensees on commercial thinning projects that meet fuels management objectives.

3.5 HAZARDOUS VALUES

Hazardous values are defined as values that pose a safety hazard to emergency responders. Generally, the Central Zone does not have a significant number of industrial sites and facilities that can be considered hazardous values.

Bings Creek Recycling Centre and Transfer Station is a CVRD operated recycling and garbage transfer station located northwest of the City of Duncan (Table 6). It is the one large, centralized public transfer station in the region for materials collected throughout the region by municipalities, the CVRD and materials collected from CVRD recycling centres. It receives residential recyclables and residential, industrial, commercial and institutional solid waste from public and private haulers, including household and industrial organic waste and a variety of household hazardous materials and combustible materials (e.g., tires, vehicle batteries, propane tanks, oil and oil filters and containers)[32]. Other hazardous values identified include significant propane storage and sales and commercial fuel cardlocks (Table 6). The CVRD did not identify any other hazardous values. 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 for 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.

[30] 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

[31] 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

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

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

Critical/Hazardous Infrastructure Name	Location
Bings Creek Transfer Station and Recycling Centre	3900 Drinkwater Road, Duncan
Cowichan Petroleum Sales (diesel, bio-diesel, gasoline, furnace oil and stove oil)	2999 Allenby Road, Duncan
Super Save Propane (residential and commercial propane)	4979 Polkey Road, Duncan

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 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 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.[33] The following section is synthesized from information found on MFLRNORD's Research Branch BECWeb.[33]

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

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

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

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

The CDFmm is the most common BEC unit occurring within the AOI (approximately 68%, 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.[35] 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 CDFmm 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[34]. 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[34]. 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.

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

The CWHxm1 makes up approximately 26% of the CVRD Central Zone AOI and the CWHxm2 encompasses approximately 6% 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[35]. The CWHxm is characterized by warm, dry summers and moist, mild winters. The historical wildfire regime characteristics are similar to the CDFmm (NDT 2).[34]

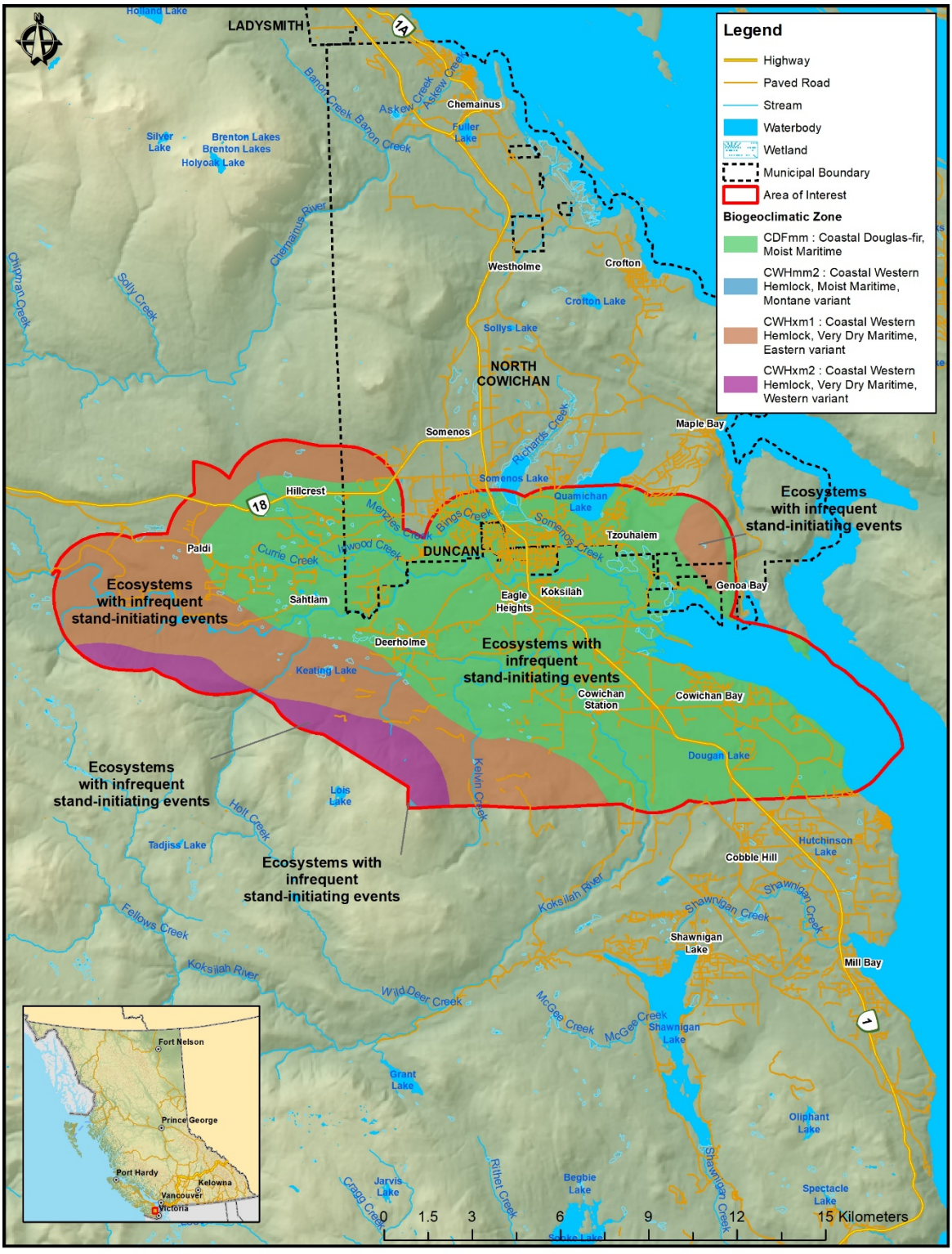
3. Coastal Western Hemlock, Moist Maritime, Montane Variant (CWHmm2) – NDT 2

The CWHmm2 is present in a very small proportion of the AOI (9 ha), in pockets above the CWHxm2 from approximately 700-1100m. Forests on zonal sites are dominated by western hemlock, amabilis fir, and Douglas-fir and minor amounts of yellow cedar and mountain hemlock.[35] The CWHmm2 commonly has a growing season moisture deficit. The historical wildfire regime characteristic of CWHmm2 is similar to that of CWHxm and CDFmm (NDT 2).[34]

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	15,708	68%
CWHmm2: Coastal Western Hemlock, Moist Maritime, Montane variant	NDT2	9	0%
CWHxm1: Coastal Western Hemlock, Very Dry Maritime, Eastern variant	NDT2	6,107	26%
CWHxm2: Coastal Western Hemlock, Very Dry Maritime, Western variant	NDT2	1,268	6%
TOTAL		**23,092**	100%

[35] Green & Klinka, 1994



Map 3. Biogeoclimatic Zones within the AOI.

Forest Health Issues

The Coast Forest Health Overview outlines forest health issues present within the Arrowsmith TSA.[14] 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.[36] These include laminated root disease, a common damaging agent in southern BC; balsam bark beetle; and five spot disturbances of armillaria root disease; Douglas-fir beetle infestations, which rose in the West Coast Region; and white pine blister rust.

Spatial data available through DataBC[37] indicates that historic outbreaks of western spruce budworm occurred between 1909-1930, particularly in the eastern part of the AOI. More recently (2008-2012) the forest health impacts reported in DataBC are smaller scale instances of white pine blister rust (21 ha) and fire damage (6 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 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 (grass) fuel types.

Since the establishment of communities within the CVRD Central 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 33% of land base is characterized as Agricultural Land Reserve (ALR). This area is dominated by farmland, cattle rearing, and wineries where the potential wildfire behaviour is greatly reduced due to the year-round irrigation, resulting in lower potential for curing during the wildfire season.

[36] 2017 Summary of Forest Health Conditions in British Columbia. 2017. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/aerial-overview-survey-documents/aos_report2017.pdf

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

- 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 favourable climate and high recreational and landscape values make it a desirable place to live and work.
- Industrial development has also increased the hazardous infrastructure present within the AOI.
- 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, and along the Cowichan Valley Trail in 2007 and 2010 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 (Section 5.1.2).
- Developed areas in the AOI include the City of Duncan, Cowichan Station, Cowichan Bay, Koksilah Village, Glenora, Paldi, and Sahtlam, and numerous satellite intermix neighbourhoods (where forest and structures are intermingled). These satellite neighbourhoods are highly intermixed within conifer leading stands, and are generally 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 North Cowichan (EC) weather station (years 2008 – 2017). According to Figure 1, the months with the highest average number of 'high' and 'extreme' fire danger class days are June, July, August and September. August historically has the highest number of days in the 'extreme' class when compared to June, July and September, while July has the highest number of 'high' danger class days. Although highest fire danger is within these four months, it should be noted that there are 'high' danger class days which extend into June and October and 'extreme' danger class days that extend into October (Figure 1).

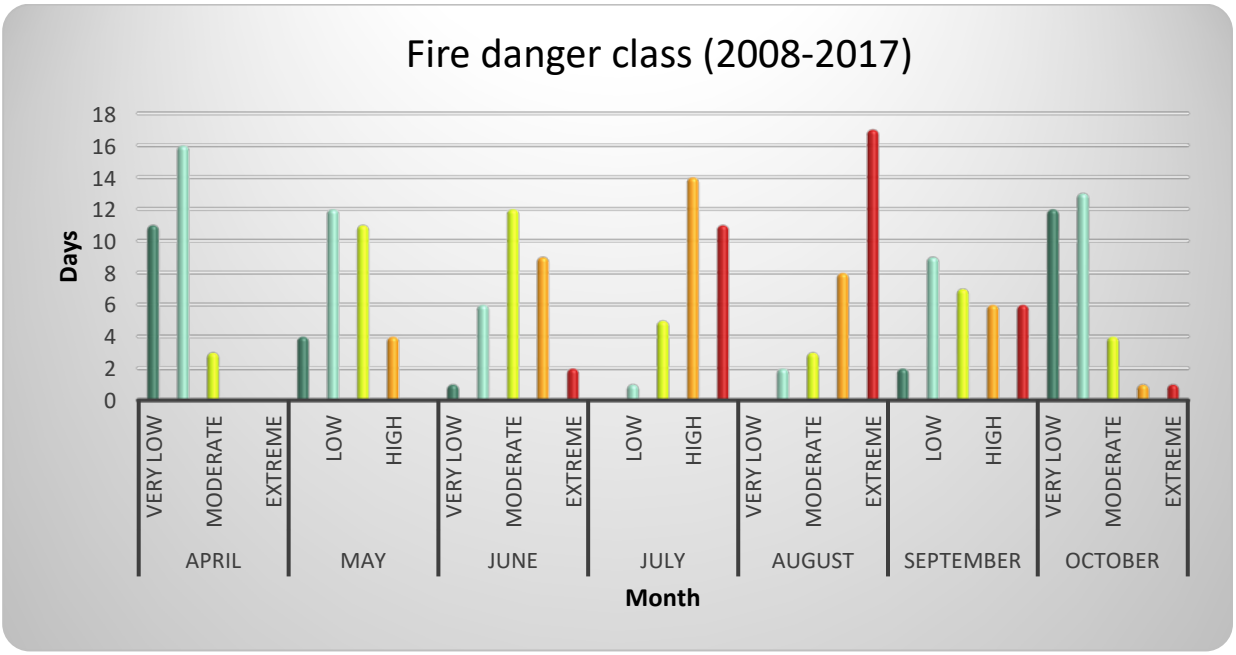


Figure 1. Average number of danger class days for the North Cowichan (EC) weather station. Summary of fire weather data for the years 2008 - 2017.

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.[38]

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.[39] Despite the uncertainties, trends within the data are visible. As outlined *in Climate Projections for the Cowichan Valley Regional District*[40], 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);

[38] International Panel on Climate Change. (2014) Climate change 2014: Synthesis report, summary for policymakers. 32p.
[39] 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.
[40] Cowichan Valley Regional District. 2017. Accessed online at: https://www.cvrd.bc.ca/DocumentCenter/View/81884/Climate-Projections-Report?bidId=

- 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:

- 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.[41] 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.[42]
- 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.[43] 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

[41] 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

[42] 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.

[43] 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.

temperatures; larger and more intense fires are expected and fire management will become more challenging.[44, 45]

- 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.[46]
- Future climatic conditions may be more suitable for, or give competitive advantage to, new species of plants, including invasive species.[47]

In summary, climate scientists expect that the warming global climate will trend towards wildfires that are increasingly larger, more intense and difficult to control. Furthermore, it is likely that these fires will be more threatening to WUI communities due to increased potential fire behaviour, fire season length, and fire severity. This trend is expected to be disproportionately felt in northern latitudes.[48]

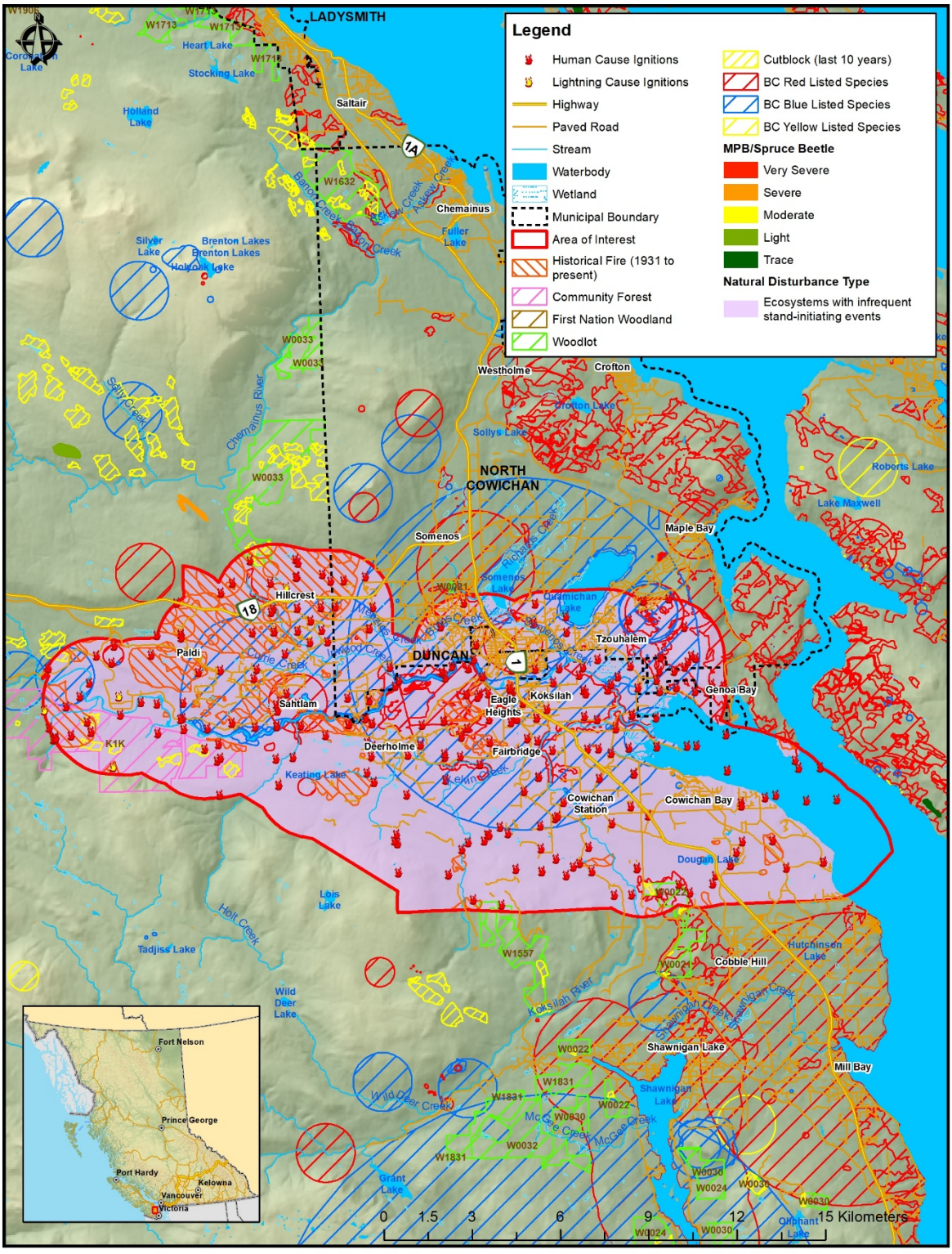
[44] Flannigan, M.D., A.S. Cantin, W.J. de Groot, M. Wotton, A. Newbery, L.M. Gowman. 2013. *Global wildland fire season severity in the 21st century*. Forest Ecology and Management (2013) 294: 54 - 61.

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

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

[47] 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

[48] 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 datasets to provide a coarse (high-level) spatial representation of wildfire threats across BC. The information in this section is a synthesis of the BCWS' Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component.[49] 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 fire front, 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.

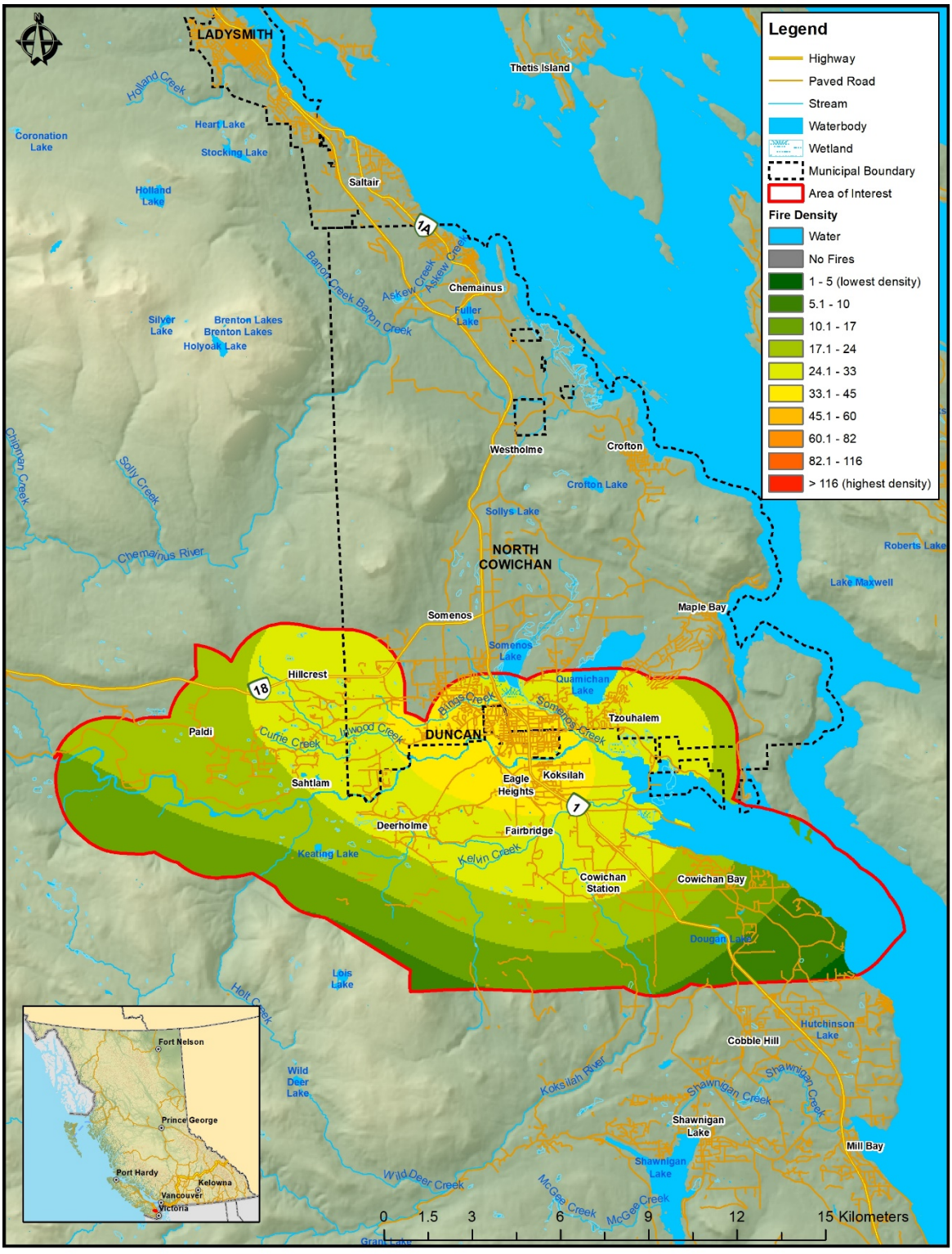
The final wildfire threat analysis value was developed through an average weighting process of the aforementioned three layers: fire density 30%; HFI 60%; and spotting impact 10%. Water bodies were automatically given a value of -1. The values were then separated into 10 classes (1 – 10) which represent increasing levels of overall fire threat (the higher the number, the greater the fire threat); threat class 7 is considered the threshold. Threat classes of 7 and higher are locations where the threat is severe enough to potentially cause catastrophic losses in any given fire season, when overlapping with values at risk. Classes were grouped into the following general threat class descriptions: low (1 – 3); moderate (4 – 6); high (7 – 8); and, extreme (9 – 10).

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

- Limited accuracy and variability of the fire history point data;
- Sensitivity to fuel type and the associated limitations of using fuel type approximations for fire behaviour modelling; and,
- 90th percentile rating for HFI, which represents a near worst-case scenario which may be artificial in some circumstances.

[49] BC Wildfire Service. 2015. *Provincial Strategic Threat Analysis 2015 Wildfire Threat Analysis Component*. Available online at: https://www.for.gov.bc.ca/ftp/!Project/WildfireNews/PSTA/Provincial_Strategic_Threat_Analysis_PSTA_2015_REPORT.pdf.

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.



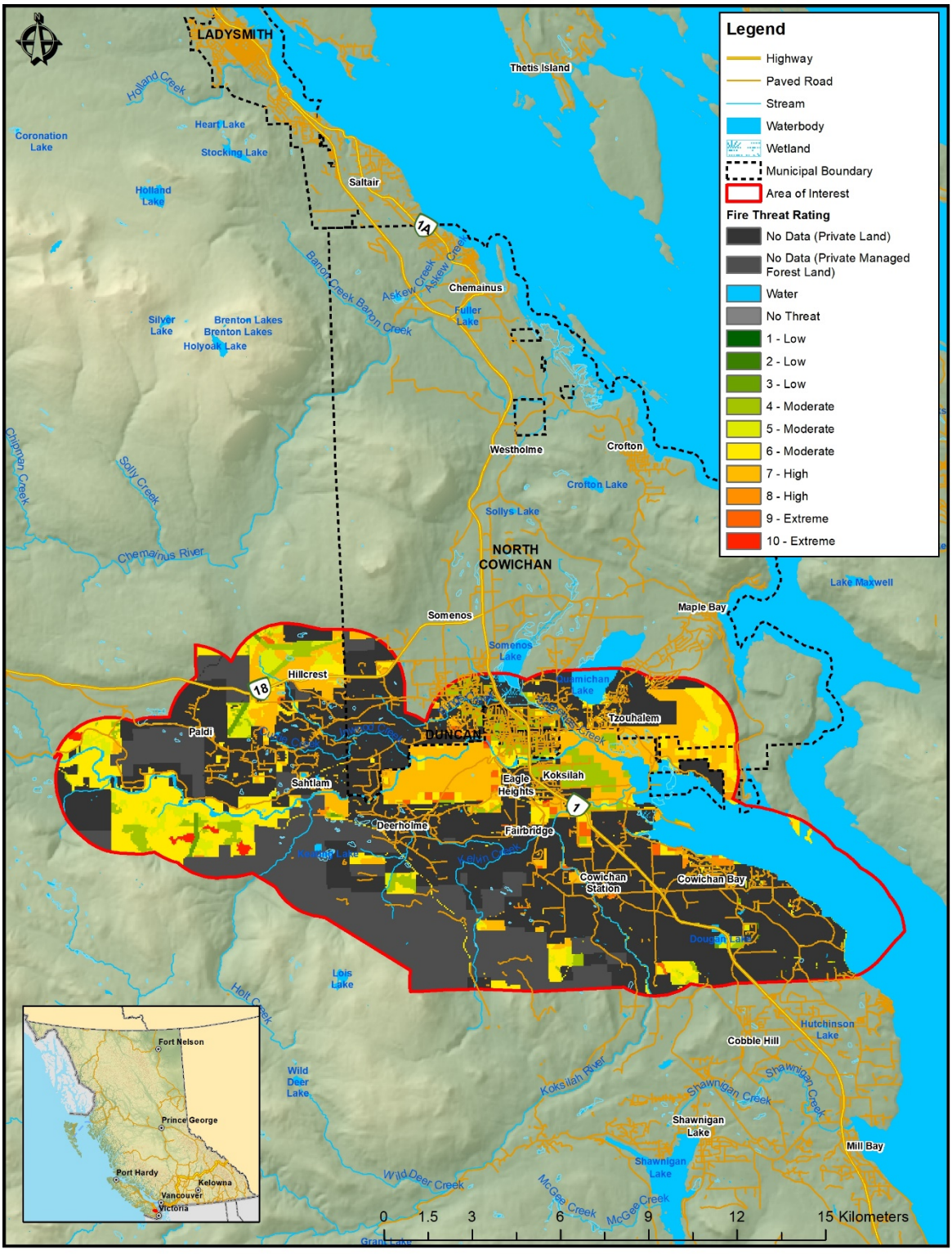
Map 5. Historical Fire Density

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 less than 1% of the AOI and water covers 11%. Approximately 16% 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 11% of the AOI, with the most notable high-threat areas being concentrated west of Duncan along the Cowichan River, in Cowichan Bay, surrounding parts of Tzouhalem and Hillcrest, and in smaller concentrated areas located south of Paldi and southwest of Sahtlam near Cowichan River (Map 6).

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

Threat Class	Area (ha)	Threat Class Description	Percent of AOI
-3	10,299	No Data (Private Land)	45%
-2	3,987	No Data (Private Managed Forest Land)	17%
-1	2,499	Water	11%
0	0	No Threat	0%
1	0	Low	0%
2	1		
3	72		
4	1,045	Moderate	16%
5	463		
6	2,174		
7	2,269	High	10%
8	68		
9	158	Extreme	1%
10	56		
Total	**23,092**	-	**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.

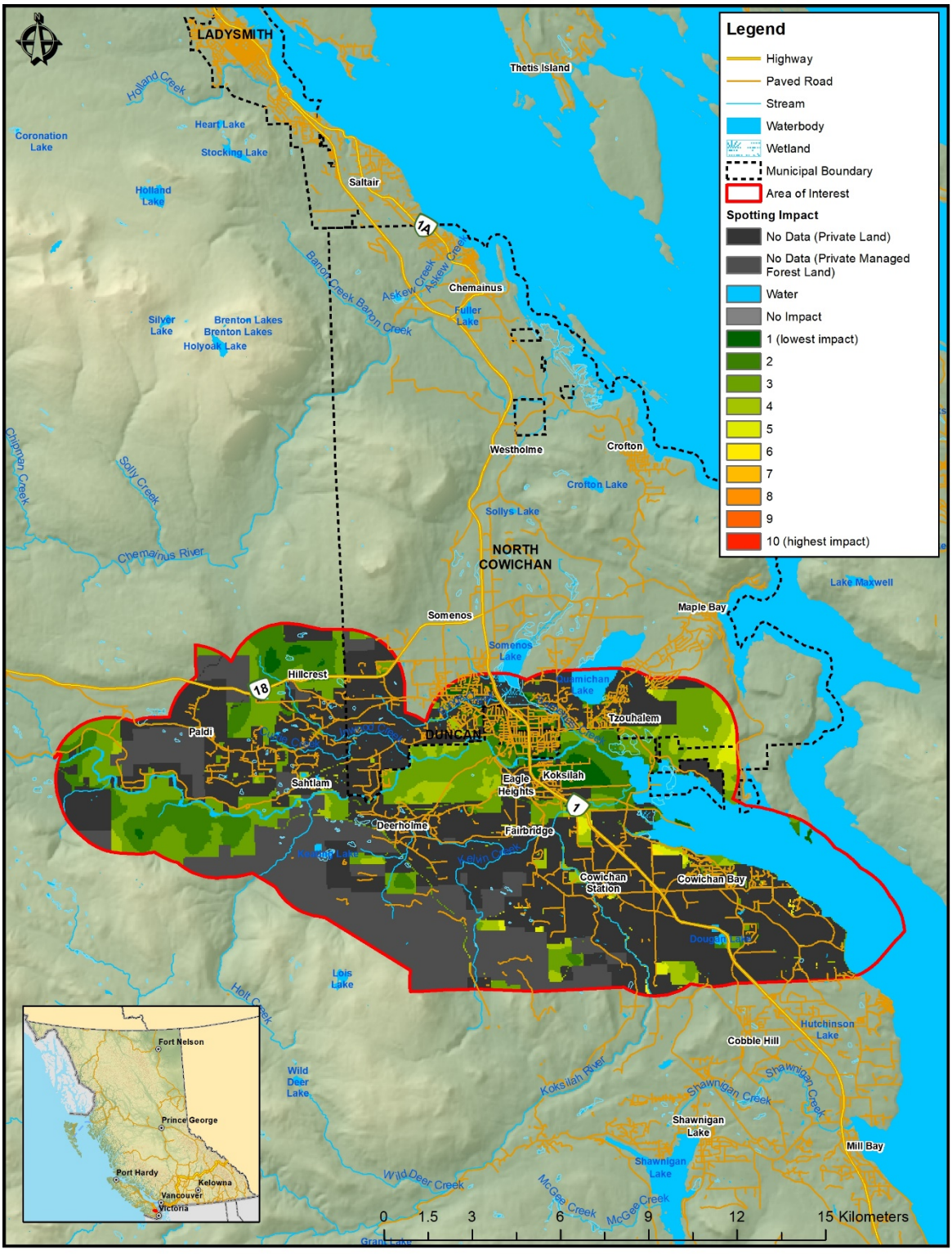
For example, an investigation of home destruction from the 2016 Fort McMurray, Alberta fire found that the vast majority of home ignitions in the interface (outer edges of urban neighbourhoods) were attributable to embers alighting on combustible material (home or adjacent areas).[50] Similarly, reports from the 2010 Fourmile Canyon fire outside Boulder, Colorado, found that only 17% of the 162 homes destroyed were attributed to crown fire.[51,52] 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.[52] 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 Cowichan Bay, east of Tzouhalem, and near Cowichan Station (Map 7).

[50] 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

[51] 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/.

[52] 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.

4.2.3 Head Fire Intensity

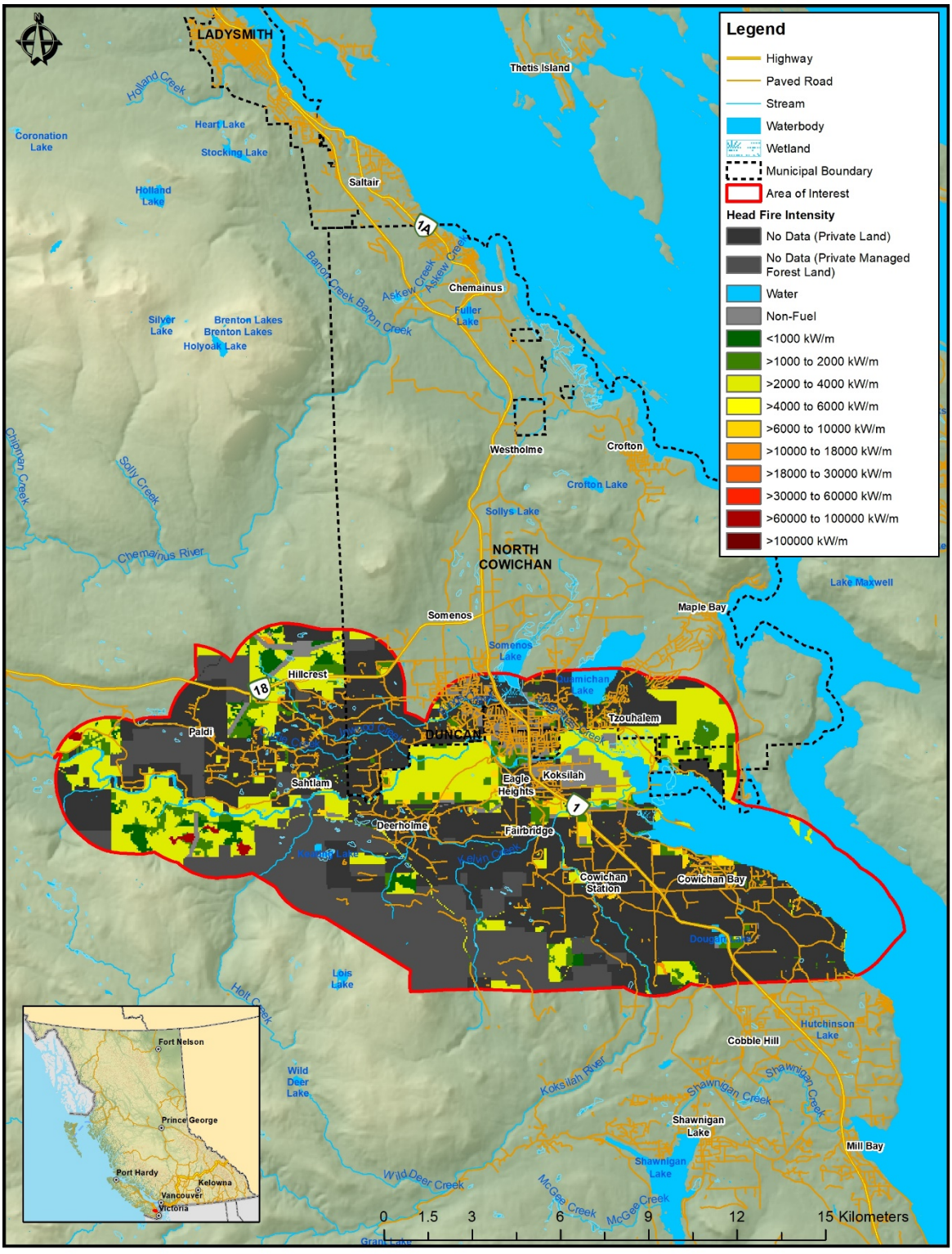
HFI is correlated with flame length and fire behaviour. The greater the fire intensity (kW/m), or HFI and fire intensity class, the more extreme the fire behaviour is likely to be and the more difficult the fire will likely be to suppress (Table 9 and Map 8).

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 4, 3 and 2 dominate throughout (Map 8). Class 2 is described as moderate vigour surface fire. Classes 3 and 4 are described as vigorous surface fire, with occasional torching in class 4.

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

PSTA - HFI Class	Fire Intensity kW/m	Fire Intensity Class[53]	Percent of AOI	Flame Length (meters)[54]	Likely Fire Behaviour[55]
1	0.01 – 1,000	2	1%	< 1.8	Smouldering surface fire
2	1,000.01 – 2,000	3	5%	1.8 to 2.5	Moderate vigour surface fire
3	2,000.01 – 4.000	4	17%	2.5-3.5	Vigorous surface fire
4	4,000.01 – 6,000	5	0%	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	0%	18.2 to 25.6	Extremely vigorous surface fire and continuous crown fire
8	30,000.01 – 60,000	6	0%	>25.6[56]	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

[53] Head fire intensity should be classified by intensity class not fire rank. Fire rank is a visual description of conifer fires for air operations.
[54] 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).
[55] These characteristics will be different in open and closed forest fuel.
[56] With HFI over 30 000 kW/m the function of the equation is 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 Central 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 415 fire incidents within the AOI; 304 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 1923 and 1951 with the largest covering 1,616 ha and the smallest of the ten covering 61 ha within the AOI (average of 275 ha). Regardless of area burn extent, however, the majority (68%) of the fire events occurred in the two decades between 1919 and 1939, with the remainder occurring in the 1940s-1970s (25 fires) and 2012 (1 fire). All but one fire were defined as human-caused. The majority (86%) of the fires that overlapped or occurred exclusively within the AOI were under 100 ha in size and 51% were under 20 ha in size.

4.3 LOCAL WILDFIRE THREAT ASSESSMENT

WUI Threat Assessments were completed over three field days in February of 2018, 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 AOI 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 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 24 WUI threat plots were completed and over 110 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.[57] 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.[58] 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 AOI, fuel types which cannot accurately capture the natural variability within a polygon, and limitations in the data used to create initial fuel types.[58] 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 AOI 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 the AOI, the fuel type that may be considered hazardous in terms of fire behaviour and spotting potential is C-3. This fuel type can sometimes represent hazardous fuels, particularly if there are large amounts of woody fuel accumulations or denser understory ingrowth. C-5 fuel types have a moderate potential for active crown fire when wind-driven.[58] An M-1/2 fuel type can sometimes be considered hazardous, depending on the proportion of conifers within the forest stand; conifer fuels include those in the overstory, as well as those in the understory. An O-1b fuel type often can support a rapidly spreading grass or surface fire capable of damage or destruction of property, and jeopardizing human life, although it is recognized as a highly variable fuel type dependent upon level of curing.[59] The O-1b fuel

[57] Forestry Canada Fire Danger Group. 1992. Development and Structure of the Canadian Forest Fire Behavior Prediction System: Information Report ST-X-3.
[58] 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.
[59] Ibid.

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 variable height to live crown; variable crown separation 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
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)

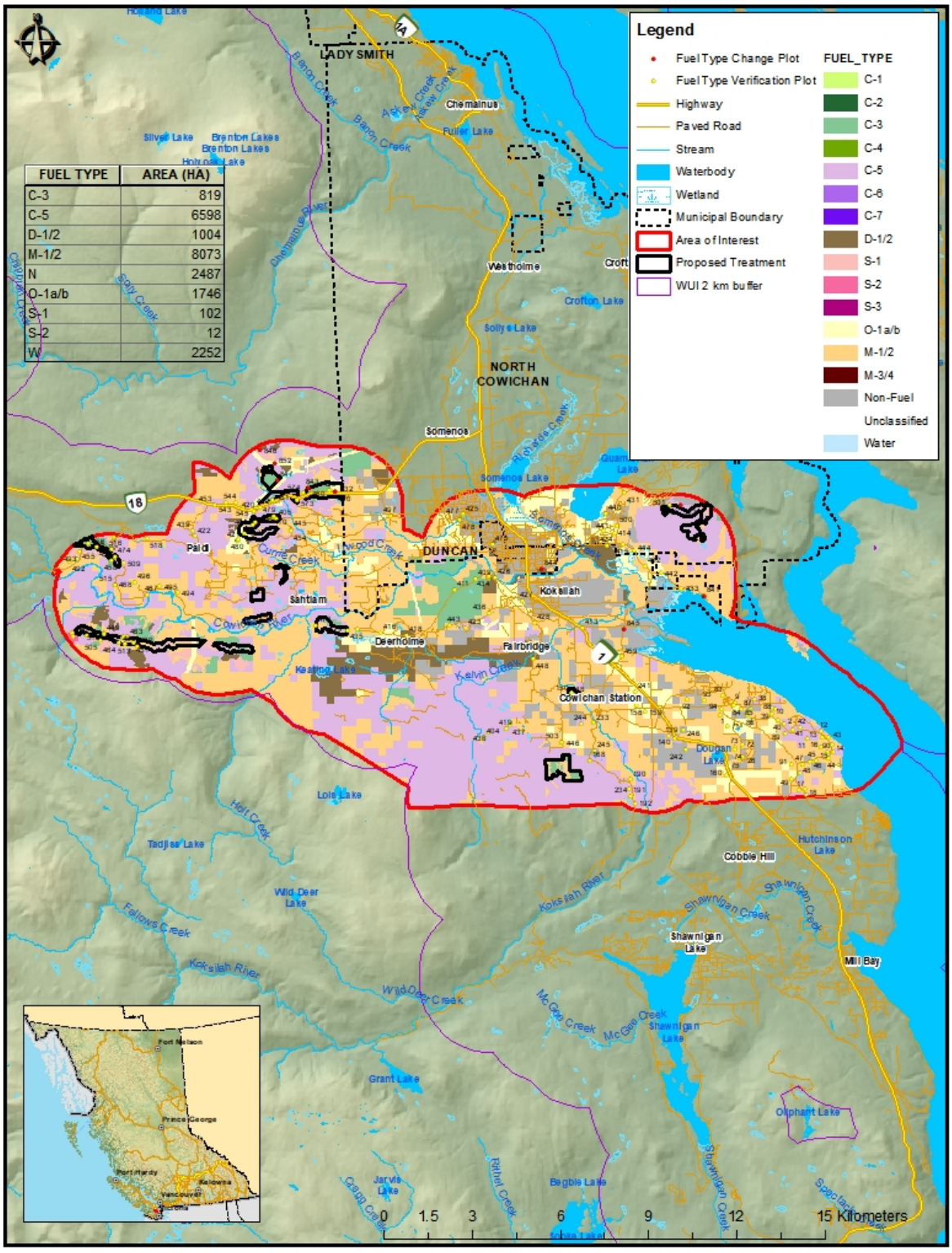
Fuel Type	FBP/CFDDRS Description	Study Area Description	Wildfire Behaviour Under High Wildfire Danger Level	Fuel Type – Crown Fire/Spotting Potential
D-1/2	Aspen (leafless and green)	Deciduous stands	Always a surface fire, low to moderate rate of spread and fire intensity	Low
S-1/2	Slash (jack/ lodgepole 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 AOI 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, six recurring patterns of fuel type errors were found in the provincial dataset. They were:

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

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. 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. Representative BCWS ISI Roses were not available for the AOI; however, hourly wind data from the North Cowichan Environment Canada (EC) weather station was used and compiled to produce wind roses (Figure 2). These provide 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 north (approximately 27-42% of the time). Winds also occur to a lesser degree from the northeast to southwest in most

months (<5-18% of the time). Wind speeds over 20 km/hour are rare (≤1% frequency), but occur in April, May, July and October (Figure 2). An average of hourly wind readings for the fire season also shows that winds are predominantly from the north and to a lesser degree from the northeast and south; predominantly at windspeeds up to 10 km/hr (approximately 90% of the time) and gusting upwards of 20 km/hr (Figure 3). Potential treatment areas were identified and prioritized with the predominant wind direction in mind; wildfire that occurs upwind of a value poses a more significant threat to that value than one which occurs downwind.

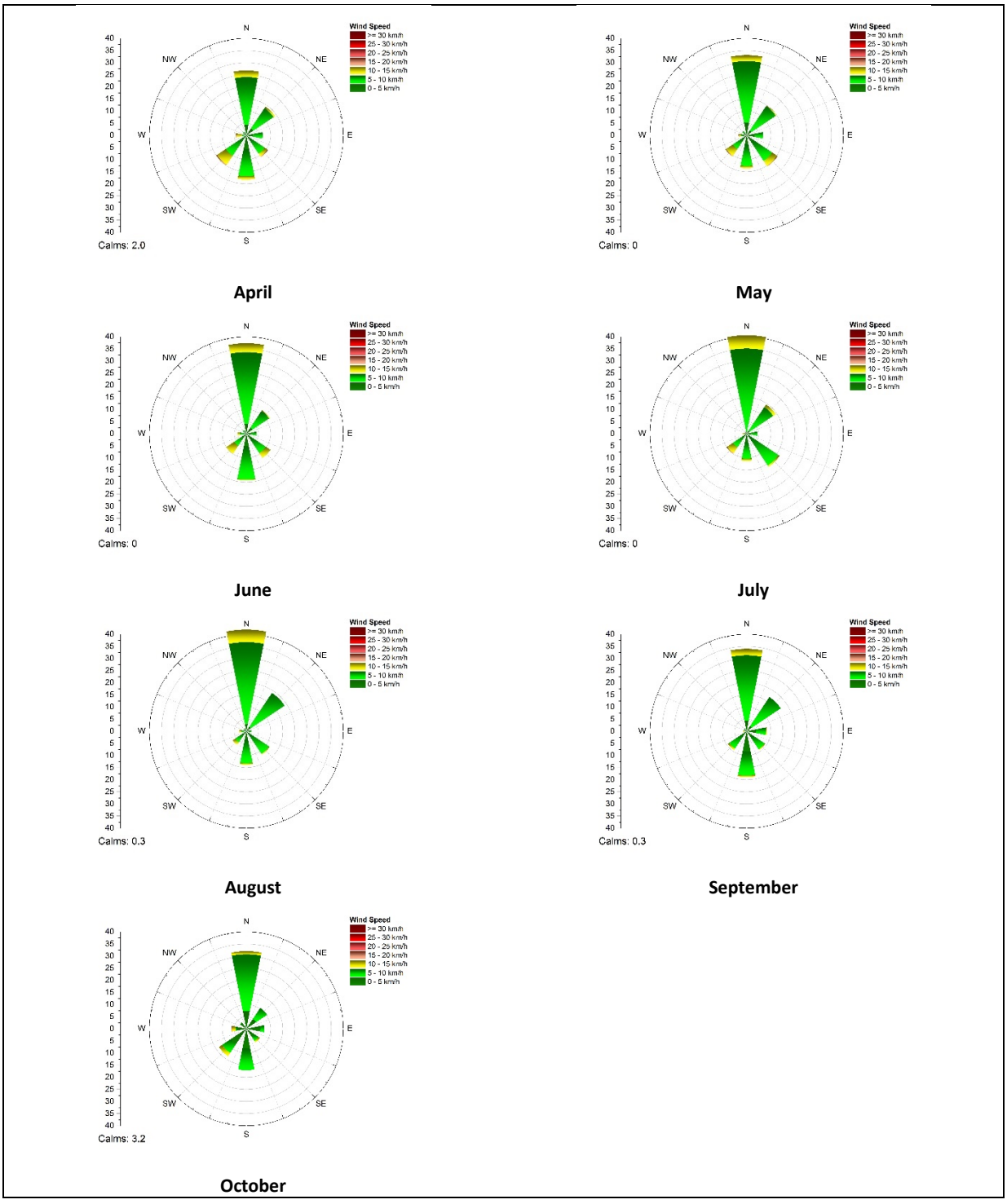


Figure 2. Wind roses depicting average hourly wind speed for the fire season April – October. Left scale represents the frequency of readings in %, while calms represent the frequency of no wind events.

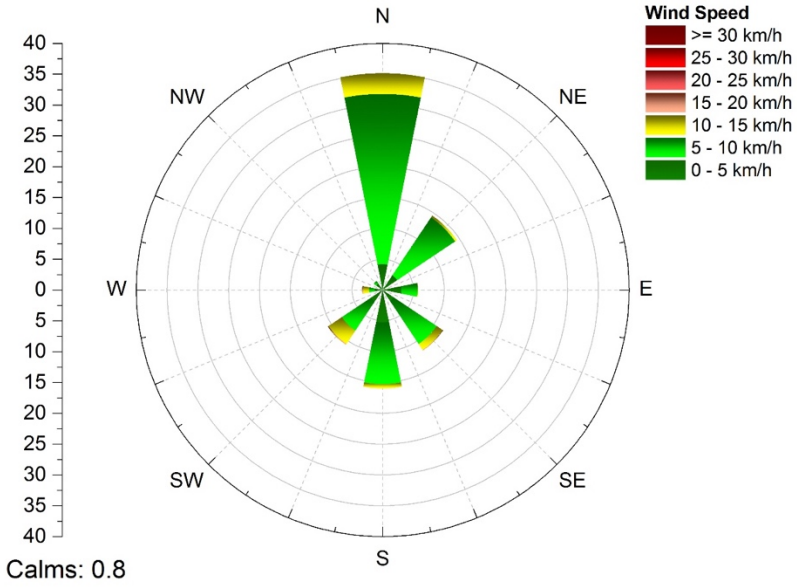


Figure 3. Windrose showing average hourly wind readings during the fire season (April 1 – October 31) for the period 2008-2017. Data taken from the North Cowichan (EC) weather station.

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 (82%) is on less than 20% slope and will likely not experience accelerated rates of spread due to slope class. Approximately 15% percent of the AOI is likely to experience an increased or high rate of spread, while 3% is likely to experience very high to extreme rate of spread. On the larger topographic scale, the communities in the Central 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%	82%	Very little flame and fuel interaction caused by slope, normal rate of spread.
21-30%	9%	Flame tilt begins to preheat fuel, increase rate of spread.
31-45%	6%	Flame tilt preheats fuel and begins to bathe flames into fuel, high rate of spread.
46-60%	2%	Flame tilt preheats fuel and bathes flames into fuel, very high rate of spread.
>60%	1%	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 AOI 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).

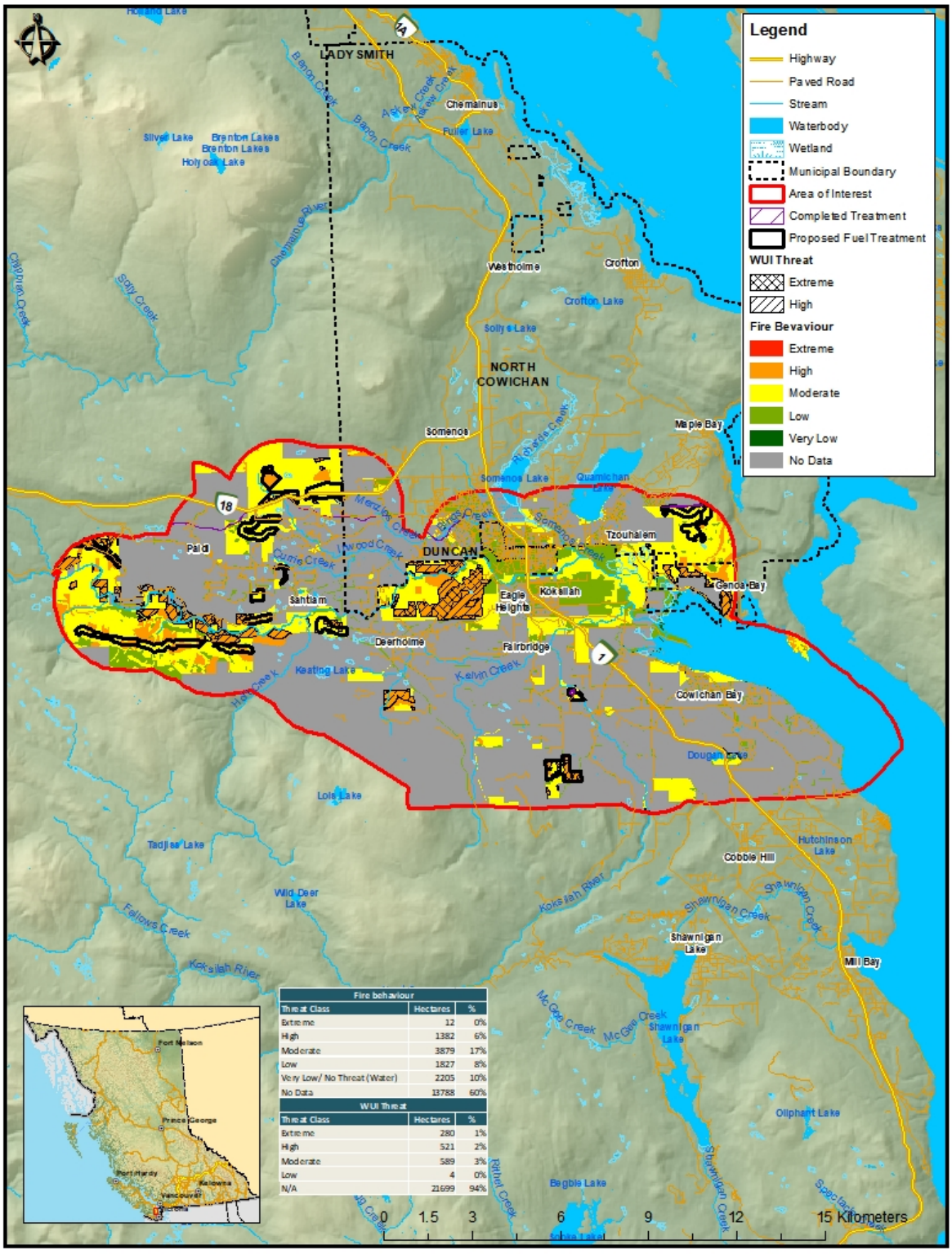
The result of the analysis shows that the AOI is composed of a mosaic of very low, low, moderate and high threat class stands; the variability in wildfire threat is dictated primarily by the level of natural and anthropogenic disturbances that have historically occurred and persist on the landbase. The AOI is less than 1% extreme threat class rating, 6% high, 17% moderate, 8% low and 10% 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 Central Zone are areas of high threat class along the Cowichan River west of Sahtlam, southwest of Duncan along Indian Road, south of Deerholme east of Keating Lake, surrounding Genoa Bay, and in the Mines Road area 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 AOI.

Wildfire Behaviour Threat Class	2017 Fire Behaviour Threat	2017-2018 CWPP
	Percent of AOI	Percent of AOI
Extreme	1%	0%
High	10%	6%
Moderate	16%	17%
Low	<1%	8%
Very Low/ No Threat (Water)	11%	10%
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 and federal), First Nations and private landowners. The cooperative effort of the aforementioned parties is crucial in order to develop and proactively implement a wildfire risk mitigation program. Development of a successful wildfire risk mitigation strategy is dependent on hazard identification within the community, which accounts for forest fuels, high risk activities, frequency and type of human use, and other important environmental factors. The resulting wildfire risk management and mitigation strategy aims to build more resilient communities and produces strategic recommendations or actionable items that can be categorized as follows:

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

5.1 FUEL MANAGEMENT

Fuel management, also referred to as vegetation management or fuel treatment, is a key element of 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. The principles of fuel management are outlined in detail in Appendix I – Principles of Fuel Management.

Fuel treatments have been completed on approximately 30.5 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 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. It should also be noted that although fuel treatments have the potential to decrease potential fire intensity and the likelihood of extreme fire behaviour, they can also increase surface wind speeds by opening up the canopy and therefore have the potential to increase the speed at which a fire may spread across the landscape. Those undertaking the planning and implementation of fuel treatments should acknowledge this and plan accordingly.

Historically, funds from public sources, such as Union of British Columbia Municipalities (UBCM) and the Forest Enhancement Society of BC (FESBC), 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 FireSmart planning on private land and partial rebates for select FireSmart activities (subject to program requirements and limits).[60] 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.

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;

[60] 2019 CRI FireSmart Community Funding & Supports – Program & Application Guide: https://www.ubcm.ca/assets/Funding~Programs/LGPS/CRI/cri-2019-program-guide.pdf

- Treatment implementation should consider the possibility of invasive species spread during treatments and mitigation options should be considered;
- 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, 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 best management practice 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.[61]

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 Highway 1 in the event of evacuation through reduction of hazardous fuels and landscape level fuel treatment.

RECOMMENDATION #23: Work with the Ministry of Transportation and Infrastructure (MOTI), to assess the entirety of Hwy 1 and Hwy 18 and reduce hazardous fuels within 150 m of either side of the road, where possible. This is to increase public safety/improve emergency access in the event of an evacuation or wildfire event.

5.1.1 Proposed Treatment Units

Funding opportunities from UBCM and SWPI 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[62]. Fire

[61]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

[62] 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

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. It should be noted that the location of proposed treatment units on these land ownership types does not imply that high and extreme hazard areas do not exist on private or private managed forest land within the AOI. As stated in Section 5.1, mitigation approaches should also be pursued on private land where hazard exists, bearing in mind the different funding resources and objectives on these land types. Recommendation for treatment in areas of moderate fire hazard areas were limited to areas which would increase efficacy of, and/or create continuity between, previously treated areas (link treatment areas to each other or to low/no fuel areas). All polygons identified for potential treatment have been prioritized based on fire hazard, operational feasibility, estimated project cost, type and number of values at risk, common fire weather (wind direction), and expected efficacy of treatment. Although potential treatment areas have been ground-truthed during field work, additional refinement of the polygons will be required at the time of prescription development.

Proposed treatment areas within the AOI are outlined in Table 15 and depicted in Map 11.

Fuel Treatment Types

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

Interface Fuel 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 treatments 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[63], 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 #24: 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 #25: Develop 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.

[63] 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		
4	Skutz Falls 1	High	16.0	Primary Fuel Break	14.3	1.7	0.0	This proposed treatment unit (PTU) overlaps entirely with trapline tenure TR0105T317, in addition to the Cowichan FDU per the BCTS East and Southwest Coast FSP 2007. There is overlap with a non-legal old growth management area (OGMA), the Conservation Data Centre (CDC) blue-listed Macoun's groundsel (*Packera macounii*), and with Marbled Murrelet wildlife habitat area (WHA). Coastal cutthroat trout have been observed within the PTU. Consultation with the ecosystem biologist, MFLNRORD South Island Natural Resource District, BC Timber Sales (BCTS), Snaw-Naw-As Forest Services Ltd., Otter Point Timber Ltd and all appropriate licensees must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is located approximately 650 m west of homes and businesses on Stoltze Rd, north of Cowichan River Provincial Park. This area has been recommended for treatment due to its potential to act as a Primary Fuel Break, due to the presence of hazardous fuels, and its high potential for commercial thinning opportunities to offset the costs of treatment. The stands characteristic of this area are primarily mature, conifer dominated stands (C-5 fuel types) with moderate stand densities, high fine woody fuel continuity, moderate medium and coarse woody fuel levels, and scattered/patchy ladder fuels. The combination of these factors contributes to potential for crown fire behavior. This PTU extends beyond the Central Zone AOI and into the West Zone AOI. It is recommended that these areas are treated concurrently to enhance the ability of the treatment area to act as a fuel break and to maximize the area of reduced fire threat. Recommended treatments include thinning from below, pruning of retained trees, and reducing fuel loading and fuel continuity.

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	Skutz Falls 2	High	13.6	Primary Fuel Break	11.0	2.6	0.0	This proposed treatment unit lies entirely within trapline tenure TR0105T317. The northern portion of the PTU overlaps with Cowichan FDU, per the BCTS East and Southwest Coast FSP 2007. There is minimal overlap with a non-legal OGMA and there are overlaps in the eastern extent with the CDC red-listed species common bluecup (*Githopsis specularioides*). A Marbled Murrelet wildlife habitat area (WHA) is present and the southern portion overlaps with Cowichan Lake Provincial Park. Consultation with the ecosystem biologist, MFLNRORD South Island Natural Resource District, BCTS, Snaw-Naw-As Forest Services Ltd., Otter Point Timber Ltd., all appropriate licensees, and BC Parks must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Skutz Falls 2 PTU is located approximately 350 m southwest of homes and businesses on Stoltze Rd, north of Cowichan River Provincial Park. This area has been recommended for treatment due to its location relative to values, the presence of hazardous fuels, and its high potential for commercial thinning opportunities to offset the costs of treatment. The stands characteristic of this area are primarily conifer dominated stands with moderate to high densities (C-5 and C-3 fuel types), high fine woody fuel continuity, moderate medium and coarse woody fuel levels present throughout, and scattered/patchy ladder fuels. The combination of these factors contributes to potential for crown fire behavior. Recommended treatments include thinning from below, pruning of retained trees, and reducing fuel loading and continuity.
5	Inwood Park 2	High	27.1	Interface Fuel Break	9.9	17.2	0.0	This proposed treatment unit is entirely contained within trapline tenure number TR0105T317, and there is significant overlap with the Cowichan FDU, as per the BCTS East and Southwest Coast FSP 2007. This PTU is located within the buffer zone of a masked CDC SAR occurrence. Overlaps with the CDC red-listed Western Redcedar/Common Snowberry ecological community (*Thuja plicata/Symphoricarpos albus*) and blue-listed Macoun's groundsel (*Packera macounii*). Consultation with the ecosystem biologist, BCTS, Snaw-Naw-As Forest Services Ltd., Otter Point Timber Ltd., and all appropriate licensees must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is located approximately 100-200 m from private residences across Highway 18 and 30-100 m from the Cowichan Valley Trail. This area was identified for treatment due to high ingrowth of Douglas-fir, western hemlock, and western redcedar which increases potential crown fire behaviour. The PTU is also adjacent to Highway 18, which is the primary access and egress corridor for communities located west of Duncan in the CVRD. The stands characteristic of this area are primarily classified as C-5 fuel types.

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		
12	Hillcrest 2	High	26.7	Primary Fuel Break	26.7	0.0	0.0	This proposed treatment unit is entirely contained within trapline tenure TR0105T317 and slightly overlaps an active Christmas Tree Permit along its southeastern edge. The PTU completely overlaps with Cowichan FDU, per the BCTS East and Southwest Coast FSP 2007. The PTU is also located within the buffer zone of a masked CDC SAR occurrence, and there is minor overlap on western edge with the CDC red-listed Western Redcedar/Common Snowberry ecological community (*Thuja plicata*/*Symphoricarpos albus*). Negligible overlap occurs with one sensitive ecosystem area. Consultation with the ecosystem biologist, BCTS, Snaw-Naw-As Forest Services Ltd., Otter Point Timber Ltd., and all appropriate licensees must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Hillcrest 2 PTU is located north of Highway 18, approximately 600m southwest of homes and adjacent to a BC Hydro right-of-way (ROW). Proposed treatments are intended to create a primary fuel break, which would be bolstered by the pre-existing, cleared ROW. The fuel types identified in this PTU were primarily C-3, with high stand densities, high laddering potential, and moderate to low surface fuel loading. Potential treatments include thinning the smallest diameter classes to create a shaded fuel break and pruning to 3m to reduce laddering potential.
15	Tzouhalem Community Forest 1	High	31.3	Primary Fuel Break	0.0	31.3	0.0	This proposed treatment unit is located within the buffer zone of a masked CDC species-at-risk occurrence. Overlaps also occur with the CDC red-listed Garry Oak/Oceanspray ecological community (*Quercus garryana/Holodiscus discolor*); blue-listed California Tea (*Rupertia physodes*); red-listed Douglas-fir/Oregon dull-grape ecological community (*Pseudotsuga menziesii/Berberis nervosa*); blue-listed Ermine, *Anguinae* subspecies (*Mustela erminea anguinae*); red-listed Garry oak/California brome ecological community (*Quercus garryana/Bromus carinatus*); and the blue-listed Nuttall's Quillwort (*Isoetes nuttallii*). There is overlap in the PTU's western extent with one sensitive ecosystem area. Consultation with the ecosystem biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This proposed treatment unit is located less than 100m southeast of the residential neighbourhood adjacent to Mount Tzuhalem Ecological Reserve. This area has been recommended for treatment due to its location relative to homes and the ecological reserve, its high recreational use, as well as its potential as a combined commercial thinning and hazard reduction treatment. The stands within this treatment unit are characterized by C-7 and C-5 fuel types with moderate stand densities, and low fine and medium woody fuel levels present throughout. The treatment unit was strategically located adjacent to a previously treated area in order to bolster the effectiveness of this previous treatment.

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		
1	Hillcrest 1	Moderate	56.3	Primary Fuel Break	1.2	48.8	6.3	This treatment unit has complete overlap with trapline tenure TR0105T317, and a nearly complete overlap with Cowichan FDU, as per the BCTS East and Southwest Coast FSP 2007. The PTU is also located within the buffer zone of a masked CDC SAR occurrence, and there is overlap with the CDC blue-listed Macoun's groundsel (*Packera macounii*). There is minor overlap with one sensitive ecosystem area and, in the southeastern extent, with a mapped swamp. Consultation with the ecosystem biologist, 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.	The Hillcrest 1 PTU is intended to act as a primary fuel break to protect Highway 18, a main access and egress corridor for communities in the western part of the CVRD. It is also located less than 100m west of private residences. Stands within this area range from high density conifer dominated stands (C-3 fuel types) to moderate density, mature conifer stands (C-5 fuel types). Potential treatments include thinning of smaller diameter class stems and pruning to reduce laddering potential, removing standing dead or dying trees, and removing surface fuels.
2	Cowichan River Park	Moderate	31.8	Interface Fuel Treatment	5.6	25.7	0.5	The CDC red-listed Dun Skipper (*Euphyes vestris*) is present in this proposed treatment unit, and there is significant overlap with Cowichan River Provincial Park. Consultation with the ecosystem biologist and BC Parks must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Cowichan River Park PTU is a mixture of C-3, C-5 and mixed wood (M-1/2) fuel types. Densities vary substantially throughout and there is potential for commercial thinning treatment. There are private residences directly adjacent to the proposed treatment unit, which is intended to function as an interface fuel break to protect adjacent structures and bolster access and egress routes for local residents. Recommended treatments include thinning of smaller diameter class stems, surface fuel removal, and pruning retained trees.

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		
3	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.	The Pannel Road 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.
6	Hanks Road 1	Moderate	13.2	Interface Fuel Treatment	0.0	13.2	0.0	A non-legal OGMA is almost entirely contained within the northern half of this proposed treatment unit. The CDC blue-listed Macoun's groundsel (*Packera macounii*) is present; otherwise, there is a minor overlap with one sensitive ecosystem area on the western edge of the PTU. Consultation with the ecosystem biologist and MFLNRORD South Island Natural Resource District must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is located south of private residences in the western part of Sahtlam. The stands characteristic of this area are mature, conifer stands (C-5 fuel types) of primarily Douglas-fir. A light treatment is recommended to reduce the fire behaviour potential in this PTU, including thinning of smaller diameter stems, pruning retained trees, and removing surface fuels.
7	Skutz Falls FSR Central	Moderate	49.0	Primary Fuel Break	18.2	30.8	0.0	This proposed treatment unit has significant overlap with Community Forest FFID K1K A Schedule B, Khowutzun Forest Services Limited Partnership, and the CFA FDU, per Cowichan Tribes Community Forest FSP K1K. This PTU also has overlap with two sensitive ecosystem areas. Consultation with the ecosystem biologist, Khowutzun Forest Services Ltd. and all appropriate licensees must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Skutz Falls FSR proposed treatment areas (3) are intended to function together as a Primary Fuel Break by creating a 200 m wide area with decreased fire behaviour potential. The proposed fuel break is located south of the Cowichan River and was strategically selected given its location at a 90-degree offset to prevailing wind conditions in relation to private residences. Skutz Falls FSR Central is primarily composed of mixed conifer and deciduous stands (M-1/2 fuel types), with some conifer dominated C-3 and C-5 fuel types.

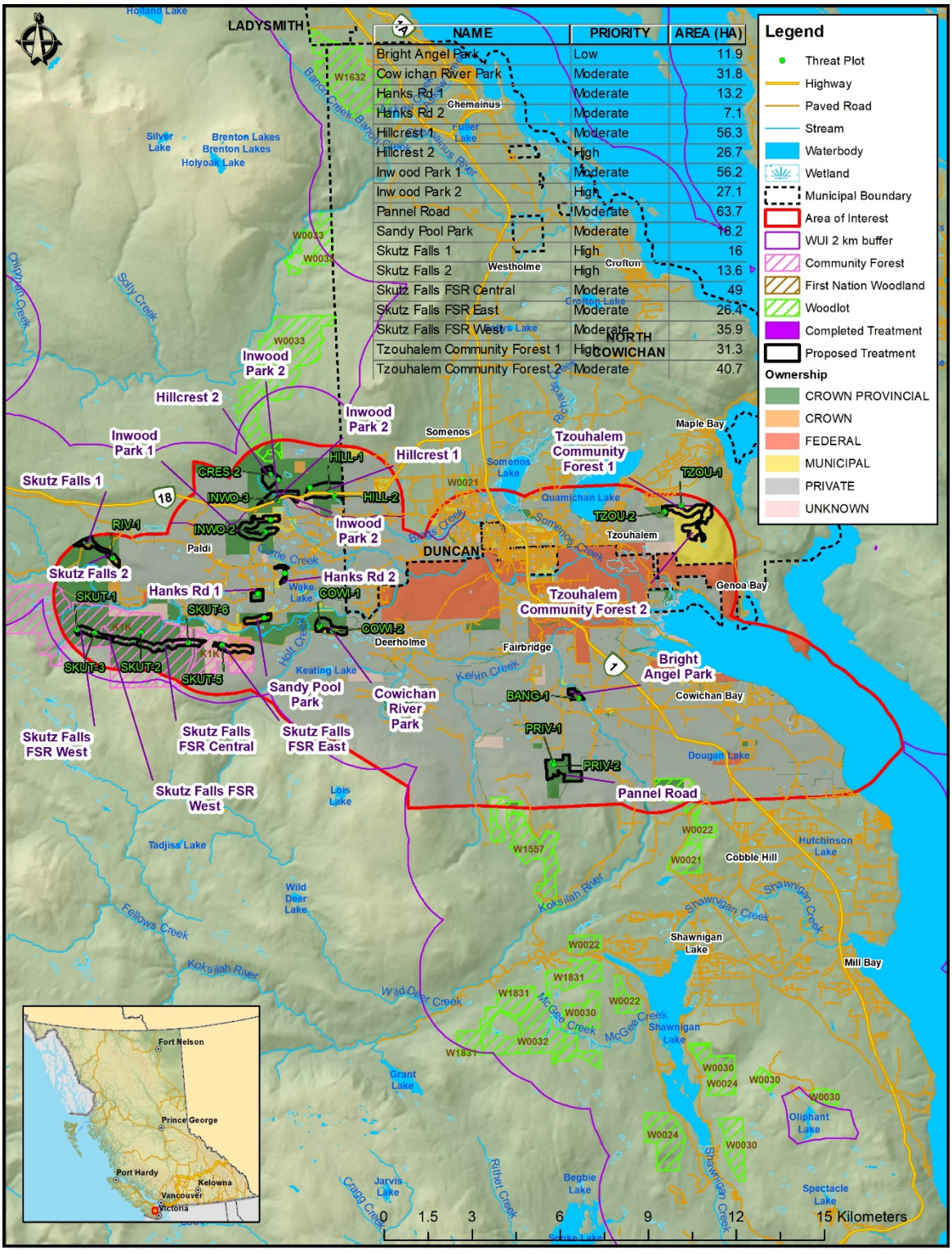
FTU # and Stratum	Geographic Area	Priority	Total Area (ha)	Treatment Unit Type/ Objective	Local Fire Threat (ha)			Overlapping Values/ Treatment Constraints*	Treatment Rationale
					Extreme/ High	Mod	Low		
17	Skutz Falls FSR West	Moderate	38.2	Primary Fuel Break	11.2	27.0	0.0	This proposed treatment unit has significant overlap with Community Forest FFID K1K A Schedule B, Khowutzun Forest Services Limited Partnership, and the CFA FDU, per Cowichan Tribes Community Forest FSP K1K. The western half of PTU overlaps with trapline tenure TR0105T317. There is also overlap with one sensitive ecosystem area. Consultation with the ecosystem biologist, Khowutzun Forest Services Ltd., and all appropriate licensees and/or clients must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Skutz Falls FSR proposed treatment areas (3) are intended to function together as a Primary Fuel Break by creating a 200 m wide area with decreased fire behaviour potential. The proposed fuel break is located south of the Cowichan River and was strategically selected given its location at a 90-degree offset to prevailing wind conditions in relation to private residences. Skutz Falls FSR West is dominated by mature forest stands (C-5 fuel types), higher density conifer stands (C-3 fuel types) and mixed deciduous and conifer stands (M-1/2 fuel types). These stands have significant accumulations of coarse woody fuels and conifer ingrowth in openings. Laddering potential varies throughout the PTU but is high in some areas.
8	Skutz Falls FSR East	Moderate	26.4	Primary Fuel Break	14.0	10.5	1.9	This proposed treatment unit has significant overlap with Community Forest FFID K1K A Schedule B, Khowutzun Forest Services Limited Partnership, and the CFA FDU, per Cowichan Tribes Community Forest FSP K1K. This PTU also has overlap with five sensitive ecosystem areas. Consultation with the ecosystem biologist, Khowutzun Forest Services Ltd., and all appropriate licensees and/or clients must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Skutz Falls FSR proposed treatment areas (3) are intended to function together as a Primary Fuel Break by creating a 200 m wide area with decreased fire behaviour potential. The proposed fuel break is located south of the Cowichan River and was strategically selected given its location at a 90-degree offset to prevailing wind conditions in relation to private residences. Skutz Falls FSR East is composed of a mixture of fuel types, but is dominated by higher density coniferous stands (C-3 fuel types) and mature coniferous stands (C-5 fuel types), with a small component of M-1/2 with high conifer percentage.

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		
9	Sandy Pool Park	Moderate	18.2	Interface Fuel Break	3.2	15.0	0.0	There are three occurrences of red and blue-listed species and ecosystems within or intersecting with this PTU, including red-listed Western Red-cedar/Common Snowberry ecological community (*Thuja plicata/Symphoricarpos albus*), blue-listed Macoun's groundsel (*Packera macounii*), and blue-listed Black Cottonwood-Red Alder/Salmonberry ecological community (*Populus trichocarpa - Alnus rubra/Rubus spectabilis*). There is also overlap in the east with a growth and yield plot and significant overlap with Cowichan River Provincial Park. Consultation with the ecosystem biologist, BC Parks and Forest Inventory MFLNRORD department must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Sandy Pool Park PTU is located directly adjacent to private residences along West Riverbottom Rd, south of Sahtlam. The stands that are characteristic of this area are primarily a mix of deciduous and conifer tree species, with a higher proportion of deciduous species. The majority of the PTU was assessed as moderate fire threat. Potential treatments would include surface fuel removal and dwarf mistletoe mitigation (currently affecting ~20% of western hemlock) to reduce future fuel loading.
10	Hanks Road 2	Moderate	7.1	Interface Fuel Break	0.0	6.5	0.6	This proposed treatment unit overlaps with the CDC blue-listed Macoun's groundsel (*Packera macounii*). A stream passes through this PTU. Consultation with the ecosystem biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	The Hanks Road 2 PTU is located adjacent to private residences (<50m) in Sahtlam. The PTU is primarily comprised of mature Douglas-fir forest stands (C-5 fuel types), with smaller components of western redcedar and western hemlock. The location of this unit was strategically planned due to its position 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		
11	Inwood Park 1	Moderate	56.2	Primary Fuel Break	0.0	54.7	1.5	This proposed treatment unit overlaps with the CDC blue-listed Macoun's groundsel (*Packera macounii*), and there is small overlap in the northern extent of the PTU with two sensitive ecosystem areas. Consultation with the ecosystem biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This PTU is located south of Highway 18 and the Cowichan Valley Trail. The stands are dominated by mature, conifer dominated stands (C-5 fuel types) and conifer and deciduous mixes (M-1/2 fuel types). This unit is directly west of private residences in the Hillcrest area. A light treatment is recommended to reduce fire behaviour potential to acceptable levels, specifically by thinning smaller diameter stems to reduce laddering potential.
14	Tzouhalem Community Forest 2	Moderate	40.7	Primary Fuel Break	0.1	40.0	0.6	This proposed treatment unit is located within the buffer zone of a masked CDC species-at-risk occurrence. In addition, overlap with the CDC blue-listed Ermine, *Anguinae* subspecies (*Mustela eminea anguinae*) and the red-listed Douglas-fir/Oregon dull-grape ecological community (*Pseudotsuga menziesii/Berberis nervosa*) occurs. Consultation with the ecosystem biologist must occur during prescription development and prior to implementation to ensure all concerns are addressed.	This proposed treatment unit is located approximately 1 km southeast of the residential neighbourhood adjacent to Mount Tzuhalem Ecological Reserve. This area has been recommended for treatment due to its location relative to homes and the ecological reserve, its high recreational use, as well as its potential as a combined commercial thinning and hazard reduction treatment. The stands within this treatment unit are characterized by C-7 and C-5 fuel types with moderate stand densities, and low fine and medium woody fuel levels present throughout.

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		
16	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.

***It has been confirmed that archaeological sites are present throughout the area of interest; overlaps of the above proposed treatment units with these archaeological sites may therefore occur. Due to the sensitivity of this information specific locations have not been made publicly available. Further archaeological assessments and consultation with MFLNRORD Archaeology Branch must occur during prescription development and prior to implementation to ensure all concerns are addressed.



Map 11. Proposed 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 were implemented in 2007 and 2010 for a combined total treated area of 30.5 ha (Map 11). 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 #26: Apply for funding for maintenance activities prioritized and scheduled in this CWPP Update.

RECOMMENDATION #27: 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 AOI. 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	AP3327-3	Cowichan Valley Trail	25.4	INWO-3 (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 dead stems, surface fuel removal, and hazard tree removal.
2007	AP1554-1	Tzouhalem	0.7	Walkthrough	3	3-5	Additional pruning and/or thinning should be completed to reduce crown continuity and increase strata fuel gap. Other activities could include surface fuel removal.
2007	AP1554-2	Tzouhalem	0.8	Walkthrough	3	3-5	
2007	AP1554-3	Tzouhalem	2.4	TZOU-1 (Moderate)	3	3-5	
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.

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.[64] 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[65], 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.[66]
- 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.[66]
- Solutions are required at all scales from individual backyards, to communities and the wider landscape. In order to succeed, these efforts must be integrated across the mosaic of land ownership (Figure 4).

[64] FireSmart is the registered trademark held by the Partners in Protection Association.
[65] FireSmart guidelines first published in the 1999 manual "*FireSmart: Protecting Your Community from Wildfire*", with a second edition published in 2003.
[66] 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.

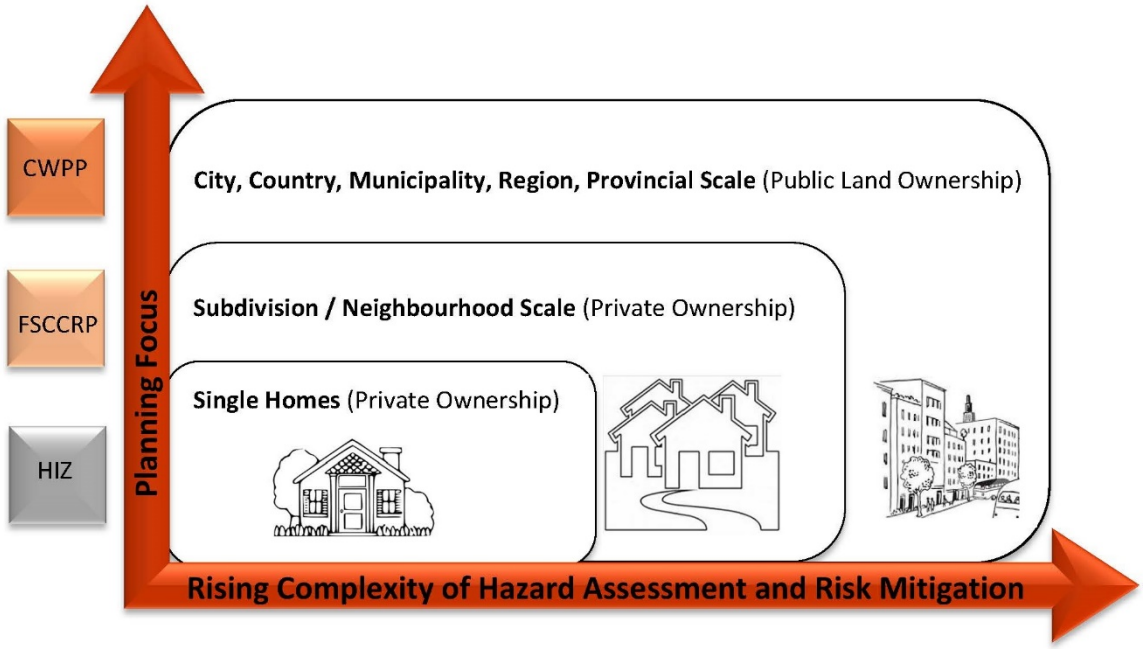


Figure 4. Diagram of the various, coordinated levels of the FireSmart program.[67] CWPP: Community Wildfire Protection Plan, FSCCRP: FireSmart Canada Community Recognition Program, HIZ: Home Ignition Zone.

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).[68,69] 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

[67] Figure and content developed by A. Westhaver. Adapted by A. Duszynska, 2017.
[68] 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.
[69] Cohen, J. Preventing Disaster Home Ignitability in the Wildland-urban Interface. Journal of Forestry. p 15 - 21.

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

It has been found that, during extreme wildfire events, most home destruction has been a result of low-intensity surface fire flame exposures, usually ignited by embers. Firebrands can be transported long distances ahead of the 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.[69] 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 structures burning, 4) overwhelms suppression efforts and capabilities, and 5) leads to unprotected homes, and therefore 6) considerable structure loss (Figure 5).

Once multiple homes are ignited in an urban area, there is increasing potential for fire to spread from structure to structure, independently of the wildland vegetation. This is known as an urban

conflagration. Effective fire protection depends on ignition resistant homes and properties during extreme wildfire events.[70]

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.[70]

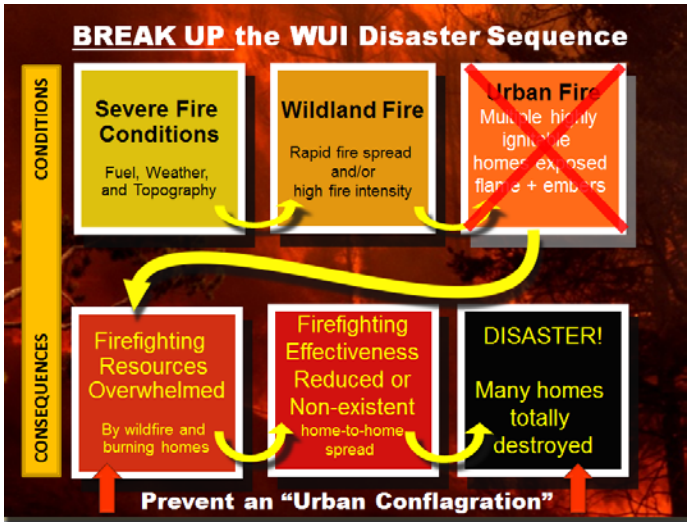


Figure 5. Wildland/urban interface disaster sequence.[71] It is possible to break up the disaster sequence by decreasing the number of highly ignitable homes exposed to embers, therefore reducing the number of homes ignited and removing the consequences of multiple structures lost.

5.2.2 Key Aspects of FireSmart for Local Governments

Reducing the fire risk profile of a community through FireSmart implementation requires coordinated action from elected officials, municipal planners, developers, private land owners and industrial 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 Central Zone is also presented in this Section.

Communication, Education and Partnerships

Communicating effectively is a key aspect of any education strategy. Communication materials must be audience specific and delivered in a format and through mediums that reach the target audience. Audiences should include home and landowners, 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.

[70] Calkin, D., J. Cohen, M. Finney, M. Thompson. "*How risk management can prevent future wildfire*"
[71] Graphic adapted from Calkin et. al, by A. Westhaver.

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. The CVRD does not currently enforce FireSmart landscaping requirements within development permits. However, Cowichan Bay does enforce FireSmart landscaping requirements within areas designated as high hazard wildfire interface areas. More detailed recommendations regarding municipal policies and bylaws are provided below in Planning and Development.

RECOMMENDATION #28: Apply for a FireSmart demonstration grant through the CRI program. This type of fuel treatment can display the practices and principles of FireSmart activities to the public in the form of demonstration treatments. These small projects are not necessarily completed to reduce fire behaviour or increase stand resiliency in any measurable way, but instead are prioritized more by their visibility to the public and combining the treatment with elements of public education (signage, community work days, public tours, active demonstrations of operations, etc.

RECOMMENDATION #29: Develop and implement a community chipper program with the help of neighbourhood representatives. As a demonstration, this program can begin twice per year in two separate neighbourhoods. This program can also be implemented in conjunction with community clean up days.

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).

With the exception of the Sensitive Lands Development Permit Area in Cowichan Bay (Area D), 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 in other parts of the Central Zone AOI. Other jurisdictions' wildfire development permit areas can serve as models for various components. [72] 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 flows 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 (*Standard for Reducing Structure Ignition Hazards from Wildland Fire*[73]) 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.

[72] The District of North Vancouver and City of Maple Ridge have robust and well-documented Wildfire Hazard Development Permit processes.

[73] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1144

- 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.
- 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.[74]

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

RECOMMENDATION #30: Review the Official Community Plan (OCP) and include wildfire as a natural hazard development permit area (DPA). A recommended development permit area for the CVRD would include all areas within the Central 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, such as Cowichan Bay, 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 #31: Ensure that wildfire hazard development permit applications are provided to fire departments for opportunity for input prior to approval. As more wildfire development permit applications are received, the importance of communication and integration between fire departments and the Development Services Division will increase.

RECOMMENDATION #32: 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 DPA (can be provided at issue of building permit and made available at Municipal Office or other strategic locations).

RECOMMENDATION #33: Engage the development/building community (may include developers, builders, landscapers, and architects) in the DPA 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 measurably reduce the risk to the homeowner and community, 3) discuss various strategies and actions which could be implemented to meet DP objectives, and 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 Central 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.[75] When the time for evacuation is limited, poor access has contributed to deaths associated with entrapments and vehicle collisions during wildfires.[76] 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.[75]

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.

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; 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 Central Zone and recommendations to address gaps is provided in SECTION 6.

FireSmart Compliance within the AOI

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 Central Zone communities. Landscaping in the AOI is also in a range of FireSmart compliance. Generally speaking, most homes in interface areas do not maintain 10 m defensible space. These areas and neighborhoods include the Inwood Creek neighbourhood (a highly-intermixed area being newly developed adjacent to Inwood Creek Park); Kaspa Road developments adjacent to Mount Tzouhalem; and intermixed areas in Sahtlam, Paldi, Deerholme, Koksilah, and Cowichan Station. Particularly in new developments, greatest concerns exist in relation

[75] 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.

[76] 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

to the ubiquity of flammable landscaping (i.e., cedar hedging) in proximity to residences; across all aforementioned areas, however, there is a general lack of defensible space between property footprints and adjacent forested areas. Otherwise, bark mulch is commonly used as a landscaping material within the HIZ, and 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. Within the CVRD Central Zone, Duncan proper exhibits 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 Central 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, especially through utilization and/or augmentation of existing naturally or agriculturally-reduced fuel loading.

RECOMMENDATION #34: 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

Table 17 outlines the identified areas where FireSmart activities have been prioritized. These priorities are based on general field observations 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 (including the downtown and surrounding areas) 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 ID	Wildfire Risk Rating (E/H/M/L)	FireSmart Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Paldi Area	H	N	N	*Develop strategic plan with 2018 FireSmart Planning & Activities Grant Program funding, promote FSCCR program, ongoing communication/community engagement and education partnering with local BCWS.*
Sahtlam Area	H	N	N	
Inwood Creek Area/Hillcrest	H	N	N	
Eagle Heights	M	N	N	
Residences adjacent to Mount Tzouhalem	M	N	N	
Cherry Point	M	N	N	
Cowichan Station	M	N	N	

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 #35: 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 #36: 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 #37: 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. [77]

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

RECOMMENDATION #38: Promote 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 #39: 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 #40: Facilitate the FSCCRP uptake within the Central 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 #41: 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 #42: 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 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.).

RECOMMENDATION #43: 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 #44: 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).

5.4 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 Land Clearing 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 AOI 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 AOI. A cooperative approach for addressing the industrial area concerns must be undertaken by the CVRD and pertinent industrial partners.

RECOMMENDATION #45: 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 #46: 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[78]. The aforementioned document establishes a protocol for collaborative and integrated emergency management in the event of WUI fires within British Columbia.

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

6.1 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 five primary 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 Central AOI is activated, as required, between the principal 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 5 volunteer fire departments (VFD) within 9 Fire Service Areas (FSAs). These include the Cowichan Bay VFD, the Duncan VFD, Southend Fire Department, Maple Bay Fire Department and Sahtlam Volunteer Fire Rescue. At the southern 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 15,955 ha (69% of the total AOI area, inclusive of water bodies) and all major communities including First Nations Indian Reserves but excluding large tracts of largely undeveloped and forested lands in the southwestern portion of the AOI, south of the Cowichan River and north of Hillcrest. 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

Fire Protection Zones	Fire Department	Number of Stations	Number of Members	Apparatus type and number
Southend First Nation Contract Area; Southend; Maple Bay Zone 21	North Cowichan Fire Department	2 (Maple Bay and South End Fire Halls)	1 Fire Chief per Fire Hall 1 Deputy Fire Chief per Fire Hall Firefighters	2 pumper trucks, 1 ladder, 1 rescue, 1 marine, 1 UTV
City of Duncan; Duncan First Nation Contract Area; Eagle Heights FSA	Duncan Volunteer Fire Department	1	1 Fire Chief 25 Firefighters 8 Line Officers 3 Command Officers	2 pumper trucks, 100' platform, 3,500-gallon tender, rescue truck, command vehicle and a utility truck.
Sahtlam FPSA Zone 28; Sahtlam FPSA Zone 36	Sahtlam Volunteer Fire Rescue	1	6 officers 17 Firefighters	1 engine, 2 tankers, 1 utility truck

Within the AOI, all 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. These mutual aid agreements are typically utilized twice to three times a year for structure fires, and in some cases more frequently. For example, in 2017, Southend FD responded to 12 mutual aid calls. 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 Structure Protection Program (SPP) Wildland Firefighter Level 1 (SPP-WFF 1, an S-100 and S-185 equivalent) or SPP Structure Protection Workshop (SPP-115, formerly S-115) training. It is recommended that all fire services members within the CVRD Central Zone AOI have at a minimum S-100 introductory wildfire suppression training or SPP-WFF 1 (or equivalent). It is recommended that the fire department members also 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 Central Zone. Within recent years the Sahtlam VFD has had no exposure to practical cross-training with the BCWS. 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 the local fire departments to prepare its responders with the technical and practical firefighting experience in order to action both structural and wildland fires.

Over the previous 7 years (2011-2016), the five Central Zone fire departments responded to an average of 200 calls per year (averaged over all fire departments from 2011 to 2017), of which only

approximately 6 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 1 for the Sahtlam VFD in 2011, 2013, 2016 and 2017, and 1 for the Maple Bay VFD in 2013 and 2017 to a high of 28 for the Southend Fire Department in 2012. Wildland fires averaged yearly over the period of 2011-2017 for each fire department are as follows: Cowichan Bay – 5, Duncan – 6, Southend – 14, Sahtlam – 2, and Maple Bay – 3.

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).[79] 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 Central 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 Sahtlam, 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 that create suppression challenges in the AOI. The CVRD Water and Wastewater Utilities and 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 neighbourhoods of Sahtlam and Paldi.

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

Water supply within the CVRD Central 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) Cherry Point Water system (adjacent to farm which may increase likelihood of contamination); 2) Cowichan Bay wastewater infrastructure (improvements are required due to leaks and inflow problems); 3) Eagle Heights wastewater infrastructure (improvements are required due to leaks and inflow problems); and 4) Lambourn Estates water system and wastewater infrastructure (water contamination issues in reservoir and improvements are required in wastewater due to leaks and inflow problems).

The CVRD fire departments can draft from natural water sources such as Cowichan River and Quamichan Lake, other much smaller lakes, ponds, rivers, and even swimming pools, or the ocean when necessary for fire suppression purposes. The natural water sources are known and mapped; however, static water sources can be severely impacted by summer drought. As a last resort, the ocean can be used to draft water, depending upon equipment.

RECOMMENDATION #47: All new rural development 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 #48: Complete 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, Highway 1 is the only reliable, paved access route north and south from the AOI and Highway 18 is the only reliable, paved access route to the west. Paved roads also connect Cowichan Bay, Eagle Heights, Deerholme, Fairbridge, Koksilah, Tzouhalem, and Cowichan Station to Highway 1 and Sahtlam, Hillcrest, and Paldi to Highway 18. Evacuation would be conducted by First Responders, RCMP, and the Search and Rescue team (tactical). If a wildfire were to block Highway 1 or 18, 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 Central Zone are located on single access roads which branch off of the Highway 1; this limits the ability of fire crews to respond to fires and safely evacuate residents. 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

and Island Timberlands 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 and Island Timberlands 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 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 Bings Creek Recycling Centre can be designated as the EOC and the CVRD Office and Duncan City Hall can be designated as Emergency Coordination Centres (ECCs). 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 Central 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 #49: Complete and participate in regular testing of, and updates to, the evacuation plan.

RECOMMENDATION #50: Develop 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 #51: 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 #52: Include a qualified professional with experience in operational wildland/interface fire suppression in the planning and strategic siting of future trails and parks.

RECOMMENDATION #53: Develop 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 Central 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 and/or SPP-115. It is recommended that the fire departments in the Central Zone ensure currency with techniques, applications and procedures for wildland urban interface fire suppression through applicable wildland firefighter training offered by the Office of the Fire Commissioner (OFC) and/or BCWS. 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. it is recommended that all fire department members at minimum have S-100 or SPP-WFF 1 (or equivalent), and that the fire departments engage in yearly practical wildland fire training with BCWS.

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. Mill Bay, District of North Cowichan, Cobble Hill, etc.) to conduct joint training so as to further strengthen regional emergency response and firefighting training.

Recommendation #54: 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. It is recommended 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. Interface training should include completion of a joint wildfire simulation 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 is highly dependent upon the current fire season and other BCWS priorities.

Recommendation #55: 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 #56: Ensure that the fire departments maintain the capability to effectively suppress wildland fires, through wildfire-specific training sessions. Maintain a high level of member education and training specific to interface and wildland fires; it is recommended that all Central Zone fire department members at minimum have S-100 or SPP-WFF 1 (or equivalent) and consider expanding training. 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 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.

6.2 STRUCTURE PROTECTION

The Central 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 Central 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 with regard to interface fire, there are still ways to reduce home vulnerability. Changes to roofing materials, siding, and decking can be achieved over the long-term through voluntary upgrades, as well as changes in bylaws and building codes. The FireSmart approach has been adopted by a wide range of governments and is a recognized process for reducing and managing fire risk in the wildland urban interface. More details on FireSmart construction can be found in Appendix 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), cleaning 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.

RECOMMENDATION #57: Work with local distributors and homeowners within CVRD Central 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) Development 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.
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).
4) Develop general cost implications of improvements so property owners can prioritize replacements

RECOMMENDATION #58: Develop 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 (in 2018 the CRI program has made available funding for FireSmart activities on private land). 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).

RECOMMENDATION #59: 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.

RECOMMENDATION #60: Acquire a Type 2 SPU trailer to improve wildfire response (provides protection for 25-30 residences).

REFERENCES

BCWS. 2018. Wildfire Causes. Retrieved from: https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-response/fire-characteristics/causes

City of Duncan. 2007. Bylaw 2030: City of Duncan Official Community Plan. Retrieved online from: https://duncan.civicweb.net/filepro/document/37474/Official%20Community%20Plan%20(OCP)%20Bylaw%20No.%202030%20-%20Consolidated%20to%20August%2017,%202015.pdf

CVRD. 2018. Our Regional District. Retrieved from: https://www.cvrd.bc.ca/2379/Our-Regional-District

CVRD. 2013. Bylaw 3605: Electoral Area D - Cowichan Bay Official Community Plan. Retrieved online from: https://www.cvrd.bc.ca/DocumentCenter/View/9799/Area-D-Bylaw-3605

CVRD. 1994. Bylaw 1409: Electoral Area E and Part of F – Cowichan-Koksilah Official Community Plan. Retrieved online from: https://www.cvrd.bc.ca/DocumentCenter/View/556/Area-E-Bylaw-1490

Innova Strategy Group. 2017. Water and Wastewater Utilities Review and Assessment for the Cowichan Valley Regional District. Retrieved from: https://www.cvrd.bc.ca/DocumentCenter/View/79863/Attachment-A---CVRD-WWURA-Innova-FULL-Report-Feb-03

Mid Island Emergency Coordinators & Managers 2015.CVRD Local Authority Emergency Plan – Emergency Operations Centre Response Guidelines. Mid Island Emergency Coordinators & Managers. February 2015.

Mid Island Emergency Coordinators & Managers. 2017. Emergency Preparedness Workbook. Retrieved from: https://www.cvrd.bc.ca/DocumentCenter/View/84184/MIECM-Emergency-Preparedness-Workbook---2017?bidId=

Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2018. Vancouver Island Central Coast Response Fire Management Plan.

Ministry of Forests, Lands and Natural Resource Operations. 2015. Coast Area 2015-17 Coastal Timber Supply Area Forest Health Overview. Retrieved from: https://www.for.gov.bc.ca/ftp/HFP/external/!publish/Forest_Health/TSA_FH_Strategies/2015-Coast%20FH%20Strategy.pdf

The Province of British Columbia. 2000. Vancouver Island Land Summary Land Use Plan. Retrieved July 02, 2014, from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/westcoast-region/vancouverisland-rlup/vancouver_island_slup.pdf

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

Provided separately as a PDF package.

APPENDIX B – WILDFIRE THREAT ASSESSMENT WORKSHEETS AND PHOTOS

Provided separately as a PDF package.

APPENDIX C – MAPS

Provided separately as a PDF package.

APPENDIX D – SUMMARY OF 2005 CWPP RECOMMENDATIONS

The following recommendations were provided as part of the 2005 CWPP for the 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.
- Utilize 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 minimize 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 utilize 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 firefighting 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 6.

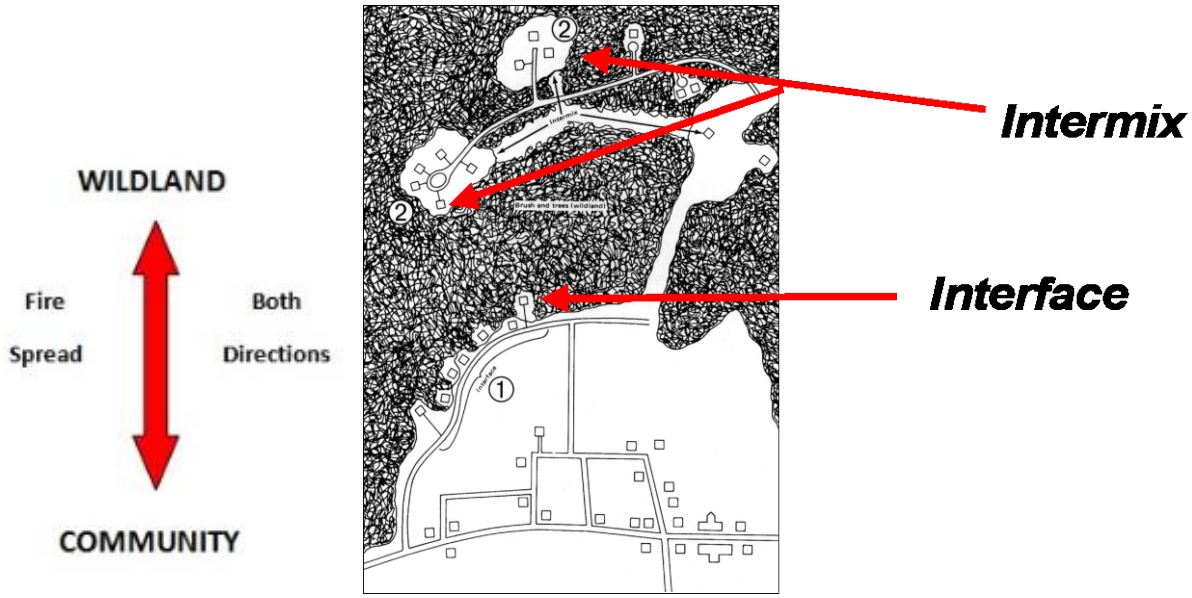


Figure 6. Illustration of intermix and interface situations.

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

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

1. From sparks or burning embers carried by the wind, or convection that starts new fires beyond the zone of direct ignition (main advancing fire front), that alight on vulnerable construction materials or adjacent flammable landscaping (roofing, siding, decks, cedar hedges, bark mulch, etc.) (Figure 7).

2. From direct flame contact, convective heating, conductive heating or radiant heating along the edge of a burning fire front (burning forest), or through structure-to-structure contact. Fire can ignite a vulnerable structure when the structure is in close proximity (within 10 meters of the flame) to either the forest edge or a burning house (Figure 8).

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

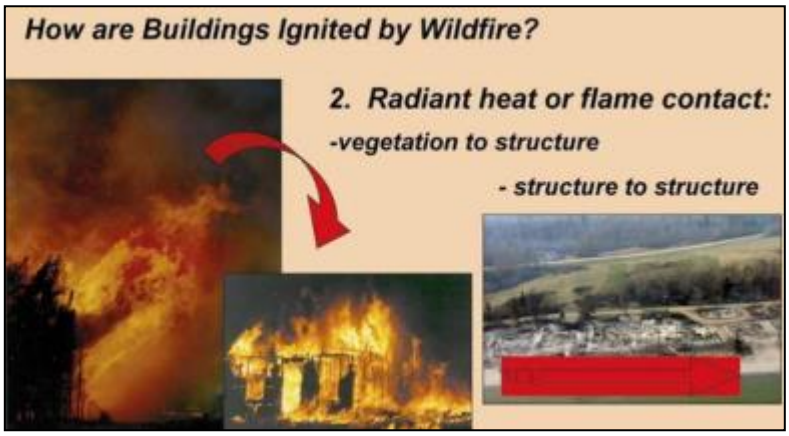


Figure 8. Radiant heat and flame contact allows fire to spread from vegetation to structure or from structure to structure.

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

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
BANG-1	Bright Angel Park	Moderate	N/A
COWI-1	Cowichan River Provincial Park	Moderate	N/A
COWI-2	Cowichan River Provincial Park	Moderate	N/A
CRES-1	Hillcrest Forest Service Road	Moderate	N/A
CRES-2	Hillcrest Forest Service Road	High	Moderate
HANK-1	Near Hanks Road Park	Moderate	N/A
HANK-2	Hanks Road Park	Moderate	N/A
HILL-1	Hillcrest	Moderate	N/A
HILL-2	Hillcrest	Moderate	N/A
HILL-3	Hillcrest	Moderate	N/A
INWO-1	Near Inwood Park	Moderate	N/A
INWO-2	Near Inwood Park	Moderate	N/A
INWO-3	Near Inwood Park	Moderate	N/A
PRIV-1	Behind private land south of Pannell Road	Moderate	N/A
PRIV-2	Behind private land south of Pannell Road	Moderate	N/A

WUI Plot #	Geographic Location	Wildfire Behaviour Threat Class	WUI Threat Class
RIV-1	Off Riverbottom Road West, northeast of Soltz Pool	High	Low
SAND-1	Off West Riverbottom Road, east of Tzart-Lam 5	Moderate	N/A
SKUT-1	South of Cowichan River Provincial Park	Moderate	N/A
SKUT-2	South of Kakalatza 6	High	Moderate
SKUT-3	South of Cowichan River Provincial Park	Moderate	N/A
SKUT-5	South of Cowichan River Provincial Park	Moderate	N/A
SKUT-6	South of Cowichan River Provincial Park	Moderate	N/A
TZOU-1*	East of the Mt Tzouhalem Kaspa Road Trailhead, north of Resurrection Trail	Moderate	Moderate
TZOU-2	Outside the eastern edge of Mt Tzouhalem Ecological Reserve	Moderate	N/A

*Note that Wildland-Urban Interface (WUI) threat scores are only collected for untreated polygons that rate high or extreme for Wildfire Behaviour Threat (WBT) score. However, if a plot falls within a previously treated area, then WUI threat scores will be collected regardless of WBT.

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.[80]

[80] 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 19 WUI threat plots on a variety of fuel types, aspects, and slopes and an additional 150 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 17 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 19. 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		

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

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

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

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

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

- fuel scores were reviewed and applied to the fuel type in which the threat plot was completed;
- conservative fuel scores were then applied to the polygons by fuel type to check the initial assessment;
- high 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 Appendix G – Fuel Typing Methodology and Limitations) 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 9 and Figure 10). 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 11). 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.

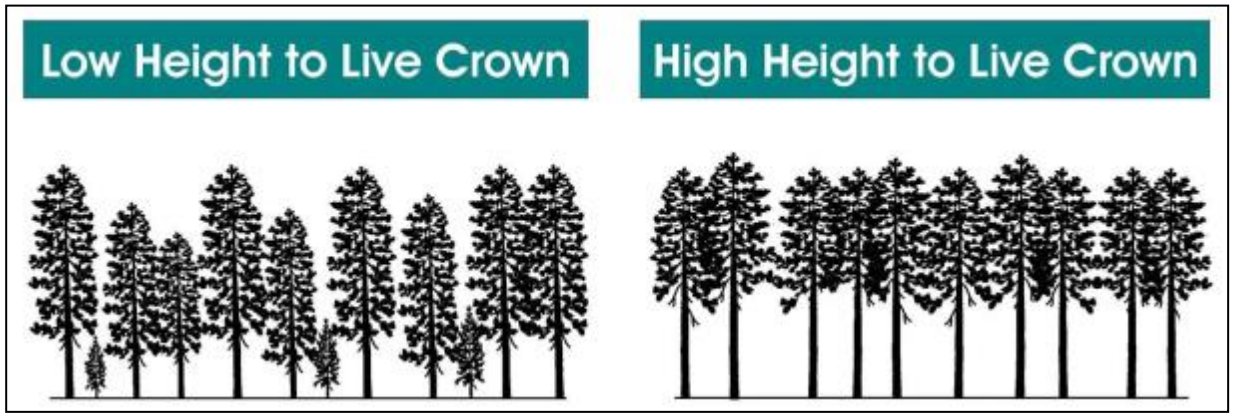


Figure 9. Comparison of stand level differences in height-to-live crown in an interior forest, where low height to live crown is more hazardous than high height to live crown.

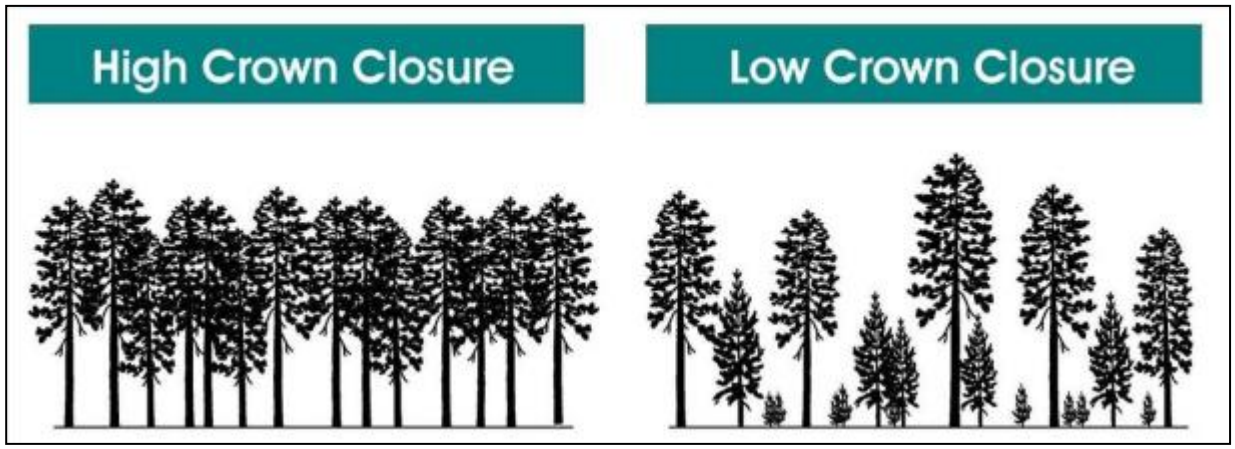


Figure 10. Comparison of stand level differences in crown closure, where high crown closure/continuity contributes to crown fire spread, while low crown closure reduces crown fire potential.

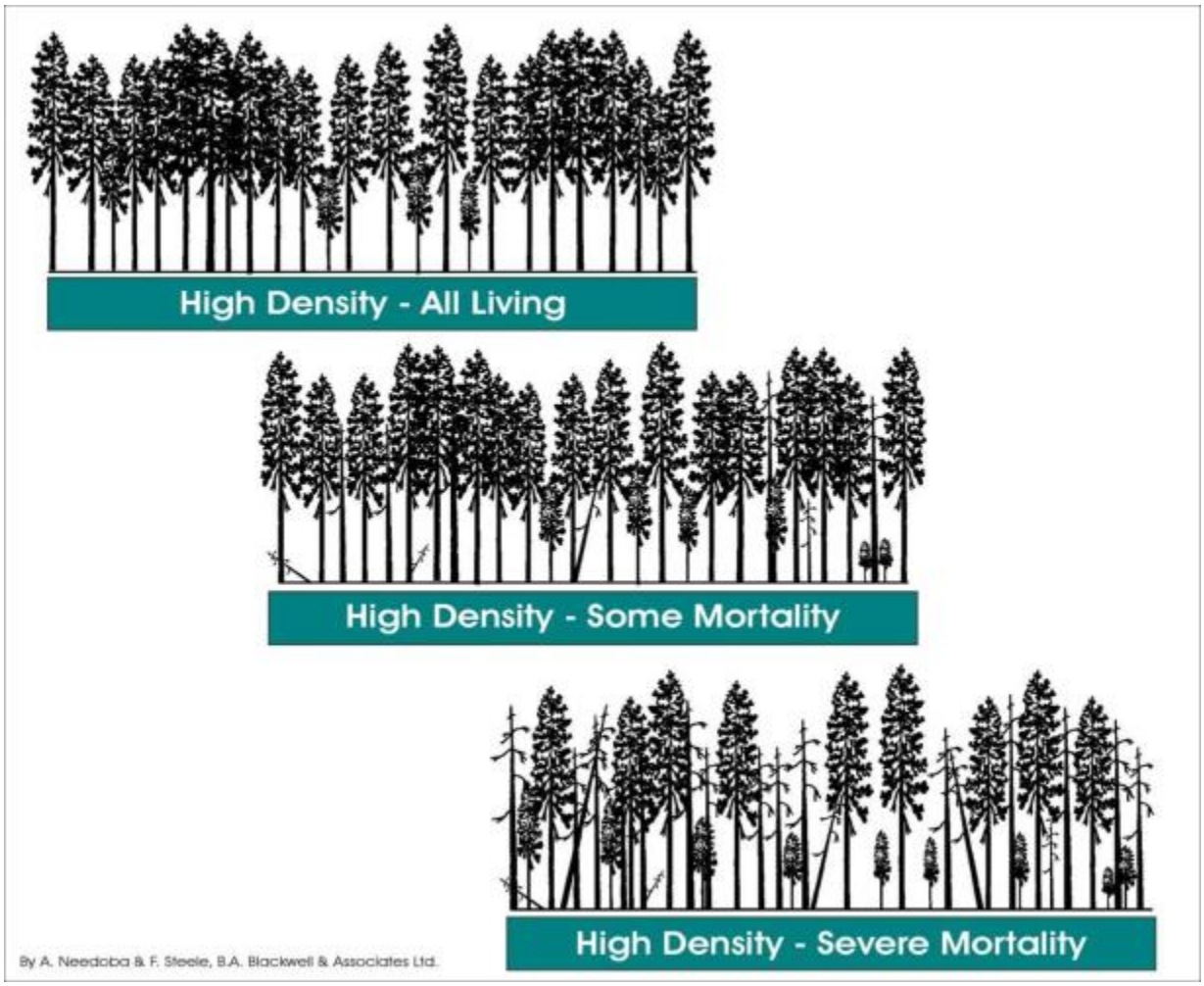


Figure 11. Comparison of stand level differences in density and mortality, and the distribution of live and dead fuels in these types of stands.

Thinning is a preferred approach to fuel treatment (Figure 12) 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.

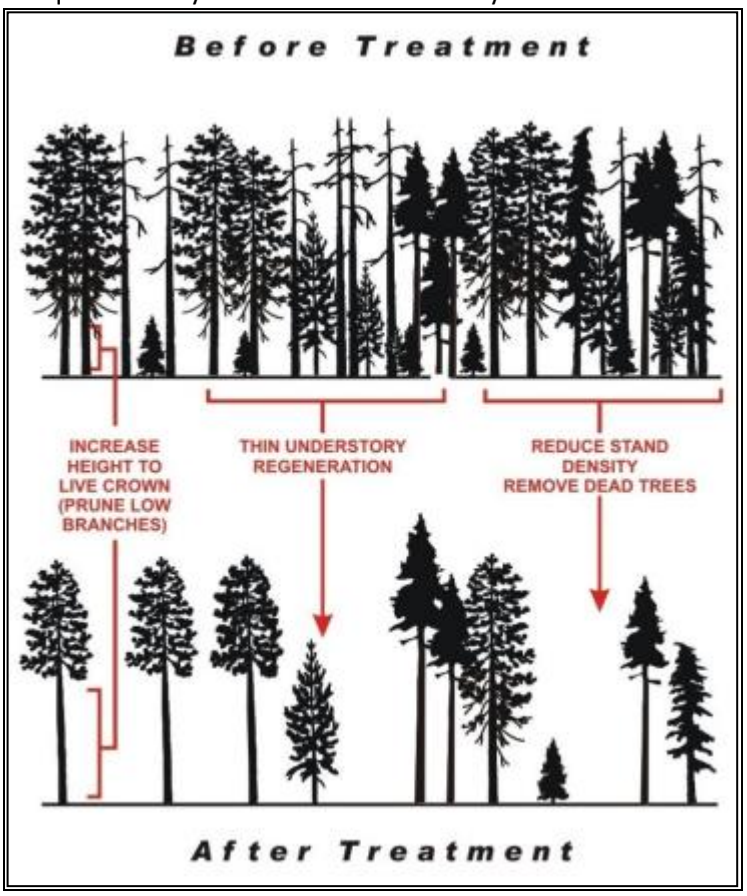


Figure 12.Illustration of the principles of thinning to reduce the stand level wildfire hazard.

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.

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).

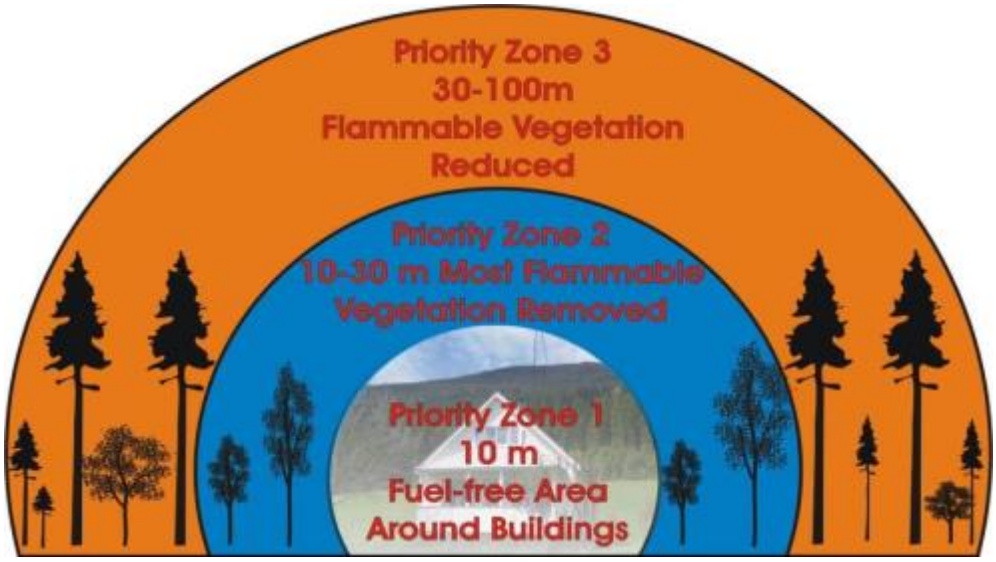


Figure 13. Illustration of FireSmart zones[81].

[81] (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[82].

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.[83,84] 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

[82] 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

[83] Ibid.

[84] Using the FireSmart hazard assessment system.

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

Balconies and Decking:

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

Combustible Materials:

Combustible materials stored within 10 m of residences are also considered a significant issue. Woodpiles, propane tanks, recreational motorized vehicles, and other flammable materials adjacent to the home provide fuel and ignitable surfaces. Locating these fuels away from structures helps to reduce structural fire hazards and makes it easier and safer for suppression crews to implement suppression activities adjacent to a house or multiple 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.[85]

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

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

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

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

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

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

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

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

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

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

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

APPENDIX 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.[86] 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.[87]

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'.[88]

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

[87] 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.

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