Village of Lions Bay

Community Wildfire Protection Plan

Report by Diamond Head Consulting

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Community Wildfire Protection Plan for Village of Lions Bay

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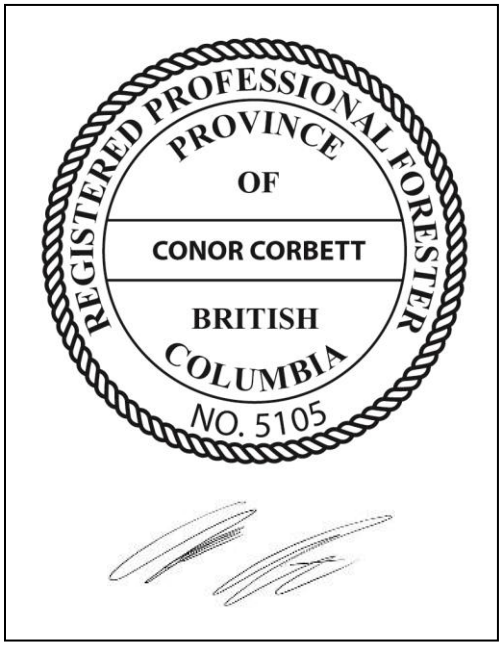

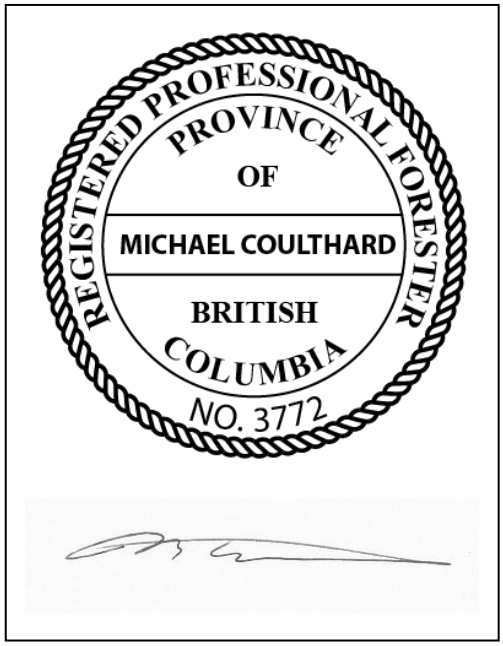

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Executive Summary

The Village of Lions Bay (the Village) has been managing wildfire risk within its urban-forest interface for decades. The Village's original Community Wildfire Protection Plan (CWPP) was prepared in 2006, shortly after the Province's introduction of the Strategic Wildfire Prevention Initiative (SWPI). This plan identified levels of wildfire risk associated with forest fuels and provided recommendations for managing this risk using a host of tools, which were adopted by the Village as part of its Wildfire Risk Management System. Since 2006, there have been significant changes in the conditions underlying wildfire risk, including forest fuel densities, forest health, the extent of development, and climate. Additionally, the SWPI has been replaced by the Community Resiliency Investment Program (CRI), which has new standards for reporting and makes new risk management activities feasible that were not previously funded.

The CWPP program provides a province wide standard for wildfire risk management and analysis, as well as a host of tools for supplementing wildfire risk analysis and funding. This CWPP is a comprehensive update to the previous 2006 Plan. The study area for this update is the 255 hectares comprising the municipal limits of the Village as well as the contiguous lands within two kilometres of the municipal limits. The total land within the area of interest (AOI) is 1,922 hectares. This CWPP assesses the current wildfire risk in and surrounding the Village and makes recommendations to reduce vulnerability and increase resilience to wildfire.

The values at risk identified in this plan include human life and safety, critical infrastructure, cultural values, species and ecosystems at risk, recreation, water resources, and timber resources. Critical infrastructure identified in and around the Village includes critical drinking water infrastructure, municipal facilities for administration and emergency response, and communications infrastructure. Straddling major provincial transportation and communication lines between Metro Vancouver and the Squamish-Lillooet Regional District, protecting the Village from wildfire is important not only for residents but for the broader region as well.

In this plan, threat refers to the likelihood of a wildfire occurring and its severity, based on the biophysical characteristics of the landscape and patterns in the prevailing climate. Risk is a measure of the likelihood that a wildfire will damage identified values. It is calculated as product of the level of threat and the importance of the values that could be impacted. Critical infrastructure has been identified which include values that are invaluable to the functioning of the Village and region. These are provided to the Province as part of the CWPP submission and were identified in coordination with the Village and stakeholders and focus on human safety and community assets. Additional recreational, cultural, economic, and social values were also considered as part of the wildfire risk analysis.

Field work and desktop analysis identified the surrounding forests as posing a high *wildfire threat*. This infers that the fuels, topography and climate could produce a high-intensity wildfire. Considering the type and proximity of the values that could be impacted the overall *wildfire risk* to the community is considered high. High wildfire risk can be mitigated through a number of strategies. These include management of vegetation in strategic areas, regulating development in the wildland-urban interface, increasing community outreach to educate and inform homeowners on ignition and loss prevention, suppression preparedness as well as a number of other FireSmart initiatives. Partnership with regional and provincial governing bodies is essential to help the Village to reduce wildfire risk.

Summary of CWPP Recommendations

This report includes information about the current wildfire threat and risk within and surrounding the Village and provides a suite of recommendations to be carried out by both the municipality and private residents. Some of these recommendations are easily implemented with relatively low costs. Others, such as vegetation management, require resources and support from the Provincial government and cooperation from other agencies. Recommendations have been prioritized based on both the ease of implementation as well as their relative impact on reducing wildfire risk.

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

Table 1. Summary of CWPP Recommendations

Number	Recommendation	Priority	Timeline years	Estimated Cost
Rec 1	Periodically review the CWPP as a living document. An update is recommended every 5 years.	Medium	5+	$5,000 per update
Rec 2	Develop fuel treatment prescriptions for proposed fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).	High	3-5	$50,000
Rec 3	The Village should assess the condition of fuels and wildfire risk around their facilities and develop fuel treatment prescriptions with the target of establishing a 30m defensible space around them. (CRI Activity #9 Fuel and Vegetation Management).	Medium	3-5	$30,000
Rec 4	Develop a partnership with Metro Vancouver to pursue treatment of provincial crown lands adjacent to the Village of Lions Bay (CRI Activity #9 Fuel Management)	High	3-5	$10,000
Rec 5	Train a staff member from the Village of Lions Bay as a Local FireSmart Representative through the Local FireSmart Representative workshop. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 FireSmart Training & Cross Training)	Medium	3-5	$1,000

Rec 6	Develop neighbourhood level FireSmart plans for the priority neighbourhoods in Section 5.2. This should include neighbourhood level FireSmart committees with the Village, Fire Rescue, BCWS, and resident representatives. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education and #8 FireSmart Activities for Residential Areas).	High	3-5	$50,000
Rec 7	Apply FireSmart design principles to any changes to municipal buildings or properties. Showcase FireSmart building and landscape design through a "FireSmart Day" with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education & #7 FireSmart Projects for Critical Infrastructure).	Medium	3-5	$5,000-$10,000
Rec 8	Develop and distribute FireSmart brochures to all houses within the Village. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Medium	3-5	$8,000-$15,000
Rec 9	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).	Low	5+	$5,000-$10,000
Rec 10	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Residential Areas).	Medium	1-2	$10,000-$20,000
Rec 11	Review the Fire Bylaw to determine if building materials can be required by the Building Inspector under the justification of wildfire risk reduction. Update the bylaw so that new construction must use materials meeting NFPA 1144 standards. Funding for this review may be accessible through the UBCM Community Resiliency Investment Program (CRI #3 Development Considerations).	High	1-2	$5,000-$10,000
Rec 12	Engage the community and explore options for regulating landscaping through zoning or potential Development Permit Areas as part of the next Official Community Plan renewal. (CRI #3 Development Considerations).	Medium	3-5	$5,000-$10,000
Rec 13	During significant public events have Village and/or Fire Department staff on hand to provide educational material.	Medium	3-5	$5,000

Rec 14	Include open house components to FireSmart treatments on public property to encourage outreach and education	Medium	3-5	$5,000
Rec 15	Conduct visits by Village and/or Fire Rescue staff into the local elementary school to discuss wildfire prevention and preparedness.	Medium	3-5	$5,000
Rec 16	Update the Village's digital media, including video and web content, to reflect this CWPP update. Explore new digital methods of engagement, including interactive content and geospatial content.	Medium	3-5	$10,000-$20,000
Rec 17	Ensure all road edges are clear of vegetation and debris during the summer months	Medium	3-5	N/A
Rec 18	Post wildfire danger signage along Highway 99 and at high use trail heads. Signage should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires, properly dispose cigarettes, and avoid parking on grass or other low vegetation.	Medium	3-5	$10,000-$20,000
Rec 19	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.	High	1-2	$5,000-$10,000
Rec 20	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated, including removal of slash.	Medium	3-5	N/A
Rec 21	Water operators working within the community watersheds of Harvey Creek and Magnesia Creek should receive ICS-100 (Incident Command System) training.	High	1-2	$1,000-$3,000
Rec 22	Lions Bay water operators and Metro Vancouver wildfire suppression units should be included as emergency contacts in the event of wildfire.	High	1-2	N/A
Rec 23	Incorporate wildfire and potential road closures into the evacuation plan.	High	1-2	N/A
Rec 24	Train all Village firefighters in S100 Basic Fire Suppression and Safety training and S185 Fire Entrapment Avoidance and Safety training. Funding is available for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross-training)	Medium	3-5	$5,000-$10,000
Rec 25	Conduct annual training exercises with Metro Vancouver to enhance response in the event of wildland urban interface fire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).	High	1-2	NA

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Section 1 Introduction

1.1 Purpose

The Village of Lions Bay recognizes wildfire risk mitigation as a critical component of emergency preparedness and community planning. The Village area is heavily *intermixed* with coniferous vegetation, meaning remnants of the native forest are growing within and among buildings in the townsite. The Village also has an extensive *interface*, where contiguous heavily forested lands abut residential development. These conditions contribute to an elevated wildfire risk. The level of risk is constantly evolving with changes to the forest condition and urban development. Mitigation of this risk is an ongoing effort implemented through municipal policy, vegetation management, and education programs.

Understanding wildfire risk requires an understanding of both the biophysical attributes that influence wildfire probability and the values in the community that are vulnerable to wildfire. The purpose of this CWPP is to evaluate the wildfire risk to the Village and to provide recommendations to reduce it. Implementing these recommendations over time will result in:

1. Reduced likelihood of a wildfire entering the community
2. Reduced impacts and losses to property and critical infrastructure
3. Reduced economic and social impacts to the community
4. Increased resilience of future development

Wildfire risk *is the probability of a wildfire occurring combined with the consequences if it did occur.*

Wildland Urban Interface *is the area around communities where development abuts the forest.*

Photo 1. View of the Village of Lions Bay (EB Adventure Photography/Shutterstock.com)

Wildfire Trends

Wildfires are the most significant natural disturbance in British Columbia. The impacts of wildfire are increasing throughout the province. Over the past decade there has been an average of 1,692 fires per year in British Columbia, burning an average of 151,000 ha each year (BC Wildlife Service, 2020). Almost half of these fires were a result of human-caused ignitions. Wildfires have cost the province almost 2.6 billion dollars this decade in direct costs for suppression and emergency response (BC Wildfire Service, 2020). This does not include the impacts of evacuations and business closures, uninsured losses, public health expenditure for treating smoke inhalation, burns, and anxiety, and the lingering social trauma of living through a wildfire emergency. The 2017 and 2018 wildfire seasons are the worst on record in British Columbia, damaging over 2.5 million hectares – an area equal to 80% of Vancouver Island or 9 times the size of Greater Vancouver. In 2017, several large interface fires resulted in the displacement of 65,000 people by evacuation orders (BC Wildlife Service, 2020). The most expensive natural disaster in Canadian history is the 2016 Horse River Fire, burning through 2400 buildings in Fort McMurray, Alberta and resulting in $3.77 billion in insurance claims (Natural Resources Canada, 2017; Statistics Canada, 2017).

The trend towards increasing areas burned and fire suppression costs has been recorded across North America (Marlon, et al., 2012). The trend is in large part attributed to climate change, which is contributing to hot, dry summers and earlier springs. This is causing vegetation to start growing earlier, dry out earlier and for a longer period of time (Hope, McKenney, Pedlar, Stocks, & Gauthier, 2016). Since 1985, it is estimated that 50% of the increase in the area burned by wildfire in the western United States is due to human caused climate change (Abatzoglou JT, 2016). Worldwide, the length of the fire season increased by 19% from 1979 to 2013. Research in British Columbia has estimated that the record-setting 2017 fire season was made 2-4 times more likely by climate change (Kirchmeier-Young, Gillett, Zwiers, Cannon, & Anslow, 2019).

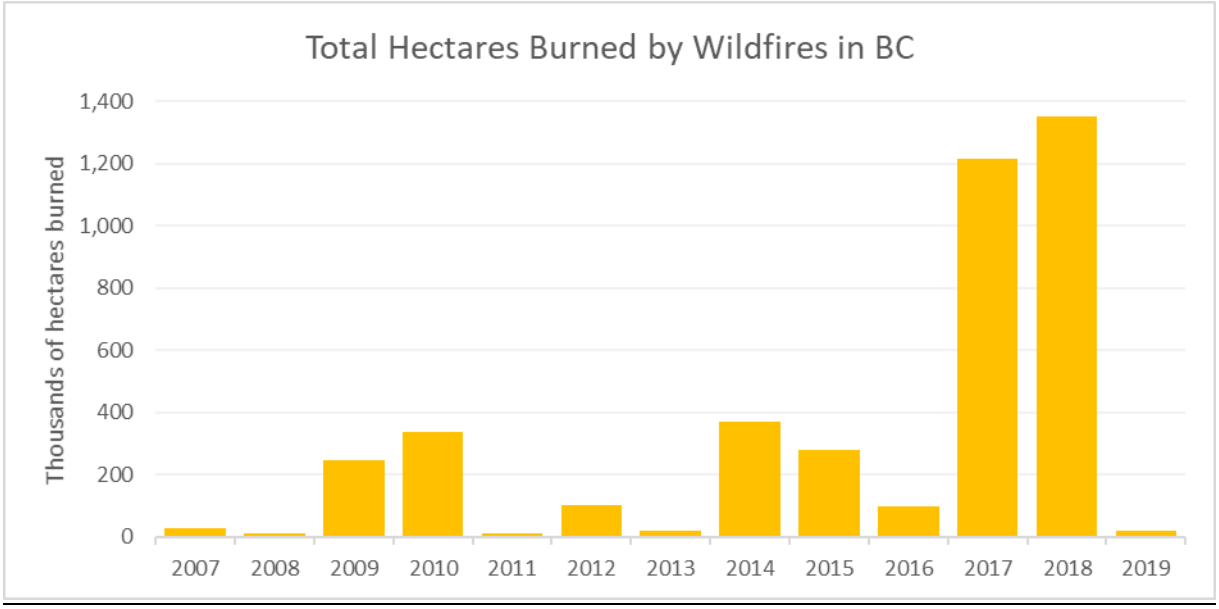


Figure 1. Total area (ha) burned by wildfires in BC by year in the past decade. (BC Wildlife Service)

In addition to the changing climate, forest fuels in BC have built up over time due to a history of effective fire suppression and tree death from pests and disease. Development and land-use changes have increased the area of wildland-urban interface and the potential for human-caused ignitions near developed areas. Climate change, fuel build-up in our forests, and expanding wildland-urban interface have created conditions that make fire suppression both challenging and expensive in BC.

Climate change modelling for Metro Vancouver predicts that average summer daytime high temperatures will increase 3.7 to 8.4°C by the 2080s with more hot days (>25°C) and lower precipitation in the summer months (Metro Vancouver, 2016). Warmer temperatures, and potential for reduced summer rainfall can be expected to increase the length of the wildfire season and the incidence of wildfire in coastal forests (Haughian, Burton, Taylor, & Curry, 2012). Much of predicted climate change in the 21st century is "locked in" by past emissions of greenhouse gases, meaning we need to act to protect our communities from wildfire regardless of whether or not climate change mitigation is widely pursued (Samset, Fuglestvedt, & Lund, 2020). Feasible strategies to protect our communities from wildfire need to focus on the factors that we can change now. This includes managing vegetation as fuel in forested areas adjacent to development, building more resilient structures, improving suppression response and capability, reducing human-caused ignitions, and increasing public awareness of wildfire risk through education.

1.2 CWPP Planning Process

CWPP Guiding Principles

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

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

CWPP Implementation History and Planning Process

In 2003, BC experienced one of its worst fire seasons in history, with several major interface fires taking place. The loss of over 230 homes resulted in a public inquiry, resulting in the report *Firestorm 2003*, also known as the Filmon Report. The Province developed the Strategic Wildfire Prevention Initiative (SWPI) to direct funding to municipalities for community wildfire planning, implementing one of the recommendations of *Firestorm 2003*. The Village prepared its original Community Wildfire Protection Plan in 2006, adopting it in 2007. This plan reviewed the character and distribution of forest fuels in the Village and within five kilometres of the municipal limits to assign risk and prioritize actions for risk mitigation. 21 recommendations were included in this plan, including more detailed hazard and risk mapping, enhanced public communications, review of development policies, vegetation management, and increasing the Village's capacity for fire suppression. This update to the CWPP addresses changes over the past decade including development, climate, infrastructure, and surrounding fuel conditions.

Since the development of the original 2007 CWPP, the Province has continued to guide communities preparing for wildfire. The Province of BC has provided up to date spatial data from the Provincial Strategic Threat Analysis (PSTA) which includes fuel typing, risk analysis, and values at risk. This analysis predicts the fire behaviour potential of the natural areas within the area of interest (AOI) and maps the potential wildfire threat to values across the landscape. The PSTA was used as the base from which to prioritize interface areas for further assessment. Critical values and infrastructure assets were identified through consultation with the Village and stakeholders. Ground-truthing was completed to assess fuel conditions and their fire behavior potential. Updated conditions were used to produce spatial data defining the values at risk, wildfire threat and overall wildfire risk to the community. This analysis was used to develop and prioritize a suite of wildfire mitigation recommendations. These have been prioritized to help the Village focus on actions that will have the greatest benefit at the lowest cost.

A Living Document

The risk from wildfire will evolve as urban development continues, and there are changes to forest conditions and the climate. This plan is intended to be a living document that will be updated every five years to assess and respond to these changing conditions.

Number	Recommendation
Rec 1	Periodically review the CWPP as a living document. An update is recommended every 5 years.

CWPP Consultation Process

This CWPP update was developed in consultation with stakeholders from both the public and private sectors. These stakeholders include the Village of Lions Bay, the regional government (Metro Vancouver), First Nations, and other stakeholders. Fuel and wildfire experts with the BC Wildfire Service and Ministry of Forests, Lands, Natural Resource Operations and Rural Development have also been consulted. Stakeholders were engaged at the start of this project and at key intervals to provide input and feedback. The level of involvement and input from these stakeholders varied depending on the level of interest and their available resources.

Section 2 Local Area Description

2.1 CWPP Area of Interest

The Area of Interest (AOI) for this CWPP is the Village of Lions Bay (the Village) as well as a buffer of two kilometres surrounding the municipal limits. The Village is located on the east shore of Howe Sound, approximately twelve kilometres north of Horseshoe Bay (West Vancouver). The Village is part of Metro Vancouver, the regional government for the greater Vancouver area. The Village is separated from other municipalities within Metro Vancouver by Electoral Area A, which is a rural, forested area directly administered by the regional government. The Village is named for the twin mountain peaks, the Lions, that rise immediately to the east. The Village's steep terrain has historically restricted development and created a mostly residential community with limited opportunity for commercial or industrial activities. The townsite is intimately set within mature coastal forests, and native trees dominate the vegetation growing between and among buildings. The Village has an area of approximately 2.55 square kilometers (255 ha), and a population of approximately 1,300 (as of 2016). The inclusion of a 2-km buffer increases the size of the AOI to 19.22 square kilometers (1,922 ha). The AOI is illustrated in Figure 2.

The Village is within the core traditional territory of the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), which encompasses the inland waterways and river valleys surrounding Howe Sound and entrances to Vancouver harbour. The municipality is also within the traditional territories of the səl̓ilw̓ətaʔɬ (Tsleil-Waututh) and xʷməθkʷəy̓əm (Musqueam) nations. No Reserves are within the AOI.

Within the AOI there is a mix of land ownership. According to the provincial forest ownership layer: The Village of Lions Bay has jurisdiction over public lands within its boundaries amounting to 2% of the AOI. A total of 15% of the AOI is privately owned and 83% is Provincial Crown Land, with fully 46% of the AOI within a crown-designated community watershed (Table 2 andTable 3, Figure 2 and Figure 3).

Table 2. Generalized land ownership within the AOI*

Jurisdiction	Area within the AOI (ha)**	% of area within the AOI*
AOI	1,922	100%
Private land	285	15%
Provincial Crown land outside of Community Watershed or Watershed Reserve	710	37%
Provincial Crown land within Community Watershed or Watershed Reserve	889	46%
Village of Lions Bay owned lands	35	2%
All other classes	3	0%

***Numbers may not add to 100% due to rounding**

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

Table 3. Detailed Land ownership within the AOI

Jurisdiction	Area within the AOI (ha)	% of area within the AOI*
Crown - Community Watershed	703	36%
Crown – Conservancy Area, Ecological Reserve, Protected Area	21	1%
Crown - Forest Management Unit	686	36%
Crown - Forest Recreation Reserves	1.2	0%
Crown - Local/Regional Park	0.4	0%
Crown - Misc. Reserves	0.7	0%
Crown - Municipal Parcels	35	2%
Crown Lease - Misc. lease	1.2	0%
Crown – Timber Alienated in Watershed	1	0%
Crown – Watershed Reserve	186	10%
Private	285	15%
Unknown Ownership/Exceptions	1.3	0%

*Numbers may not add to 100% due to rounding

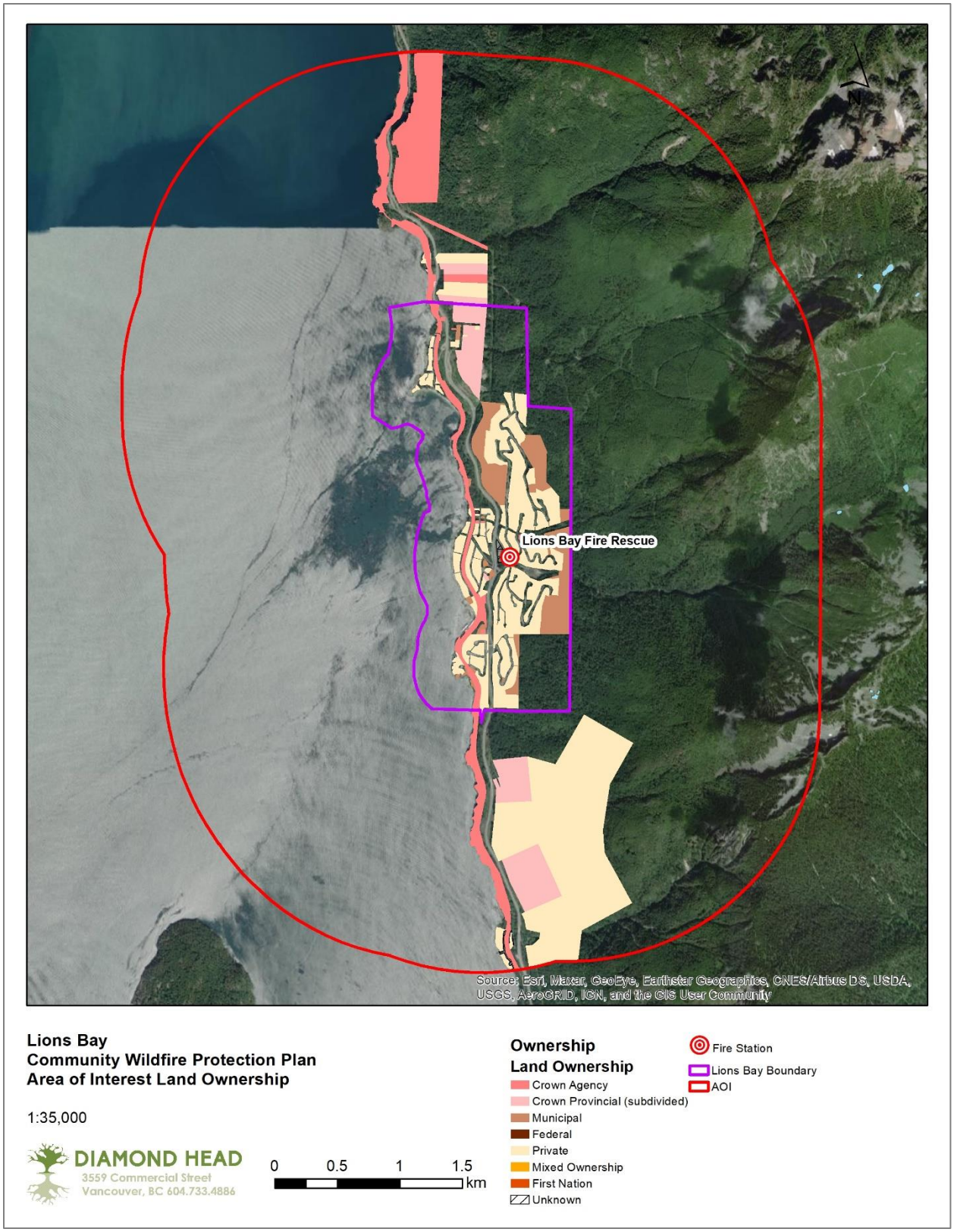


Figure 2. Land Ownership with the AOI. Blank areas in the AOI are unalienated crown land.

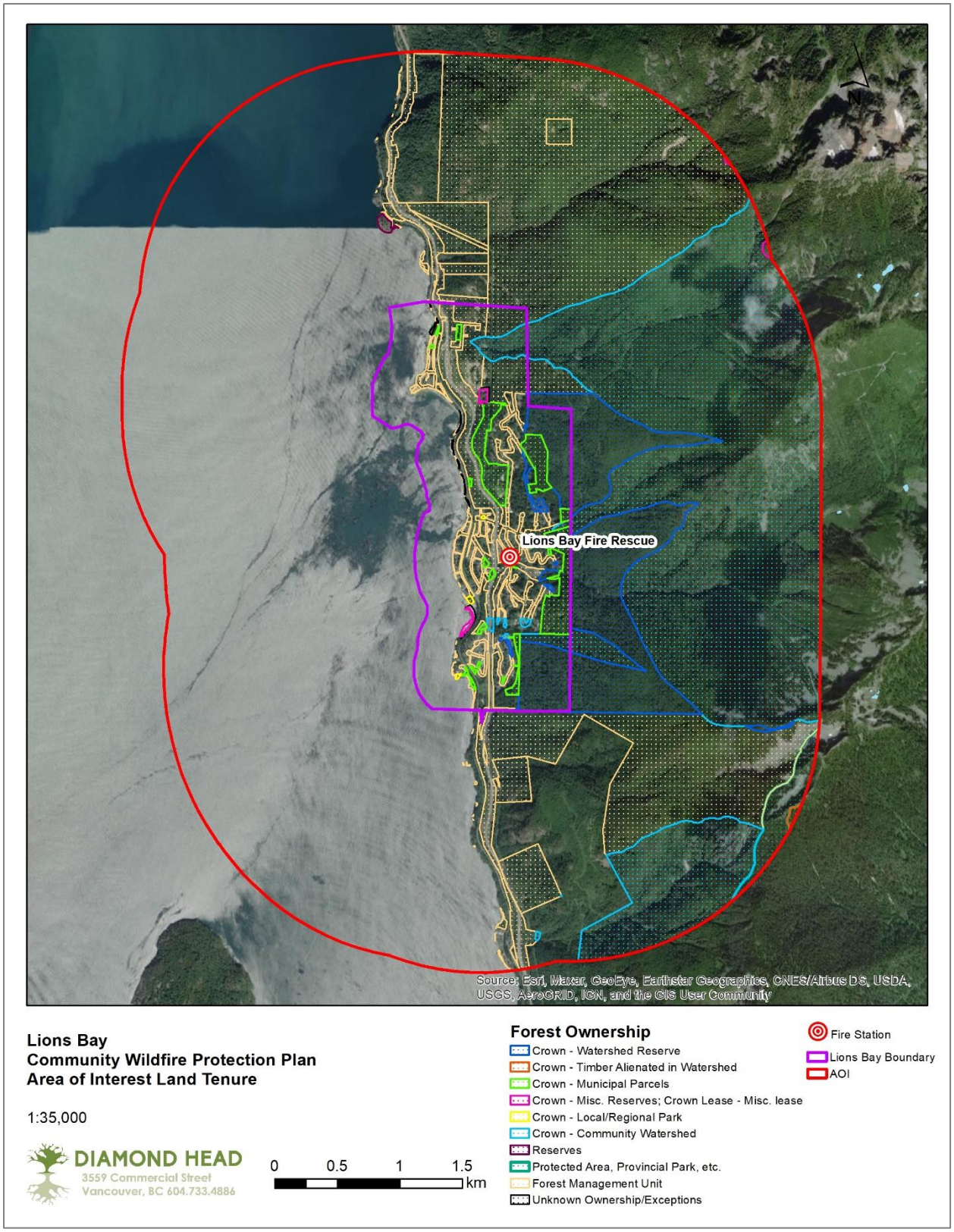


Figure 3. Land tenures in the AOI

2.2 Community Description

The Village of Lions Bay is a residential community integrated with the Metro Vancouver region. Employment is focused in the services sector, including professional services, finance, insurance, health and education. Most employed residents commute out of Lions Bay to work elsewhere in Metro Vancouver. There are however a number of home-based businesses that provide professional services.

Table 4. Employees by key sectors in the Village of Lions Bay (Statistics Canada, 2017)

Sector	Employees
Agriculture, forestry, fishing and hunting	0
Mining, quarrying, and oil and gas extraction	0
Utilities	0
Construction	55
Manufacturing	25
Wholesale trade	10
Retail trade	60
Transportation and warehousing	20
Information and cultural industries	50
Finance and insurance	50
Real estate and rental and leasing	10
Professional, scientific and technical services	140
Management of companies and enterprises	0
Administrative and support, waste management and remediation services	40
Educational services	65
Health care and social assistance	55
Arts, entertainment and recreation	70
Accommodation and food services	40
Other services (except public administration)	45
Public administration	25

2.3 Past Wildfires, Evacuations, and Impacts

There have been 43 wildfires in the AOI since 1950, burning a total area of approximately 134.2 ha. (Figure 4 and Table 5). The five largest fires account for 95% of the total area burned. Most fires were small fires that were quickly controlled. The largest fire on record in the AOI occurred in 1935, burning 172 ha. Excluding this large fire, the average size of a fire in the AOI since 1950 is 1.9 ha. If the largest five fires are excluded, the average fire size is small at only 0.19 ha. In the past 10 years a total of 5 fires have burned approximately 2.1 hectares.

Table 5. Summary of wildfires in the AOI since 1950.

AOI Fires Summary	# of Fires	Area Burned (ha)
Total 1950 – 2019	43	134.2
Average #/year	0.6	1.9
Modified Average #/year (5 largest fires excluded)	0.5	0.1
Total 2009 – 2019	5	2.1

The average number of fires that have occurred in the AOI over the past 10 years is 0.5 per year. This is slightly below the average number of fires since 1950. The average area burned over the past 10 years is 0.21 ha per year. This is double the 1950-2019 modified average. This suggests that small fires have been more difficult to control in recent years. In addition to direct fire impacts, the village has experienced periods of heavy smoke and poor air quality during the 2017 and 2018 fire seasons from wildfires elsewhere in the Pacific Northwest. This has caused impacts to the health and well being of residents.

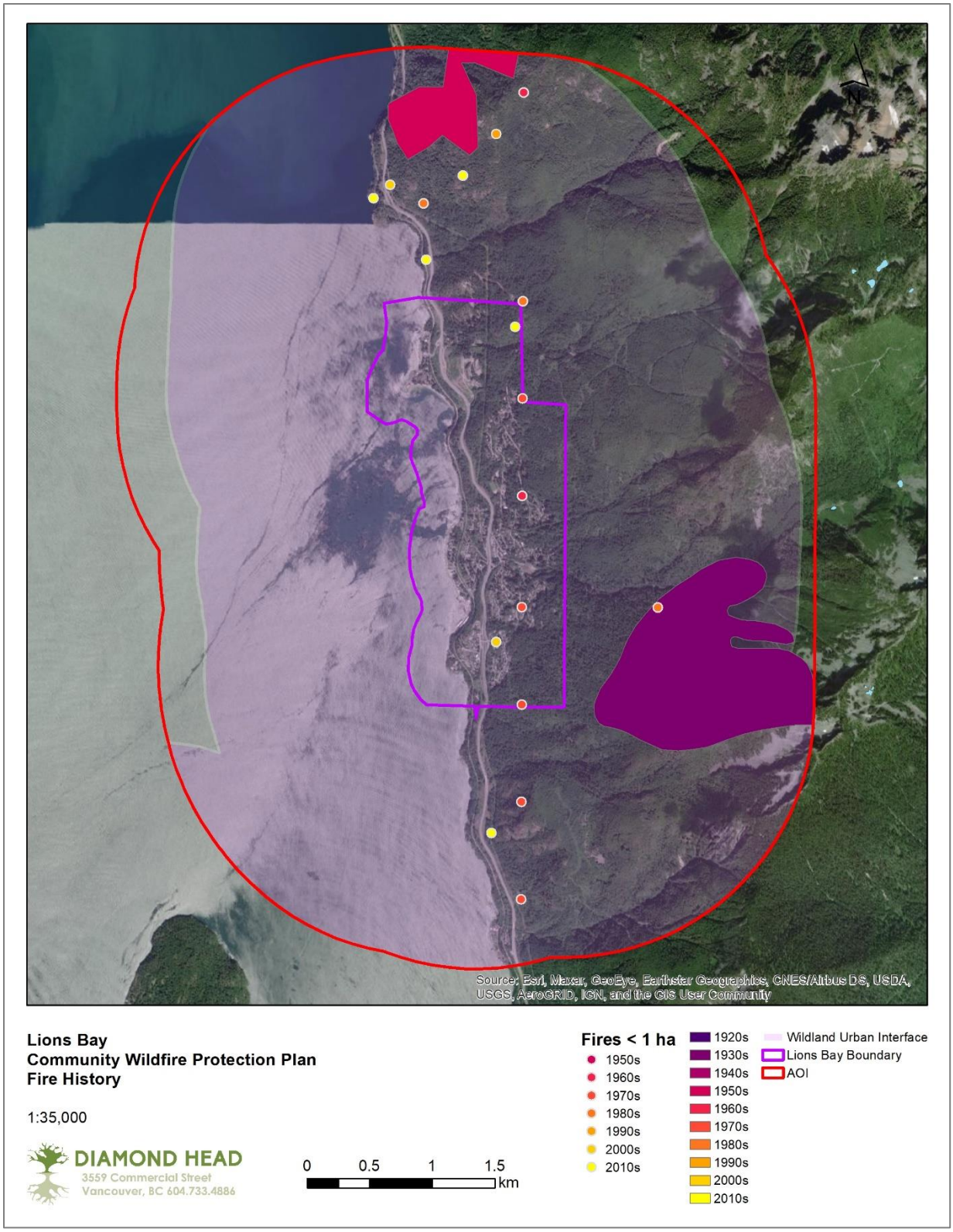


Figure 4. Location of previous wildfire events in the AOI. Polygons represent larger wildfires and points represent smaller fires. Color codes represent the decade in which fire occurred.

2.4 Current Community Engagement

Residents of the Village have had the opportunity to formally engage on wildfire management via recent (2018) proposed amendments to the Official Community Plan. This proposed OCP update included new guidelines for wildfire hazard assessment, which have not been adopted. The Village provides information and news about municipal business to residents through the Village Update, an online newsletter issued weekly.

Photo 2. The wildland urban interface is where forests abut urban development. This zone is where wildfires could potentially spread to urban neighbourhoods.

2.5 Linkages to Other Plans, Policies, and Bylaws

Many municipal plans and policies relate to wildfire planning. The most relevant are summarized below.

2.5.1 Local Emergency Plan (2019)

The Village's Emergency Plan provides a template for the municipality's response to emergencies and disasters. This Plan identifies "interface fire" as an occasional and high consequence event for Lions Bay. The Village has adopted the British Columbia Emergency Management System (BCEMS) as its model for managing and coordinating emergency response and recovery efforts, meaning the Village will prioritize securing immediate human health and safety over the protection of property or economic loss during a major event. The Plan contains several "annexes" which detail specific components of the municipality's response to a disaster, including Emergency Support Services, Evacuation, and Communications to residents. The plan supports LBAlert, a voluntary emergency notification system available to residents that can send updates, alerts, and orders directly via automated voice, email, and text messaging services. Lions Bay Fire Rescue (LBFR) has first responsibility for fire suppression within the municipal boundaries of Lions Bay.

2.5.2 Affiliated CWPPs

Lions Bay is an isolated community separated by more than two kilometers from other municipalities. Metro Vancouver, the regional district, does not have a Community Wildfire Protection Plan in place, but does maintain robust wildland firefighting response capacity for its controlled areas, including small sections of the Capilano watershed within the AOI. The nearby District of West Vancouver adopted its Community Wildfire Protection Plan in 2019, but the area covered does not overlap with the AOI of this plan.

2.5.3 Local Government Plans and Policies

Official Community Plan

The Official Community Plan (OCP) for the Village of Lions Bay was adopted in 2008 and provides a framework for all development and land use in the Village. The plan was amended in 2010 and 2016. The plan identifies climate change as a factor that can increase the intensity or frequency of wildfires and establishes Policy 4.2d to mandate planning for Wildfire Interface protection. During consultation for proposed amendments to the OCP in 2018, it was proposed that development permit areas for natural hazards, including wildfire, be adopted. The municipality continues to consider ways in which wildfire hazards can be mitigated throughout the Village. The OCP also gives direction emergency services, including negotiating mutual aid agreements for fire protection with neighbouring municipalities and establishing a fire-training facility on Crown-leased land at the "Upper Brunswick" gravel pit. In addition to these directions, the OCP sets policies to reduce the Village's corporate and community greenhouse gas emissions, which is consistent with a larger goal to mitigate climate change and thereby reduce wildfire risk.

Fire Bylaw No. 428 (2011)

The Fire Bylaw establishes the Lions Bay Fire Rescue service under the direction of the Fire Chief and addresses outdoor burning by residents as well as requirements for new construction. The Fire Chief is responsible for carrying out all fire protection activities and other activities such as wildland fire fighting.

The Bylaw establishes the Powers of the Fire Chief, which include "all necessary measures for the prevention, control and extinguishing of fires and for the protection of life and property during an incident". The Fire Bylaw also addresses legal fires and burning in Lions Bay, and outlaws open burning throughout the Village. A total ban on burning may be imposed within the Village at the discretion of the Fire Chief. For new building construction, the Fire Bylaw requires that a fire suppression sprinkler system must be installed.

Trees, Views and Landscapes Bylaw No. 393 (2007)

The Bylaw establishes tree protection and permitting on municipal lands within the Village. Trees owned by the Village must have a tree permit issued to allow for their removal or pruning. The Village may require replanting by the applicant for the tree permit. The Bylaw also recognizes a Trees, Views and Landscapes Committee as an advisory group to Council. They have the responsibility for reviewing applications for tree permits and other issues that Council directs.

Photo 3. Lions Bay is heavily forested with mature second growth stands growing on steep slopes above and within the community.

Metro Vancouver 2040 Shaping Our Future, Regional Growth Strategy Bylaw No. 1136, 2010

The Regional Growth Strategy sets out high-level land-use designations for the communities of Metro Vancouver, including Lions Bay. Growth projections within the Strategy indicate Lions Bay's population could increase to 1,700 people by 2041 from approximately 1,300. However, the Village's population between the 2011 and 2016 censuses did not increase at the rate required to see this level of growth by that time (StatsCan, 2016).

2.5.4 Higher Level Plans and Relevant Legislation

Sea-to-Sky Land and Resource Management Plan (2008)

The AOI is within the Sea to Sky Land and Resource Management Plan area, which sets a high-level framework for acceptable activities on the crown land base within over one million hectares along the Highway 99 corridor. The AOI is within the "frontcountry" area designated by the plan, where intensive public and commercial recreational uses of crown land are anticipated, with visual quality and recreational values forming primary foci for management. Small portions of the AOI are within the "Protected Areas" designation, namely the Cypress Provincial Park corridor at high elevation on the Howe Sound Crest. The status of wildlife species is reviewed at a high level, including directions for management of bald eagle, deer, moose, mountain goat, grizzly ear, marbled murrelet and spotted owl where found. Ministerial orders establish wildlife habitat areas, ungulate winter ranges, and other biodiversity features within the AOI. Objectives are also set for the retention of supporting habitat types, including old growth forest conditions. The LRMP also provides a framework for cultural management of identified areas by First Nations; however, no specific cultural management areas or cultural places have been designated within the AOI. Strategies to meet these directions will need to be proposed for areas where fuel modification is proposed.

The LRMP identifies wildfire management is important in the corridor. Strategic fuel modification plans can reduce fire severity and provide for enhanced fire control and suppression capabilities. Enhanced ability to manage fire is stated as a goal within the LRMP.

Section 3 Values at Risk

Wildfires impact our communities in many ways. They can cause direct impacts to structures, facilities, and infrastructure, and in rare cases can result in the loss of life. Damage to infrastructure can impede emergency response or provision of basic services like power and water. Smoke from nearby wildfires causes direct impacts to human health. Wildfires can also disrupt economic activity through evacuations of residents, whose assets and employment are often affected. Evacuations and area closures also disrupt the movement of goods and services via roads, railways, and utility corridors that is critical to the wider regional economy. These direct and indirect impacts can be difficult to quantify but cause significant cumulative impacts on local livelihoods. This section of the report provides an overview of the types of values that are at risk from wildfire within the AOI.

3.1 Human Life and Safety

Protection of human life is the top priority in the event of wildfire in the urban interface. Structure locations have been used to provide a measure of the density of the population across the AOI. Areas with an average density of more than 6 structures per square kilometer are defined as the Wildland-Urban Interface (WUI) (Figure 5).

Table 6 provides a summary of the total area within the AOI by structure density class. Highly urbanized areas of more than 100 structures per square kilometer make up a high percentage (38%) of the total AOI. In these areas, houses are close together with relatively few trees between them. Buildings around the outskirts of the Village border continuously forested lands, and are at the inner edge of the wildland-urban interface. Approximately half of this area contains structures at densities lower than 100 structures per square kilometer. These areas with developments that are spread apart with trees between them present the most difficulty for suppression response and evacuation.

Table 6. Summary of density

Density Structures/km^2	Area (km^2)	% of total area
1-6	2.9	15%
6-24	3.5	18%
25-100	3.5	18%
100-250	2.2	11%
250+	0.5	3%
No buildings	6.6	34%

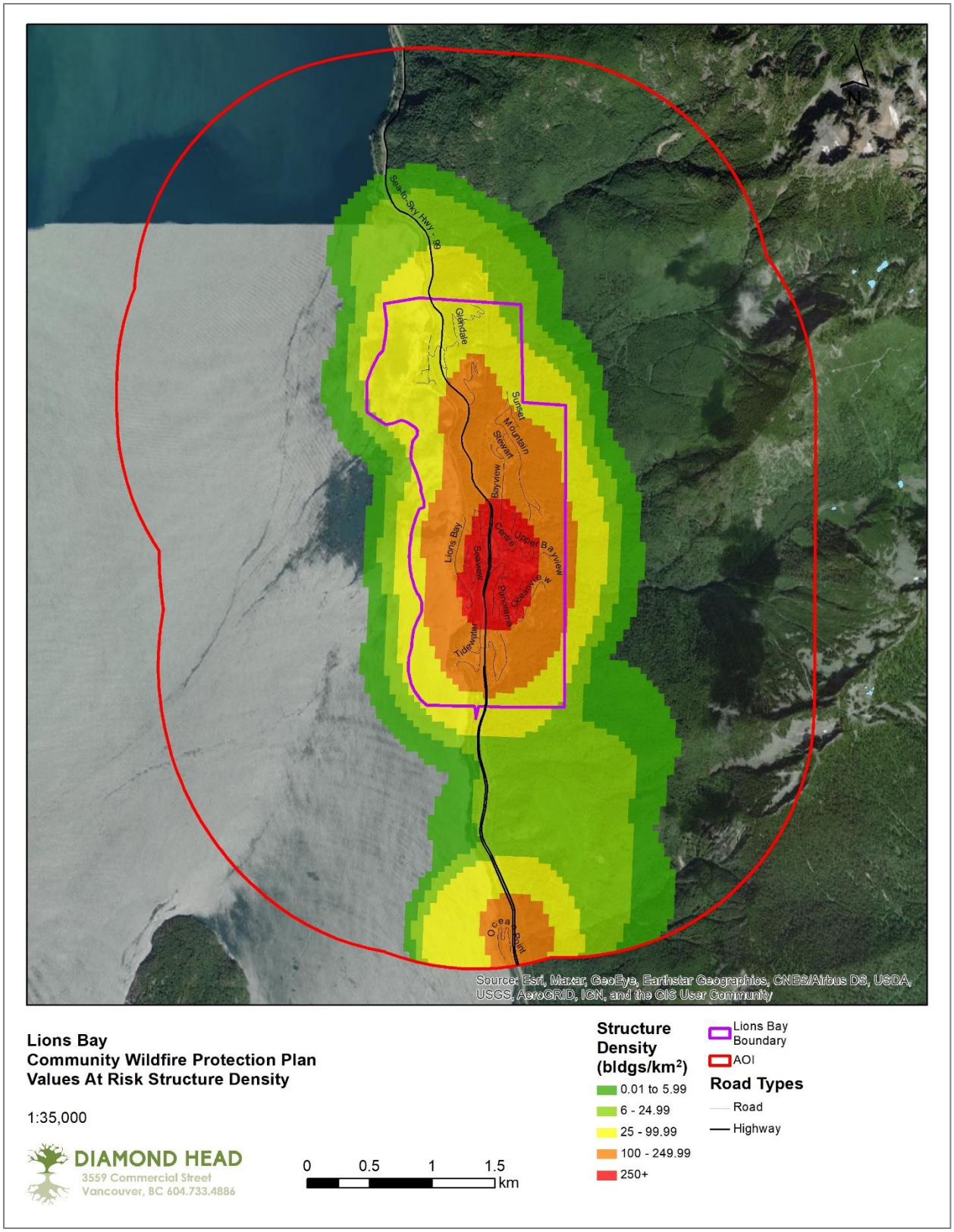


Figure 5. Density of structures

3.2 Critical Infrastructure

The features and utilities that are considered critical infrastructure were identified through consultation with stakeholders. These are features that, if disrupted or destroyed, would cause serious impacts on the functioning of government and important facilities that the public relies on. These include BC Hydro transmission lines and substations, major highways, municipal water supply, waste treatment, municipal buildings, and the fire station (Figure 6).

3.2.1 Electrical Power

BC Hydro services the Village of Lions Bay through an electrical network of mostly above-ground distribution lines and one local substation. BC Hydro has policies and mitigation activities in place to mitigate the risk from wildfire. These include fuel management surrounding infrastructure, wildfire assessments prior to work in the interface, and risk evaluations during periods of high or elevated wildfire danger. Hydro power lines and their substations are also a source of ignition, particularly if trees fall on the lines. BC Hydro is responsible for reducing the risk from trees adjacent to its power lines and has legislated authority to manage this risk.

Photo 4. BC Hydro substation on Tidewater Road (Google Earth image)

3.2.2 Communications, Pipelines, and Publicly Owned Buildings

There are many community facilities that should be considered for protection in the case of a wildfire. Critical infrastructure are those facilities that are important to protect to ensure the Village can continue functioning in the case of a catastrophic wildfire event. For the purposes of this CWPP, the following municipal and public buildings were identified as critical infrastructure:

- Lions Bay Fire Rescue & ambulance station
- Municipal Hall
- Public Works Yard & BC Hydro substation
- Water treatment plants (Harvey Creek and Magnesia Creek)
- Water supply intakes (Harvey Creek and Magnesia Creek)
- Egress north and south on Highway 99

Most of the identified Critical Infrastructure is located in the central area of the Village, near Highway 99. During a wildfire event, transportation is critical for evacuation and to support suppression efforts. Highway 99 is considered Critical Infrastructure as it is the only route of access and egress to the community. A wildfire in the interface has the potential to block or restrict movement in one or both directions along the highway, making its protection uniquely important to the community.

Photo 5. Lions Bay Fire Rescue. The ambulance station is also located in this building.

3.2.3 Water and Sewage Infrastructure

Water is supplied throughout the Village by the two municipal distributor networks, with uphill intakes and storage tanks within the community watersheds on Harvey and Magnesia creeks. UV treatment and chlorine injection are used to ensure water quality is compliant with Canadian and provincial guidelines. Gravity is used to maintain water pressure throughout the Village, with several Pressure Reducing Valves required to relieve high water pressures in the municipal distribution network. Water mains cross the creeks via exposed steel pipe.

The Municipality's watershed areas include Magnesia Creek (421 hectares), Harvey Creek (635 hectares), Alberta Creek (51 hectares), and Rundle Creek (20 hectares). The Municipality's total water supply is only drawn from the Magnesia Creek and Harvey Creek watersheds.

To treat sewage, most properties rely on septic systems except in the Kelvin Grove neighbourhood, where a small sewage treatment facility receives grey water before it is released to Howe Sound.

Photo 6. Five water storage facilities are found in the forest interface above the community.

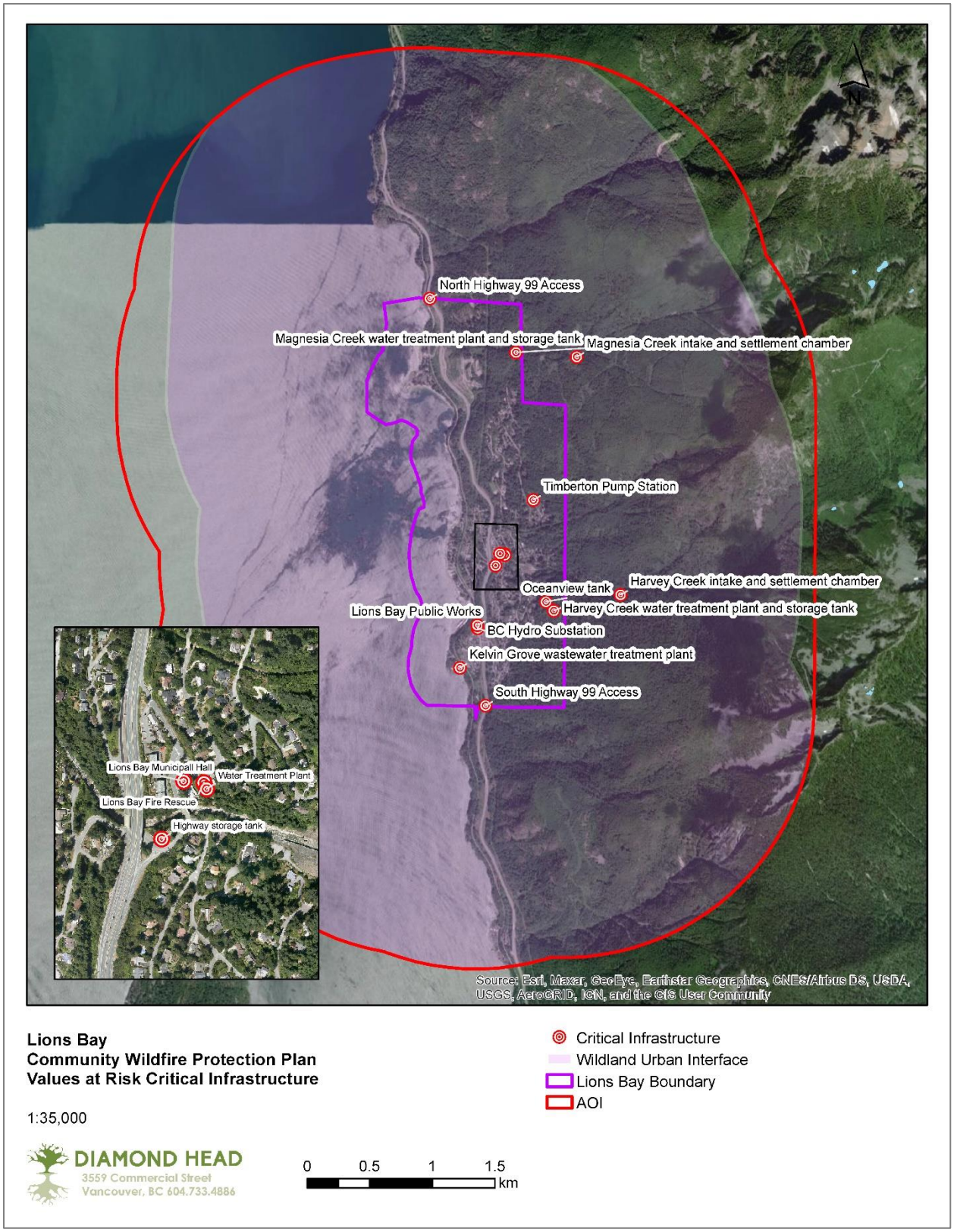


Figure 6. Critical infrastructure Map

3.3 High Environmental and Cultural Values

3.3.1 Drinking Water Supply Area and Community Watersheds

The Harvey and Magnesia watersheds are vulnerable to disturbance. These watersheds have areas of instability upstream of their intakes. Given the watersheds' small size, the consequences of small disturbances can be severe. Wildfires can cause shifts in landscape processes that can decrease water quality by increasing sedimentation and nutrients downstream, and increasing erosion adjacent to watersheds (Emelko & Sham, 2018). There have also been cases where homes and infrastructure have been destroyed or damaged during debris flows that can be attributed to wildfires (Jordan, Turner, Nicol, & Boyer, 2006).

3.3.2 Cultural Values

The Archaeology Branch of the Ministry of Forests, Lands, Natural Resource Operations and Rural Development maintains a spatial database of archaeological and historical sites. These include locations where there is evidence of past human activity. Within the AOI there are 2 recorded archaeological sites related to aboriginal life during the 14,000 years prior to European contact. These sites include petroglyphs, middens, and lithics. Due to the sensitive nature of these sites, their exact locations cannot be published. In addition to the two recorded sites, landscape-level assessments by the Archaeology Branch indicates large areas at low and mid elevations in the AOI have high archaeological potential, owing to the area's prominent location on major pre-contact routes for travel and trade.

No locations of recent historic significance (post 1846) are found within the AOI. These sites can include historic buildings or heritage trees and are listed on federal, provincial, or local government heritage registries.

3.3.3 High Environmental Values

The BC Conservation Data Centre (CDC) records BC's most vulnerable vertebrate animals and vascular plants, each of which is assigned to a provincial Red or Blue list according to their provincial conservation status rank. Species or populations at high risk of extinction are placed on the Red list and are candidates for formal endangered species status. Blue-listed species are considered vulnerable to human activity and natural events. Only one known occurrence of a provincially listed species is found within the AOI, the *Andreaea sinuosa* rock moss. This is an alpine rock moss that has been observed at high elevations along the Howe Sound crest and is unlikely to be found within the municipal limits of the Village.

The impacts of fuel treatments to rare plants, animals and ecosystems should be taken into consideration when contemplating wildfire risk reduction across the study area. Details regarding the management requirements of these entities can be found on the CDC Website (https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre). Red- and blue-listed wildlife species at risk that are known to inhabit the AOI or the adjacent natural areas are listed in Table 6 and illustrated in Figure 7.

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

CDC Occurrence ID#	Name	B.C. Status
8725	*Andreaea sinuousa* (rock moss)	Red

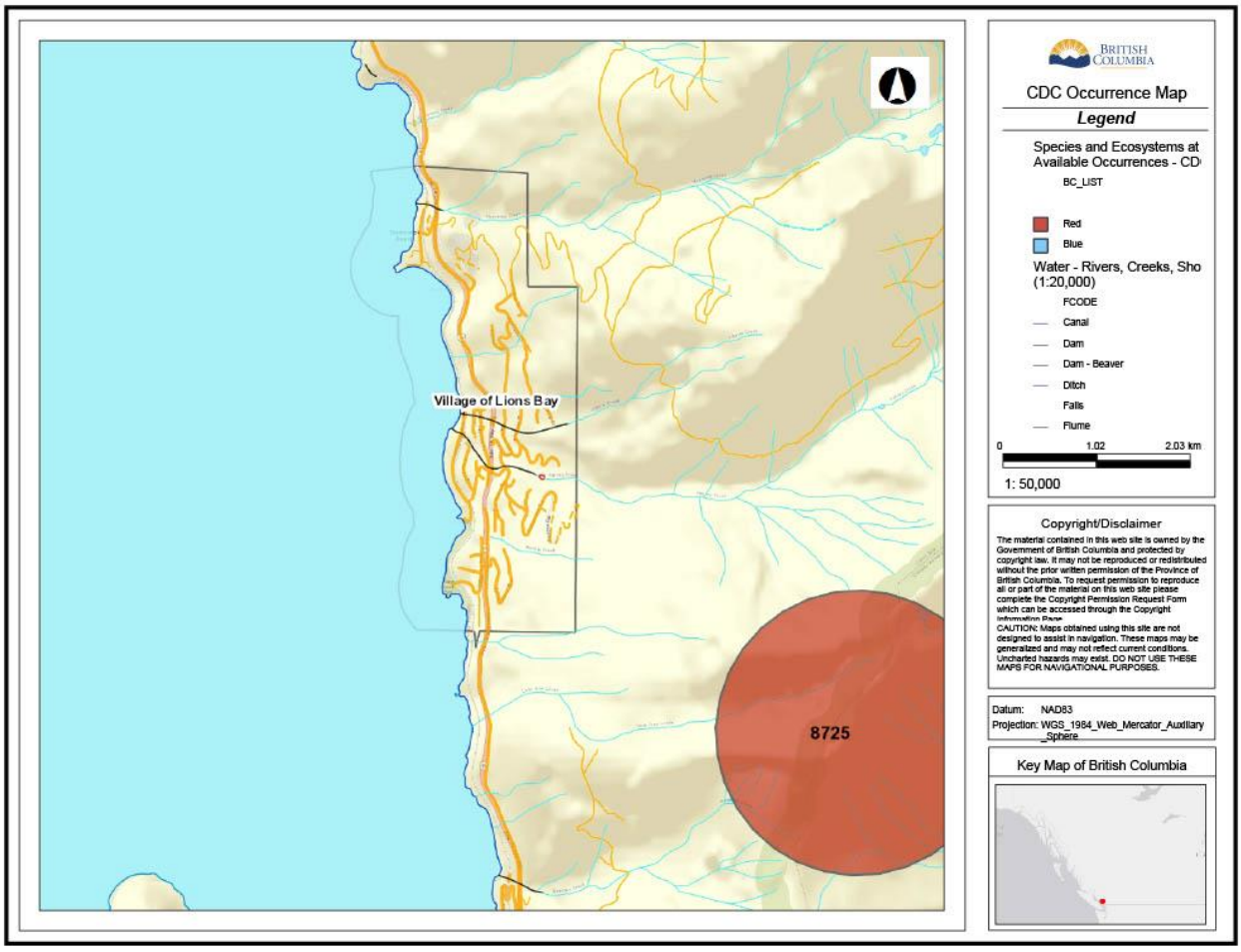


Figure 7. Known occurrences of red and blue listed species. Occurrence #8725 is *Andreaea sinuousa* - rock moss (Conservation Data Centre).

3.4 Other Resource Values

Lions Bay is a regional destination for hiking and walking as well as for marine activities. The Village is the access point for a number of short as well as multi-day hikes that are popular in the Metro Vancouver and Sea to Sky regions. These include the famous trails to the Lions and along the Howe Sound Crest. Gravel roads in the community watershed are used as hiking, walking, and biking trails. Within the municipal limits of the Village, five small Village parks and a native plant garden offer outdoor spaces primarily to residents. In recent years, the beaches at Brunswick Beach, Lions Bay, and Kelvin Grove have become popular destinations increasing crowding and causing parking issues.

Within the AOI, there is no authorised natural resource extraction. Forested land is mostly within the community watersheds. Within the Village limits, forests are generally held on private lands within residential subdivisions or within areas protected from timber harvesting, such as municipal parks.

Photo 7. Road in the Harvey Creek watershed used as part of a hiking route.

3.5 Hazardous Values

The intent of this sub-section is to recognize hazardous values that pose a safety hazard to emergency responders. During a wildfire event, stores of hazardous materials can ignite or explode; or they may pose other safety hazards to emergency workers. Hazardous values can include stores of fuels like gasoline and diesel, fertilizers or fertilizer components, and other industrial chemicals. The amount of hazardous materials within Lions Bay is expected to be low, due to the Village's small size and lack of industrial activity. The Village Fire Rescue and Ambulance Station, works yard, water treatment plants, and Lions Bay Marina are commercial locations that may store small quantities of hazardous materials. There are no commercial gas stations in the Village, though marine refueling is available at the Lions Bay Marina. Residences may also store smaller quantifies of hazardous materials. Given the setting of the community, any stored hazardous materials within 100 metres of the forest interface are a concern.

Photo 8. The Lions Bay Marina is the largest commercial enterprise in Lions Bay and may contain stores of fuel or other chemicals.

Section 4 Wildfire Threat and Risk

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

4.1 Fire Regime, Fire Danger Days and Climate Change

4.1.1 Fire Regime and Fire Weather

The Biogeoclimatic Ecosystem Classification (BEC) is used to describe ecosystems by vegetation, soil, and climate. Ecosystems are classified at the largest scale into BEC zones. Most of the AOI is in the Coastal Western Hemlock (CWH) BEC zone, with smaller areas at higher elevations in the Mountain Hemlock (MH) and Coast Mountain-heather Alpine (CMA) BEC zones. The CWH is highly unique within Canada, representing productive temperate rainforests and containing a variety of fungi, plants, and animals.

All ecosystems are influenced by periodic disturbances that vary in size, severity, and occurrence. Examples of common disturbances include wildfire, windthrow, ice and frost damage, water, landslides, insect, and disease outbreaks as well as human-caused events such as logging or land clearing. Historically, agents of disturbance were viewed as unhealthy and a threat to the integrity of the forest as a timber resource. Standard forest protection policy was to suppress all wildfires. Wildfires are rare but not unusual on the coast of British Columbia, where summer droughts dry heavy forest fuels and significantly elevate wildfire risk. Large wildfires here are often the result of a confluence of drought, windy weather without rainfall, and human-caused ignitions in the forest interface. Dry weather in the 1880s and 1920s, combined with multiple ignitions from logging operations, created large forest fires throughout the Lower Mainland. The relics of these fires can be seen today in forests adjacent to urban development throughout the region. In the century since, land management practices have excluded fire near urban areas and contributed to elevated hazard by increasing fuel loads, while urban development in the forest interface has decreased forest health and created new sources of ignition. Climate change, while affecting day-to-day weather in unpredictable ways, has increased the length of the fire season through overall warming and longer periods of drought.

Wildfire can significantly alter the physical and biological characteristics of an ecosystem. It can change the structure and species composition of a forest, remove some or all of the forest floor organic layer, and alter the chemical properties of the soil. In ecosystems where natural wildfires are frequent, wildfires help to prepare seed beds, recycle nutrients, alter plant succession, maintain a diversity of age classes (seral stages) across the landscape, control insect and disease outbreaks as well as reduce fuel accumulations. Many of the native plant species in fire-dominated ecosystems depend on wildfire during some part of their lifecycle. In our region, many older forest stands dominated by Douglas-fir germinated following large, “stand-initiating” wildfires.

The BEC zones within the study area are further broken down into subzones, which reflect more specific climates (Table 8). These subzones are associated with different natural disturbance regimes. Most of the study area is located in the CWHdm (dry maritime) subzone, which is an ecosystem with warm, dry summers and mild winters with little snow. These forests occur at elevations of up to 700 metres around

Lions Bay and thus characterize all of the lands within the municipal limits. These forests transition at higher elevations to the wetter climate of the CWHvm2 (very wet maritime, montane variant) and MHmm1 (Mountain Hemlock moist maritime, windward variant), both of which receive substantial amounts of precipitation as snow. The CMA forms a very small part of the project area and is characterized by alpine areas with reduced or no tree cover. Table 8 shows climate data for the three forested BEC zones.

Table 8. Climatic characteristics of the biogeoclimatic zones within the project area (Green & Klinka, 1994)

Biogeoclimatic Zone	Range	Annual Precipitation (mm)	Summer Precipitation (mm)	Annual Snowfall (cm)	Avg. Annual Temperature (°C)
CWHdm	Max	2412	525	177	10.3
	Min	1367	280	45	8.7
CWHvm2	Max	2850	681	605	NA
	Min	2760	550	552	
MHmm1	Max	2954	707	820	5.0
	Min	2565	694	816	4.6

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

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

Table 9. Summary of the biogeoclimatic zones within the AOI by Natural Disturbance Type

Biogeoclimatic Zone	Natural Disturbance type	Area (ha)	Percent of total area (%)
Coastal Western Hemlock – Dry Maritime (CWHdm)	NDT 2	1,045.4	54%
Coastal Western Hemlock – Very Wet Maritime, montane variant (CWHvm2)	NDT 1	446.9	23%
Mountain Hemlock – Moist Maritime, windward variant (MHmm1)	NDT 1	411.4	21%
Coast Mountain-heather Alpine – undifferentiated parkland (AT)	NDT 5	17.9	1%

More than half of the forests within the AOI are classified as Natural Disturbance Type 2: Ecosystems with infrequent stand-initiating events. These forests are those within and adjacent to the Village and are therefore of high significance for community wildfire protection planning. These ecosystems were historically characterized by major fires of 20 to 1000 hectares in size creating a mosaic of even-aged forests across the landscape. Larger fires occurred following extreme drought conditions and reset forest succession across entire landscapes.

Firefighting has effectively suppressed most of the wildfires that would have naturally occurred in this ecosystem. This has led to higher fuel accumulations, and a higher likelihood of increased fire intensity. This is reflected by the historic count and area burned of wildfires in the AOI. Wildfire activity has generally decreased as wildfire suppression techniques and equipment became more sophisticated.

At higher elevations, most forested area are classified as Natural Disturbance Type 1: Ecosystems with rare stand-initiating events. These are montane and subalpine forests higher in the community watershed where snow levels and cooler summer temperatures generally reduce wildfire activity. Historically, these forests are dominated by small “gap” producing disturbances that create multi-aged structurally diverse forests over time. The susceptibility of these forests to wildfire is increasing as a result of climate change, which has reduced average snowpack depths and increased temperatures. Natural Disturbance Type 5 is reserved for alpine areas where forest cover is minimal or non-existent.

Fire Weather Rating is the use of weather measurements to assess likely fire behavior for a defined forecast period. The BC Wildfire Service monitors Fire Weather Ratings throughout the province. Fire Weather Ratings are an essential component in most fire prediction models and are used to help determine a community's landscape level wildfire threat.

Table 10 summarizes summer temperature and rainfall statistics from the Wildfire Service fire weather station UBC Research Forest. Located approximately 45 km southeast of Lions Bay, this weather station contains hourly weather data since 1961 and is located at an elevation of 100 metres in the CWHdm, making it suitably representative of fire weather conditions in the AOI. The statistics for 2018 have been included to illustrate the weather associated with an extreme fire season.

Table 10. Weather statistics for the months of May to Sept (1990-2020)

Weather Attribute	May	Jun	Jul	Aug	Sep
30 year Daily Average High (°C)	18.3	20.3	24.1	24.3	20.5
2018 Max Daily High (°C)	29.5	31.5	34.5	34.0	28.5
30 year Average Rainfall (mm)	119.5	92.8	52.9	69.9	111.1
Rainfall in 2018 (mm)	32.8	73.4	55.4	17.2	301.8

Table 11 provides a summary of the average number of days rated as moderate, high, and extreme in the fire season (May to Sept) at nearby fire weather stations. This has been calculated from data over the past ten years. The four stations are located at elevations of less than 400 metres north of urban areas in the Lower Mainland.

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

Weather Station	Average # of Days as Moderate	Average # of Days as High	Average # of days as Extreme
Capilano – 9 km E	27.8	17	5.7
Seymour – 18km NE	29.8	20.7	3
Coquitlam – 30km E	30.7	24.6	4.6
UBC Research Forest – 48km SE	35.1	28	5

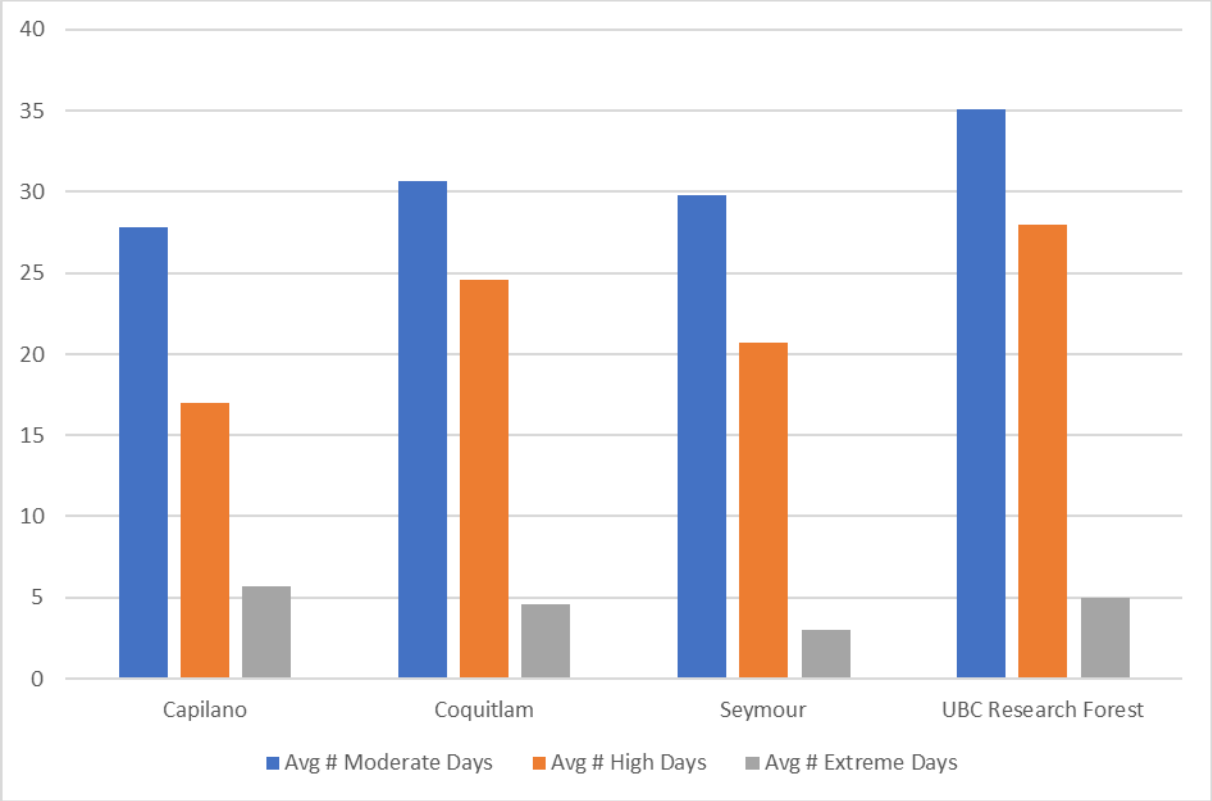


Figure 8. Average number of danger days in each fire danger class over the past ten years (2008-2018)

4.1.2 Climate Change

Climate change will result in changes to temperature and precipitation, with impacts to both forest health and wildfire risk. Estimates of future climate for the Lower Mainland were prepared by Metro Vancouver in 2016. They indicate that temperatures will increase and precipitation will decrease in summer months. Summer daytime high temperatures are expected to increase by 3.7 to 8.4 °C by the 2080s, while summertime precipitation is expected to decrease by 6 to 53% (Metro Vancouver, 2016). Patterns observed in other parts of BC and North America suggest that hotter, drier conditions are likely to result in an overall increase in wildfire frequency in the study area (Kirchmeier-Young, Gillett, Zwiers, Cannon, & Anslow, 2019; Taylor, Régnière, St-Amant, Spears, & Thandi, 2010). Warmer temperatures in spring and fall will extend the duration of the fire season, placing values at risk throughout more of the year (Abatzoglou & Williams, 2016).

Climate change will continue to have negative impacts for forest health (Spittlehouse, 2008). Climate change affects forest health by creating maladaptation between trees and sites and supporting secondary health factors like populations of insect pests. More frequent or prolonged droughts are likely to reduce tree health and vigor, increasing susceptibility to pathogens and pests (Woods, Heppner, Kope, Burleigh, & Maclauchlan, 2010; Sturrock, et al., 2011). Declining forest health tends to increase forest fuel loading by increasing the amount of dead wood and foliage in the stand.

4.2 Provincial Strategic Threat Analysis (PSTA)

The PSTA is a high-level analysis conducted by the Province and is intended to be used as a starting point for an assessment of local wildfire threat. It is an interpretation of fuel type mapping, historical fire data and weather, and topography. The PSTA includes information and maps that describe fuel types, historical fire density, and the potential for embers to land in an area (spotting impact), head fire intensity (HFI), and a final calculated wildfire threat score (Figure 9).

Provincial Strategic Threat Analysis and metadata from the BC Wildfire Service (BCWS) was clipped to the AOI. The PSTA head fire intensity and subsequent wildfire threat classes were ultimately updated based on the fuel typing changes for the local threat assessment as described in Section 4.3. For each updated fuel polygon, similar fuel types nearby were referenced to update the HFI rating. Fire density and spotting impact numbers did not change due to any input at a local level.

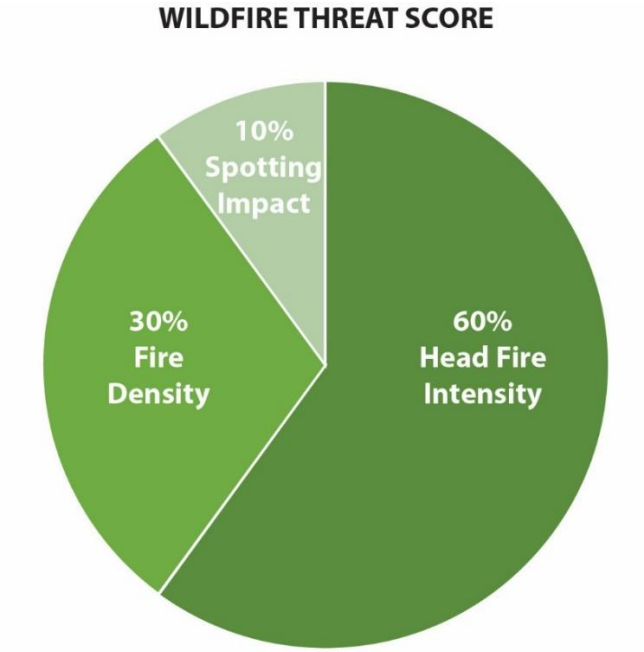


Figure 9. Input factors and contributing weights to the final Wildfire Threat score.

The PSTA mapping for the AOI (Figure 10) appears incomplete because PSTA scores cannot be published for private land. Approximately 10% of the AOI is private land. The PSTA identified the majority of the public land area assessed as a Moderate to High threat (Table 12). These areas generally include forests that have a high component of conifer tree species. The highest risk areas are also closely correlated with the steepness of the slopes. Land within the Village (where data was available) were mostly moderate threat. Very little area within the AOI was rated low threat by the PSTA.

Table 12. Summary of wildfire threat on public owned lands

PSTA Threat Rating (class)	Area (ha)	% of land area
Extreme	0	0%
High	154	8%
Moderate	1,558	81%
Low	17	1%
No Data (Private Land)	191	10%
Water	1532	NA

The PSTA is a generalized and coarse analysis completed at a province-wide scale with a resolution of 50 by 50 metres. This tool is useful for higher level wildfire analysis, but lacks detail required for a localized analysis of wildfire risk. A key component of this plan is refining this PSTA data into a refined wildfire risk map. This map has a higher detail and combines wildfire threat with the proximity to values. This process is detailed in section 4.3.

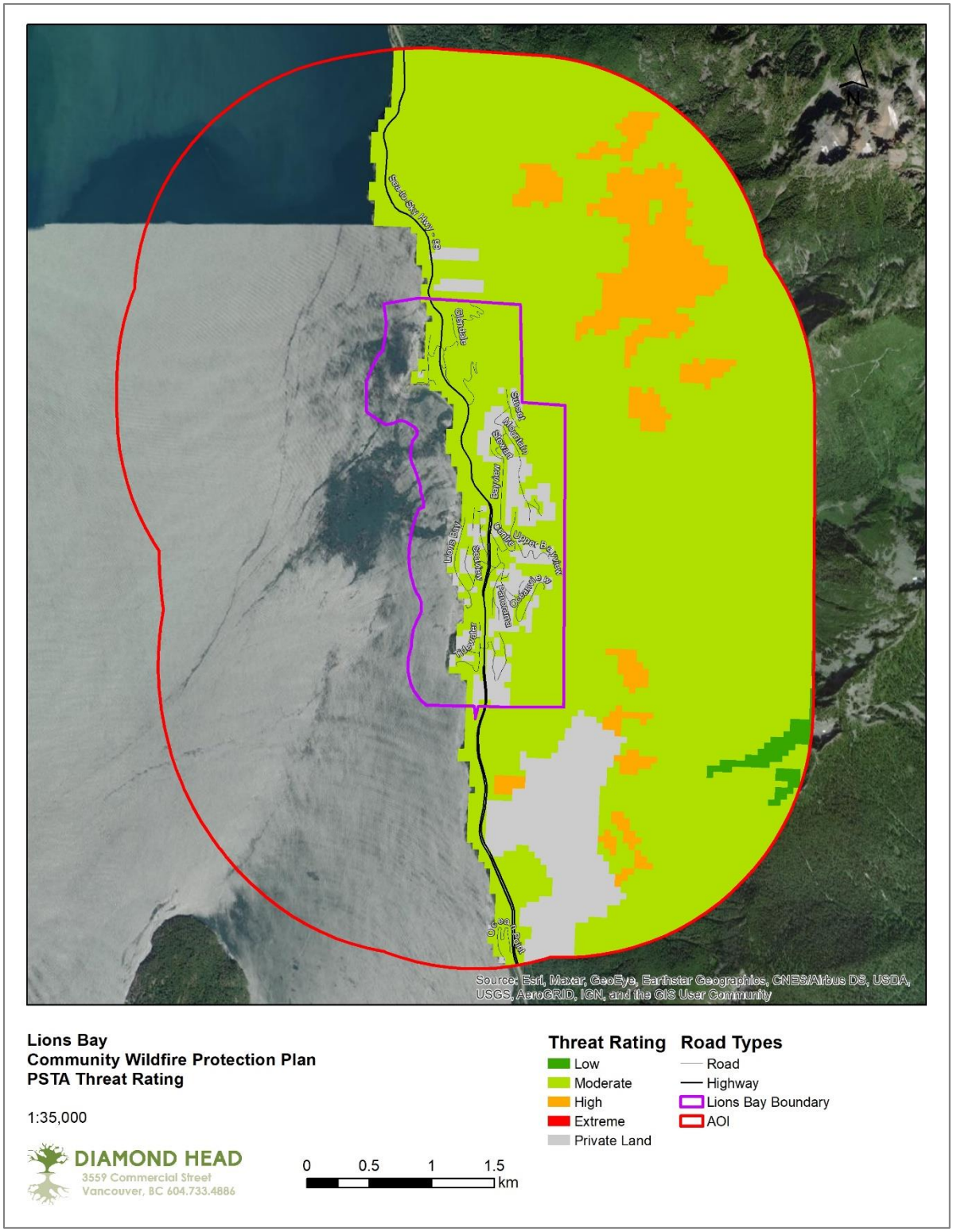


Figure 10. PSTA threat rating on public lands

Spotting Impact

Research shows that a high percentage of structure losses are from embers being transported to and igniting structures and subsequent structure-to-structure ignitions (Partners in Protection, 2018). Spotting is frequent in high intensity fires with active crown fires. Embers are carried by wind and dropped into adjacent structures and communities. Spotting is known to occur up to two kilometres away from the fire. In the AOI, the most prevalent wind direction is from the south. The communities and structures north of high-risk fuels are most vulnerable to spotting from approaching wildfires. The PSTA modelled spotting threat on public land is low, with one area of moderate threat. No areas have modelled high or extreme threat for spotting.

Table 13. Spotting classes by area on public lands in the AOI

Spotting	Area (ha)	% of Land Area
High	0	0%
Moderate	235	12%
Low	1496	78%
No Data (Private Land)	190	10%
Water	1533	NA

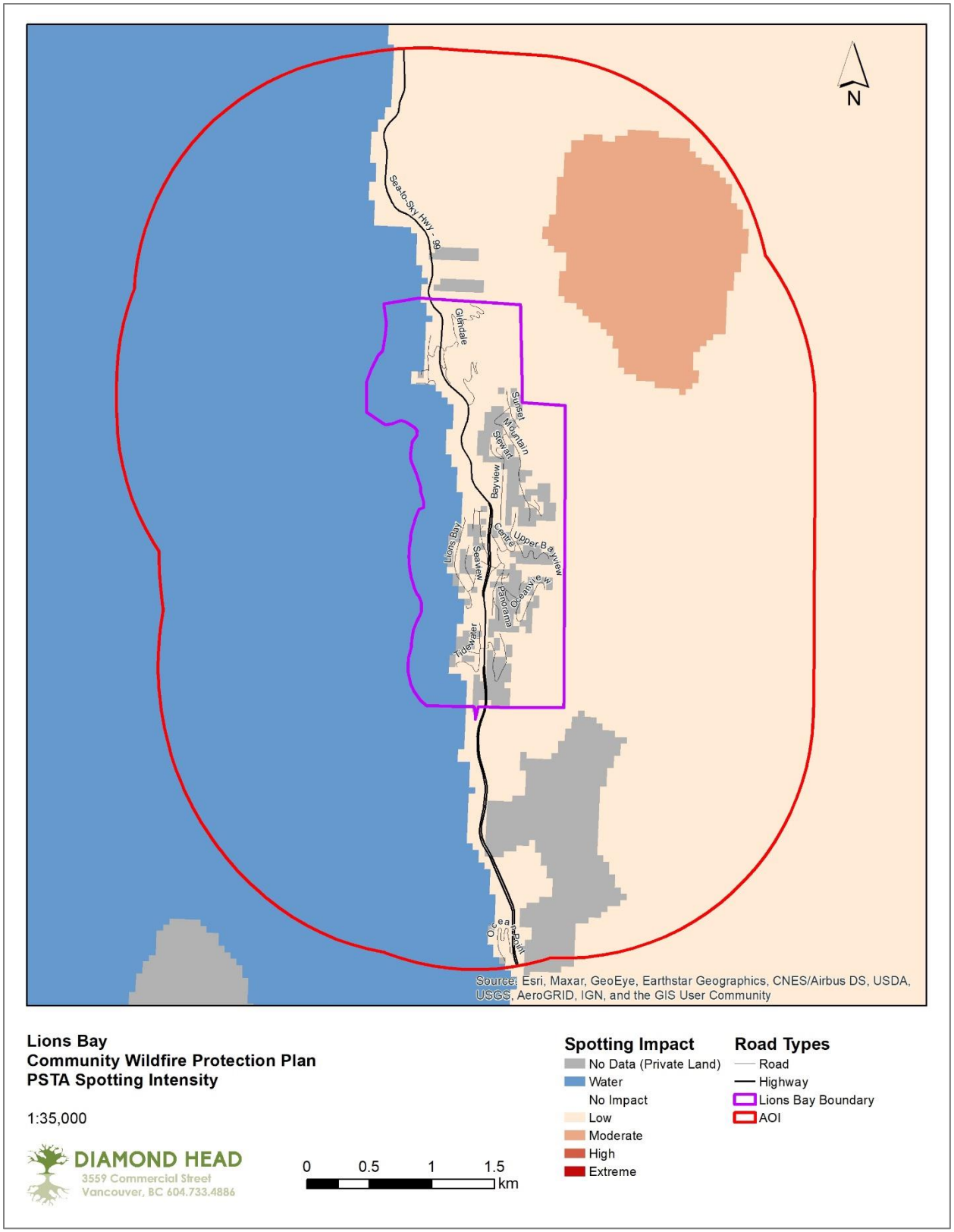


Figure 11. PSTA spotting impact for public lands

Head Fire Intensity

Head Fire Intensity (HFI) is used to predict wildfire behaviour, and therefore is a good metric of expected wildfire suppression success. HFI is a measure of the energy output of a wildfire, and a good measure of the expected spread rates, flame lengths, and crowning potential. HFI will increase as fires move upslope and downwind and is greatest where slopes and wind align. Most of the public lands within the AOI have PSTA predicted Head Fire Intensities of 2000 to 6000 kW/m.

Table 14. Head Fire Intensity Classes and Associated Fire Behaviour

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

NB: The descriptions in this table will vary by fuel type and should only be used as guidance for expected fire behaviour.

The 10 Fire Threat Classes represent increasing levels of overall fire threat (i.e. the higher the number, the higher the threat). The most severe overall threat classes include Class 7 and higher. These are locations where the fire intensity, frequency and spotting can be severe enough to potentially cause catastrophic losses in any given wildfire season.

[1] Head fire intensity should be classified by intensity class not fire rank. Fire rank is a visual description of conifer fires for air operations.
[2] 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).
[3] These characteristics will be different in open and closed forest fuel.
[4] With HFI over 30 000 kW/m the functions of the equation are stretched beyond the expectation of the equation, fire is under the influence too many other factors.

Table 15. Head Fire Intensity Classes by area on public lands in the AOI

PSTA - HFI Class	Fire Intensity kW/m	Area (ha)	% of Land Area
1	0.01 – 1,000	288	15%
2	1,000.01 – 2,000	1023	53%
3	2,000.01 – 4.000	248	13%
4	4,000.01 – 6,000	155	8%
5	6,000.01 – 10,000	0	0%
6	10,000.01 – 18,000	0	0%
7	18,000.01 – 30,000	0	0%
8	30,000.01 – 60,000	0	0%
9	60,000.01 – 100,000	0	0%
10	≥ 100,000	0	0%
No Data (Private Land)		191	10%
Water		1532	NA
Non-Fuel		16	1%

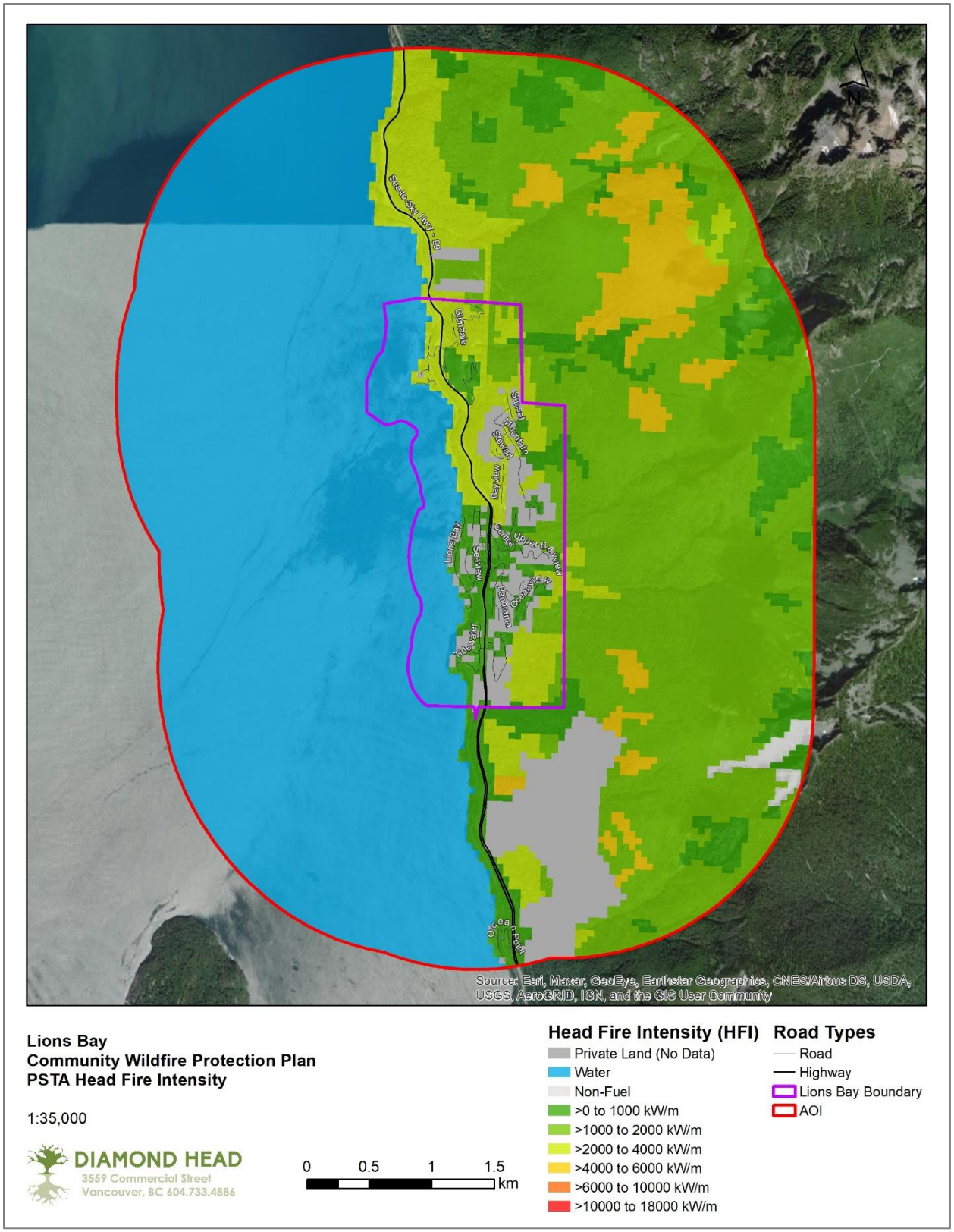


Figure 12. PSTA Head Fire Intensity on Public Lands

4.2.1 Fire History

Most historical fires in the AOI are small fires, less than 1 hectare in size. Large fires occurred in 1956 (67.8 ha) and 1935 (172.3 ha). After 1950, fires decreased in size and number as urbanization became a more important part of the landscape and fire suppression improved. In the ten years before 2018 (the most recent available data), the annual number of fires has been 0.5 per year which is well below historic averages. However, the average area burned over the past 10 years is 0.21 ha per year which is double the 1950-2019 modified average. This suggests small fires have been more difficult to control in recent years, once ignited.The PSTA contains a historical fire density layer to describe the number of human-caused fires in the landscape since 1950. The entire AOI is classified as fire frequency class 3, indicating all points within the AOI are within 10 kilometres of 17 – 24 fires in the historic record since 1950.

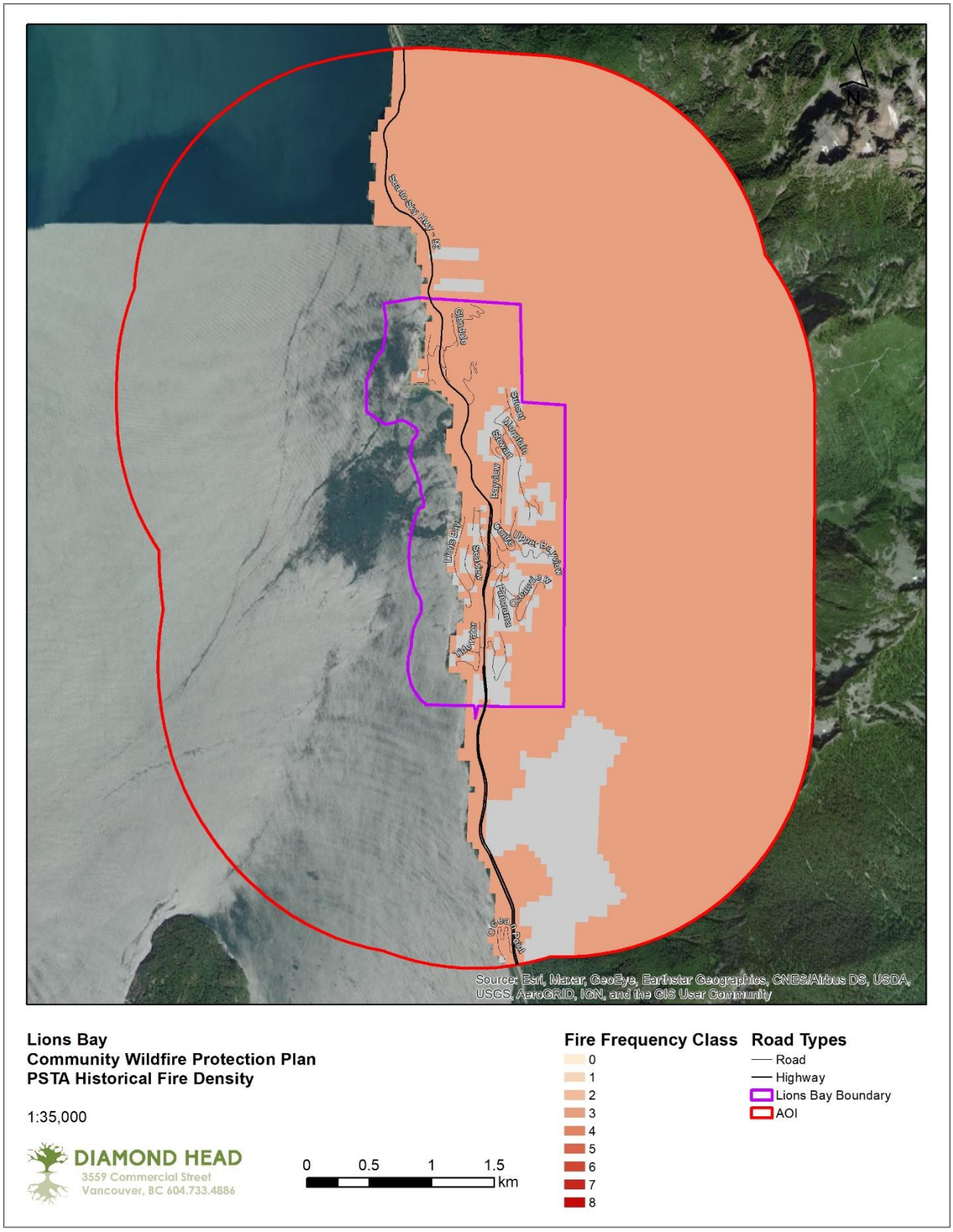


Figure 13. Historical Fire Density.

4.3 Local Wildfire Threat Assessment

This section provides a detailed assessment of the local wildfire threat, including the fuel characteristics verified in the field, proximity of fuel to the community, local fire spread patterns, topographical considerations, and local factors.

The local wildfire threat assessment process involved:

1. Verification of local fuel types to develop a fuel type map.
2. Assessment of the proximity of fuels to the community.
3. Assessment of fire spread patterns.
4. Consideration of topography.
5. Stratification of the WUI based on relative wildfire threat.
6. Classification of wildfire risk areas.

0 contains detailed considerations for the process of determining local wildfire threat. Fuel type findings and weather modelling are discussed in this section.

Fuel Type Verification

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

Fuel typing was updated based on field verification and air photo interpretation. Field plots provided direct observations for the classification of fuels. Photos were taken at each fuel plot. The location of field plots is illustrated in

Figure 14. Air photo interpretation was used to identify land use changes such as new development or changes in forest condition.

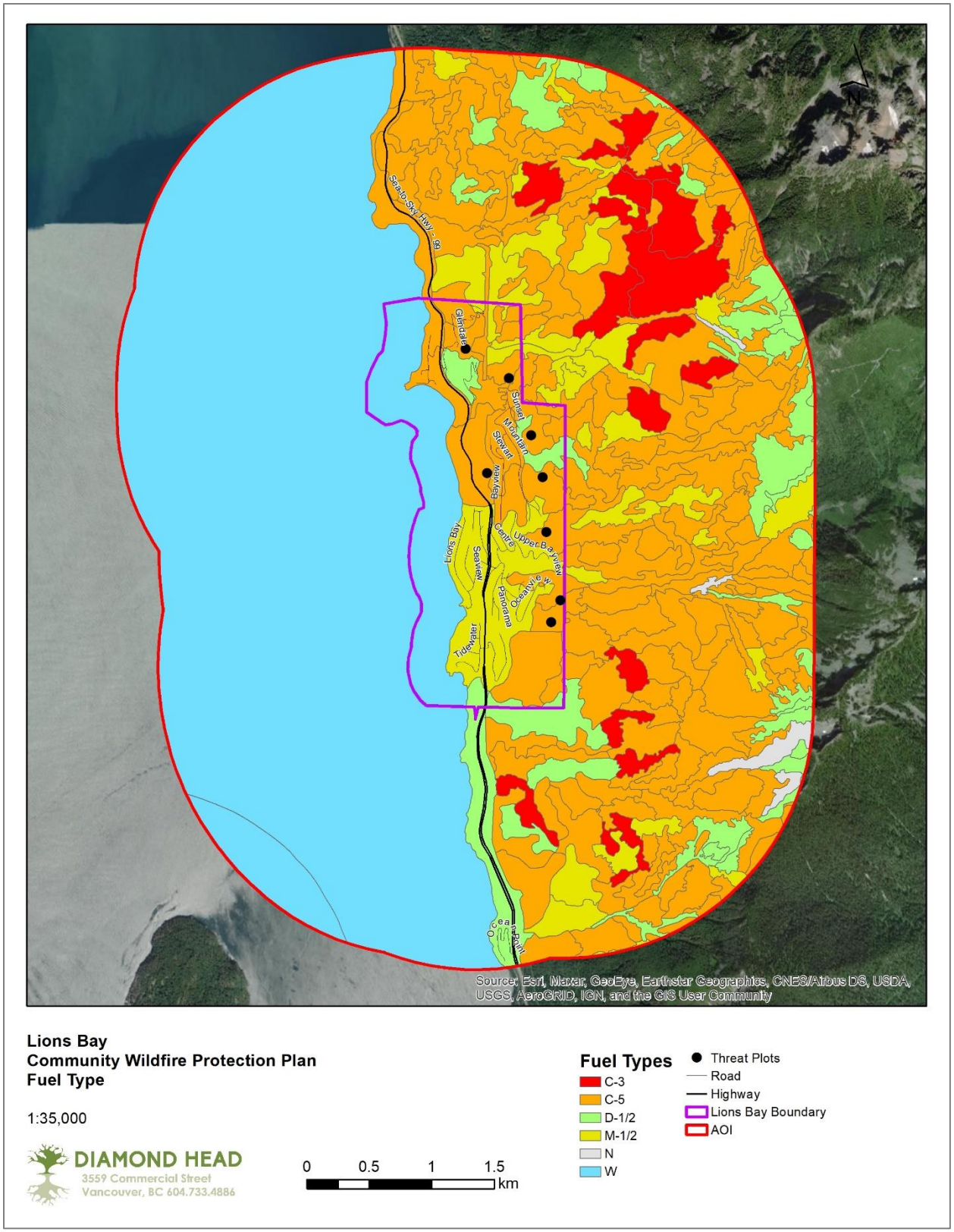


Figure 14. Updated Local Fuel Type Map and Field Verification Plots

Fire Weather Indices

Weather conditions used to calculate fire behaviour were derived from the nearest provincial weather station with suitable data for estimating fire weather, UBC Research Forest. This weather station is located approximately 48 km southeast of the study area. For comparison, results from the TS McNabb weather station are presented. This weather station is located closer to Lions Bay (approximately 15km northwest of Howe Sound) but is located in an area of higher precipitation than the Village.

Table 16. MFLNRO weather stations

Station #	Station Name	LATITUDE	LONGITUDE	ELEVATION (m)	Years
72	UBC Research	49.3	-122.6	162	1990-2020
1066	TS McNabb	49.6	-123.4	154	2010-2020

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

Table 17. Fire weather indices between the months of May to September

	Fine Fuel Moisture Code	Duff Moisture Code	Drought Code	Initial Spread Index	Build Up Index	Fire Weather Index	Relative Humidity	Precip (mm)	Temp.
UBC Research									
90th Percentile	89.70	63.25	355.39	5.39	81.78	16.02	94.0	548.9	26.3
Average	66.01	25.27	171.98	2.28	33.92	5.72	63.9	474.8	19.3
Maximum	97.12	104.43	583.61	17.17	128.77	34.80	100.0	575.2	37.4
TS McNabb*									
90th Percentile	88.78	53.39	347.86	4.39	76.05	13.46	95.0	769.8	25.1
Average	62.80	22.20	143.86	1.81	30.29	4.51	66.6	629.7	18.8
Maximum	93.67	97.13	469.48	8.34	119.48	21.46	100.0	457.2	32.0

*Only five years of data are available for this station.

4.3.1 Fire Behavior Modeling

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

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

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

The output that provides a simple measure of fire behavior potential and is comparable between areas is fire intensity. This is a measure of the rate of heat energy released per unit time per unit length of fire front and is based on the rate of spread and the predicted fuel consumption. Units for this layer are kilowatts per meter. The categories used for fire intensity class are summarised in Table 18. Wildfire behaviour on public lands is illustrated in Figure 15.

Table 18. Fire intensity units and weighting

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

Table 19. Wildfire behavior category based on fire intensity

Wildfire Behavior Threat	Total Area (ha)	% of area
Very Low	1,550	44.9%
Low	4	0.1%
Moderate	647	18.7%
High	761	22%
Extreme	282	8.2%
Private	209	6%

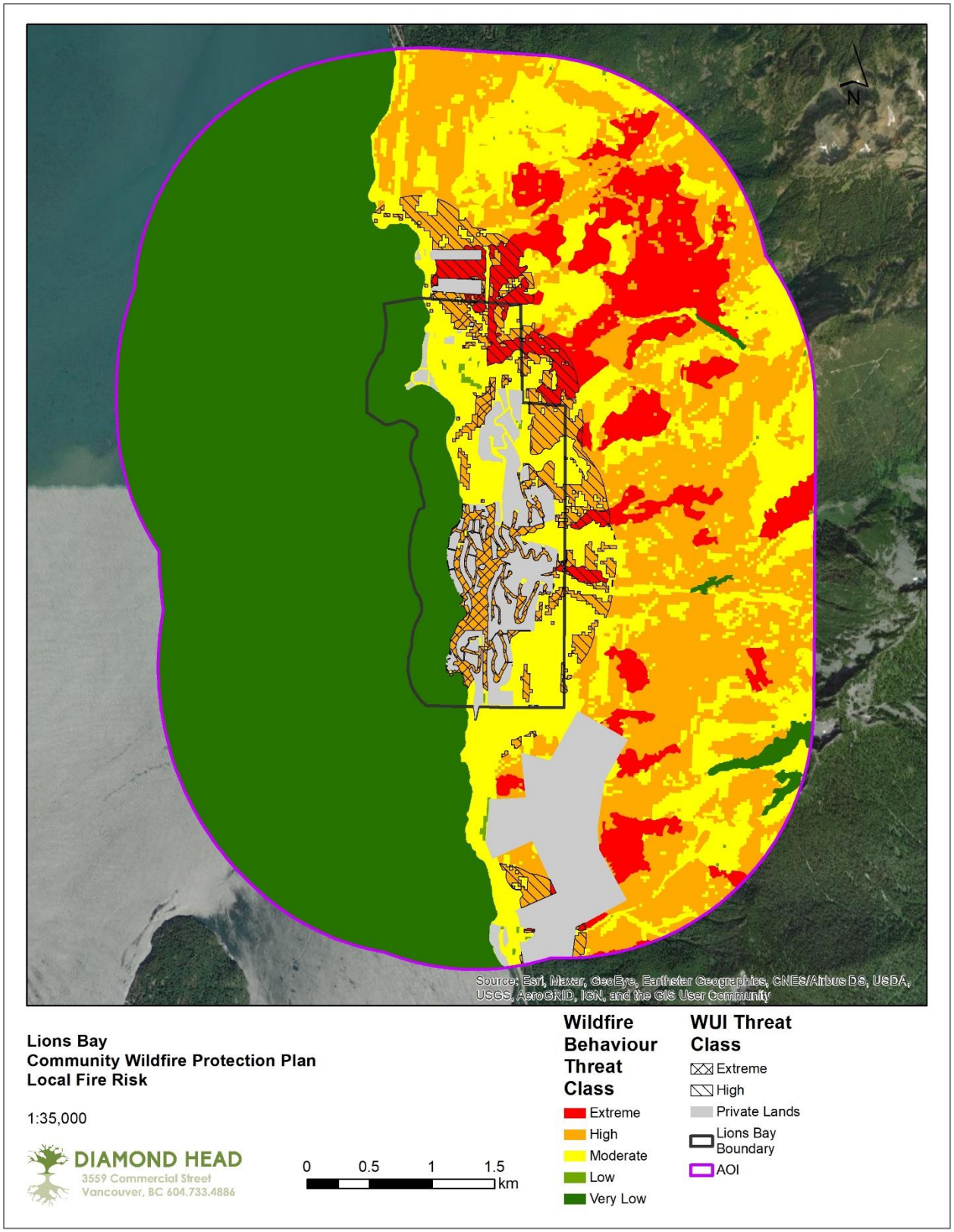


Figure 15. Local Wildfire Behavior Threat

Wildfire Risk Summary

The overall wildfire risk to the Village of Lions Bay is high. This is because of the relatively continuous mature conifer forests that extend north, south, and east combined with the steep slopes found throughout the study area. The forests surrounding the Village have high fuel loading, and there are few natural fuel breaks within the AOI. Under extreme weather conditions, wildfire spreads will be rapid with high intensity. There is heavy fuel loading throughout the interface and intermixed within the community, which increases the likelihood of a wildfire impacting structures and infrastructure.

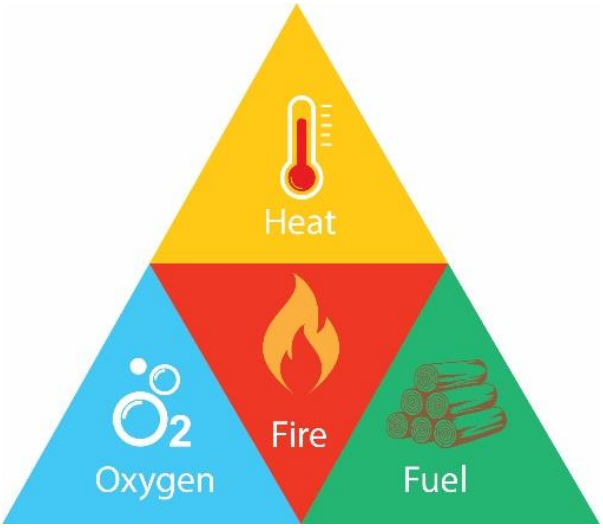
Photo 9. Lions Bay occupies moderately steep, west-facing slopes above Howe Sound.

Section 5 Risk Management and Mitigation Factors

This section identifies strategies that can be implemented to reduce the risk of wildfire to the communities and values within the AOI. These strategies have been identified through the analysis of wildfire threat and risk, stakeholder consultation, and review of best management practices. The recommendations vary in scope, implementation cost, timeline, and the party(s) responsible. These recommendations can be broadly categorized into three types: Fuel Management, Planning and Preparedness, and Communication and Education.

5.1 Fuel Management

Fire requires three contributing factors including a fuel source, oxygen, and heat. The only factor that we can feasibly alter is fuel characteristics. Fuel management means any plan to consider and control the fuel element of the fire triangle, and can range from removal of some portion of a forest's trees or small actions taken at home to reduce the proximity of the home to hazards such as woodpiles, fencing, and coniferous vegetation. This section considers the potential for *large-scale fuel management* to generally reduce wildfire hazard around the community. Section 5.2 addresses *small-scale fuel management* around the home as part of planning a FireSmart community.



The determination of wildfire threat and risk in this CWPP has identified areas that have high fire behaviour potential and threaten human lives and values at risk. These have been identified as priority areas where fuel prescriptions to reduce fuel loads and fire behavior potential will better protect the community against wildfire.

Determining whether these areas are suitable for treatment must consider the value of standing trees against increased community safety. For all prioritized treatment areas, options have been explored to partner and cooperate with other interest groups for initial treatment, maintenance and improved access. This CWPP strives to identify alternatives to conventional forestry treatments for fuel management, in recognition of the high value placed by the Lions Bay community on its existing forest character.

Interface Fuel Treatments

Areas on public lands that may be candidates for fuel treatment were visited in the field. Plots were established in representative areas. Assessments of the fuel condition were completed following the provincial assessment system, 2019-20 Wildfire Threat Assessment Guide and Worksheets (MFLNRO, 2019). This is the provincial standard for field assessments of fuel hazard in the WUI and is used to plan fuel hazard mitigation. Fuel types are scored under this system which is used to help prioritize the areas for fuel hazard mitigation funding under the Community Resilience Investment Program (CRI).

Photo 10. Photo from a potential treatment area.

Table 20 provides a summary of interface treatment areas that should be considered for subsequent detailed prescriptions and operational treatment. These are areas with fuel conditions that could support a high-risk wildfire and are adjacent to critical values and/or dense communities. Prioritizing treatment units depends on several factors, including the priority score, the threat score, and funding opportunities. The fuel threat considers fuel characteristics but does not include other biophysical characteristics such as slope, aspect, and proximity to community. The fuel threat ratings provided in table 22 likely to understate the risk, specifically as many of the areas that have been assessed are near dense residential neighbourhoods and on steep slopes. The PSTA threat rating is also provided for additional detail and rationale to treat these areas.

The objective of all the fuel treatment prescriptions is to change the fire behavior potential of these forest stands so that a crown fire will not develop under worst case (90^{th} percentile) weather conditions. This allows suppression resources to act on the wildfire and defend the adjacent values. Details of how to achieve this is provided in a fuel management prescription, which is developed by a qualified Registered Professional Forester. Options for treatment include tree thinning, spacing, pruning, surface debris removal, or creating fuel breaks. Typically treatment areas are linear, adjacent to the values at risk, a target of at least 100m wide and located up against man-made and natural fuel breaks.

Photo 11. Examples of a stand condition before (left) and after (right) fuel mitigation treatment

Photo 12. Example of a stand crown density before (left) and after (right) fuel mitigation treatment. The goal of crown density reduction is to make the main canopy of trees separated and discontinuous.

Table 20. Proposed Treatment Area Summary Table

Treatment Polygon ID	Fuel Threat Score	PSTA Threat	Priority	Fuel Type	Area (ha)	Comments
ABCK	Moderate	Moderate	High	C5	16.9	Surrounds critical infrastructure (drinking water) and is adjacent homes. Very steep with a west aspect, dense forest. Treatment options will be limited by slope, however there is good access. Portions are in Alberta Creek watershed. Located on a municipally owned parcel.
TTDR	Moderate	Moderate	High	C5	24	Surrounds critical infrastructure (water facilities) and is adjacent homes. Very steep with a west aspect, dense forest. Treatment options will be limited by slope, however there is good access. Portions are in Alberta Creek watershed. Mixed ownership between crown and municipality, separated from ABCK due to differing ownership.
HWY	Low	Moderate	High	C5	9.8	Adjacent highway 1 and homes. BC Hydro powerline bisects treatment area. Same powerline started a wildfire in 2019 as a result of tree failure onto line. Steep slope on west aspect below homes. On municipal land, can be accessed from quarry to north.

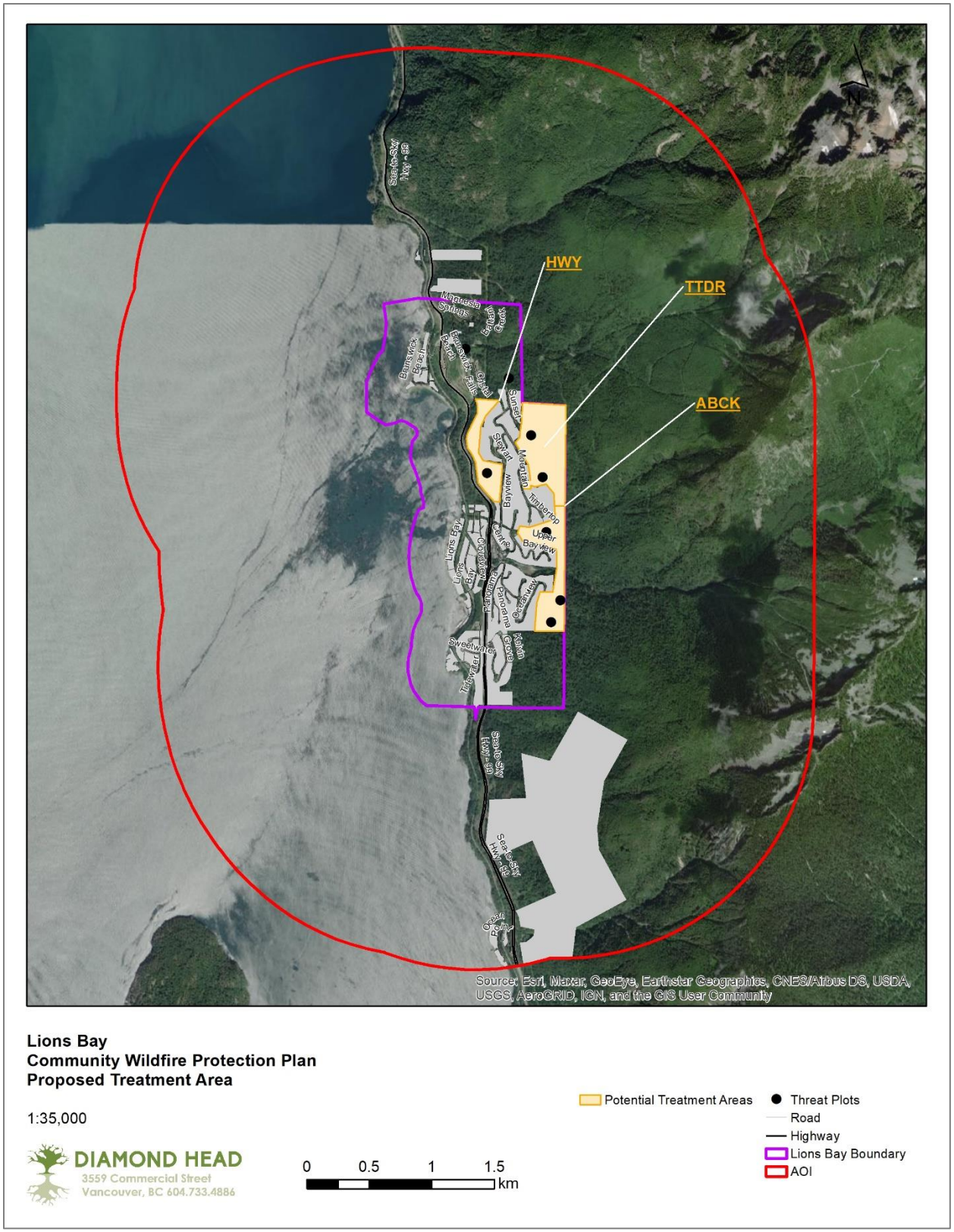


Figure 16. Proposed fuel treatment areas.

Fuel management near critical infrastructure

Critical infrastructure identified for the CWPP includes several facilities within the forest interface. Many of the identified values at risk do not have a suitable defensible space between them and the adjacent forest areas. These include storage tanks for the primary water supply in both the Harvey Creek and Magnesia Creek watersheds. Vegetation within 10 metres of these facilities can, if ignited, cause damage to the facilities through radiant heat or direct flame on hatches, valves, container walls, and piping. Burning vegetation within 30 metres of these facilities can impede access for municipal personnel to facilities during an emergency. The Village should assess the condition of fuels immediately surrounding their facilities and treat fuels to establish a 30m defensible spaces around them. Village facilities to be examined include all water supply infrastructure in the Harvey and Magnesia Creek community watersheds and shared sewage treatment facilities in the Kelvin Grove Neighbourhood.

Fuel treatment implementation and funding opportunities

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

Regional Partnerships

Wildfire risk is analyzed at a landscape scale that crosses jurisdictions. Most of the risk to Lions Bay is found on land outside the Village's boundaries. Most of the high priority stands for fuel treatment are located partially or entirely outside the Village boundary. Therefore, partnerships and collaboration with other jurisdictions are key for pursuing a landscape level strategy for wildfire risk reduction. The surrounding lands are mostly provincial crown land under the administration of Metro Vancouver. Metro Vancouver has comprehensive wildfire management planning and staffing, and has extensive experience managing wildfire risk within critical public water supply areas.

Community Resilience Investment Program (CRI)

This CWPP update was funded through the UBCM Community Resiliency Investment program. CRI contains a variety of funding categories, including Education, Planning, Training, and Fuel Management activities. The available funding ranges from $50,000 annually for low-risk communities, to $150,000 annually for higher-risk communities and eligible expenses do not require cost sharing. The Village will be eligible as a high-risk community for up to $150,000 annually for wildfire-related projects. Certain applications involving partnership between the Village and regional or provincial partners could exceed these base-levels of funding. Applications for 2021 funding grants will be due in late 2021.

The Village of Lions Bay can apply for funding through this program for several the initiatives and recommendations within this CWPP. Some of the eligible activities include:

- Development of detailed fuel treatment prescriptions for priority interface fuel treatment areas by a professional forester.
- Operational fuel management treatments in the priority interface fuel treatment areas.

- Hosting of neighbourhood level FireSmart education initiatives and workshops and distribution of FireSmart educational materials, and support for neighbourhoods to apply for FireSmart Canada Neighbourhood Recognition Program.
- Conducting FireSmart assessments and plans for public buildings and infrastructure.
- Preparing public communications to advertise and inform about a wildfire mitigation activity or program.
- Amending land use, engineering, and public works bylaws to incorporate FireSmart principles.
- Interagency co-operation including meeting with Metro Vancouver and provincial agency staff as part of a standing Community FireSmart Resiliency Committee.
- Assessing structural protection capacity as required for wildfire response, including assessment of the delivery capacity of the community water system.
- S100 and other cross training in wildfire planning and response for staff.
- Establishing a rebate program to support treatment on private lands and fund off site debris disposal for private residents.

Wildfire Risk Reduction Program

As of 2019, the provincial government is taking leadership for fuel mitigation on provincial crown lands inside municipal boundaries and beyond through the new Wildfire Risk Reduction (WRR) program. The program prioritizes critical infrastructure for emergency response around high-risk communities, accounting for the hazard assessment and mapping conducted for community CWPPs. The Village may be able to receive additional funding for wildfire management where logical treatments can be designed on combinations of land within provincial and municipal jurisdiction. Treatments on provincial crown land surrounding Lions Bay will require the involvement of the regional government, Metro Vancouver.

5.2 FireSmart Planning & Activities

Private landowners have a large responsibility to play in managing the risk to life and property from wildfire. Recent changes to the CRI program recognize the importance of actions on private lands to mitigate community risk. Private landowners can increase community safety by choosing FireSmart building materials and landscaping as well as through general emergency preparedness. This section provides recommendations to mitigate the risk of wildfire to existing and planned developments in accord with the guidance of the FireSmart Begins at Home Manual (Partners in Protection and Province of BC, 2019).

5.2.1 FireSmart Goals & Objectives

During a wildfire, homes are ignited as a result of:

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

FireSmart assessments divide the area around the home into three “priority zones”, which radiate out from the structure and are based on controlling the ignition pathways through appropriate techniques and strategies.

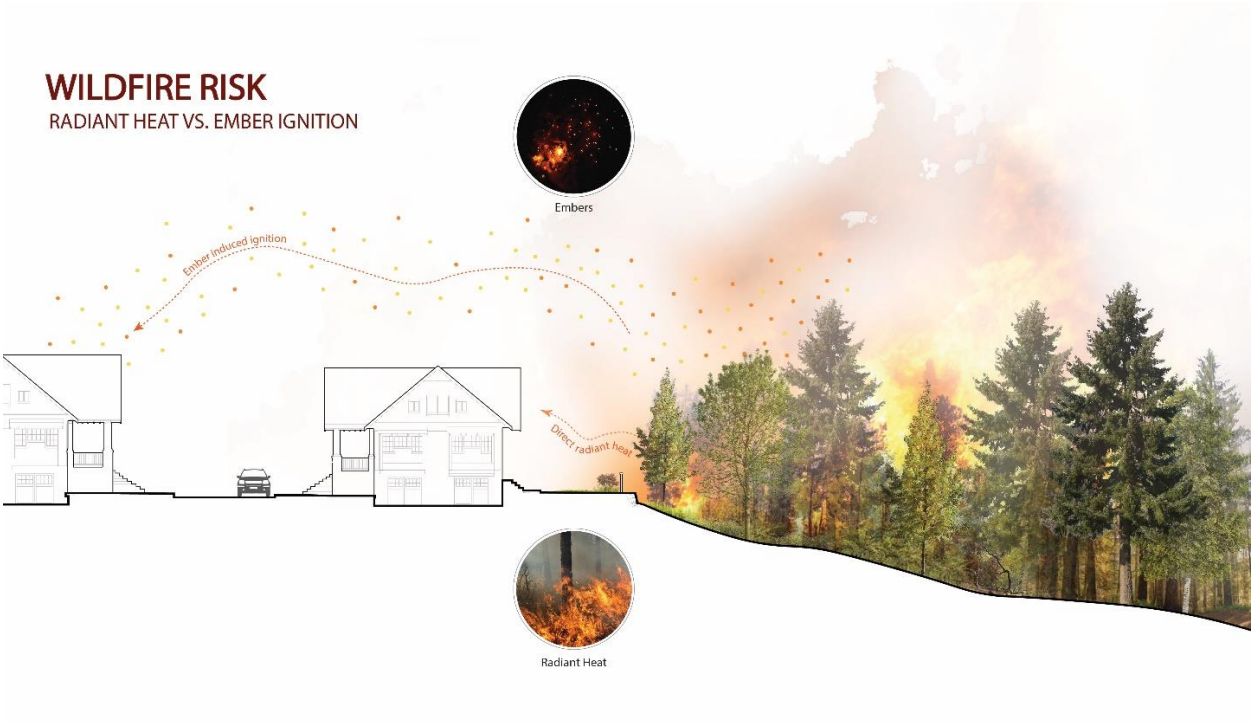


Figure 17. Wildfire risk to homes. During a wildfire, homes are ignited as a result of radiant heat as well as embers carried by winds.

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

Zone 1 is the area within 10m of the home or building. In this area people and structures are at risk from radiant heat associated with a wildfire. It has been shown through analysis of recent large-scale wildfires that the most important factors in protecting structures are the exterior construction materials and immediate landscaping next to homes (Westhaver, 2017). The structure itself is sometimes considered on its own as the Home Ignition Zone (1A). The use of non-combustible or fire-resistant building materials is emphasized, along with landscaping plans that reduce the potential for direct exposure of the home to radiant heat or flame.

Zone 2 includes the area from 10 m to 30 m from a structure. Wildfire taking hold in this area may still subject the building to radiant heat and may produce an ember shower onto the building. Fuels are generally treated aggressively in this area to prevent a crown fire from establishing and reduce the intensity of radiant heat and ember production. Treatments may include removal of ground fuel, thinning of trees and lift pruning of those retained.

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

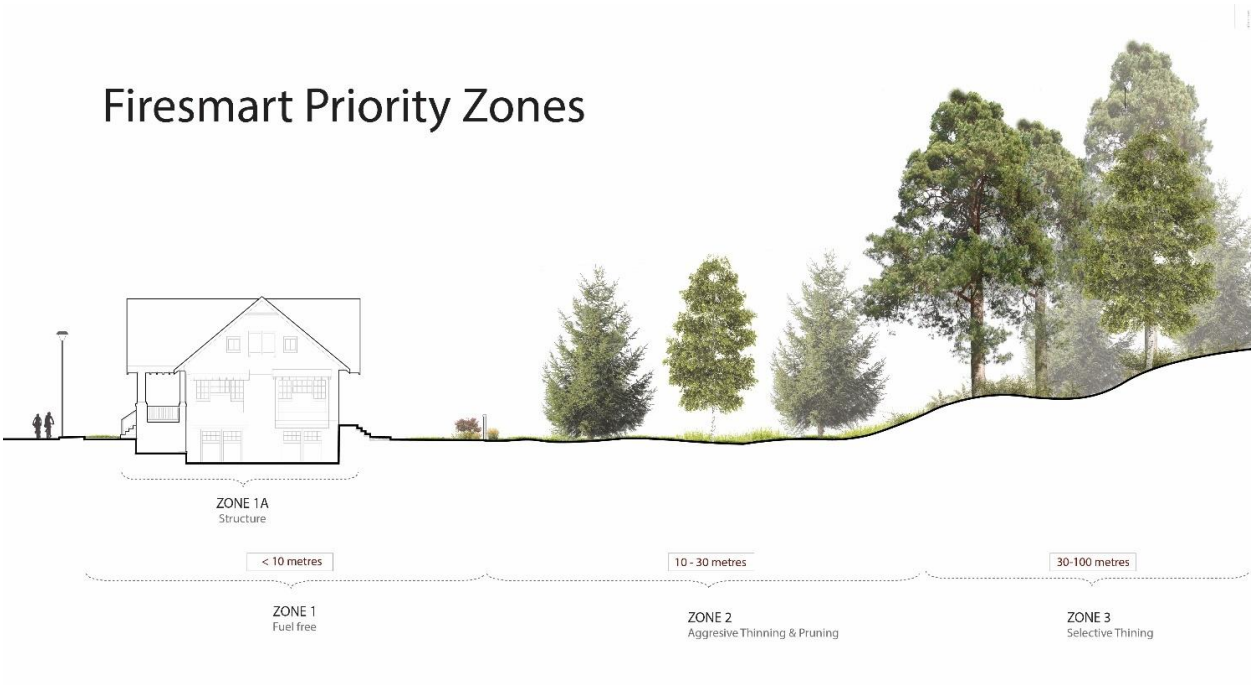


Figure 18. FireSmart Management Zones

Photo 13. Example of a structure in the interface

Goals of FireSmart

FireSmart encourages private land holders to adopt and conduct FireSmart practices to reduce the fuel hazard and implement other measures to minimize potential wildlife impacts to their property. Objectives include:

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

FireSmart Assessment

Local FireSmart Representatives (LFR) are key facilitators for FireSmart programs and initiatives within a community. These representatives engage and motivate private landowners to mitigate wildfire risk on their property, and thereby reduce risk to the community. By participating in a Local FireSmart Representative workshop, participants become designated as an LFR. Typically these workshops are attended by fire department staff, wildfire staff, emergency management staff, planners, and foresters from the local area and local regional and provincial liaisons.

5.2.2 Key Aspects of FireSmart for Local Governments

The Village is able to manage risks on municipal lands. However, most structures at risk as well as many interface fuels are located on private lands under which the Village has limited influence. Neighbourhood level community-based engagement will encourage residents to cooperate with each other for the mutual benefit of reducing risk to the neighbourhood.

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

FireSmart construction and landscaping can be enforced through updated development permit requirements. To date, the community has been reluctant to implement any additional requirements for construction and landscaping through this process. There have been concerns that the character of the Village would be threatened, and that this type of DP would result in the removal of trees and vegetation. As a result, the Village has requested that staff find ways to reduce wildfire risk to buildings through the authority of the Building Inspector.

Apart from new development, the creation of a resilient community requires voluntary action by homeowners to protect their properties. Education and outreach about FireSmart principles will help encourage voluntary improvements on private lands. Building awareness of the risk of wildfire to the community of Lions Bay and FireSmart principles will increase public support for future regulatory changes to community design. The Village should distribute information on where residents can access

wildfire awareness resources on its website, and host virtual workshops to support community engagement. Resources should include:

- http://www.bcwildfire.ca/Prevention/FireSmart.htm
- https://www.FireSmartCanada.ca/

Materials to distribute should include the FireSmart Begins at Home Manual which provides a questionnaire to help understand wildfire risk around private residences. The Village can train a staff member to act as a Local Fire Smart Representative, with the training cost eligible for funding through the CRI grants. This person can be responsible for the Village's FireSmart materials, outreach, and programming.

5.2.3 Priority Areas of Interest for FireSmart

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

- Upper Lions Bay Village (east of highway)
- Lower Lions Bay Village (west of highway)
- Brunswick Beach
-

Table 21. Summary of FireSmart priority areas.

Area ID	Wildfire Risk Rating (E/H/M/L)	Is this a FireSmart Community? Y/N	FireSmart Canada Recognition Received Y/N	Recommended FireSmart Activities
Upper Lions Bay Village	H	N	N	A comprehensive FireSmart plan is recommended for all areas. This should include communications and engagement goals, educational outreach, coordination with the BCWS, and FireSmart assessments. A committee made up of representatives from the Village, Fire Department, BCWS, First Nations, and homeowners should guide the development of this plan.
Lower Lions Bay Village	M	N	N	
Brunswick Beach	M	N	N	

Community Planning

Given public support, it may be possible to introduce FireSmart design principles by amendment of the Village's Fire Bylaw. This would not address fuel hazards from vegetation but could ensure new construction meets minimum standards for building materials and suppression capacity. The Village already mandates the inclusion of fire suppression systems in homes through this bylaw. Installation is accepted by the Building Inspector.

Controlling landscaping or vegetation requires review of the Village's zoning or Official Community Plan bylaws. Very little subdivision occurs in the Village, with most development consisting of the replacement of detached residential homes. Regulating vegetation on private land through development permitting would result in gradual changes towards more fire resistant landscapes as homes age and are replaced. Requirements would apply only to new landscaping and need not change the Village's policy on private land trees. The Village currently has no restrictions on the removal of trees on private land. The Village could revisit this type of policy during community engagement for the next Official Community Plan update.

5.3 Community Communication and Education

Community Engagement

Given the Village's limited area, most hazardous fuels within the Village boundary occur on private lands. Therefore, building public awareness and promoting stewardship of the Village's forest landscape is a key component of this wildfire program. Following are general recommendations to be considered for development of a public education program. Chapter 6 of the FireSmart Canada's *FireSmart Planner* provides detailed recommendations for developing a public communications plan. There are two main goals of a comprehensive public education and awareness strategy:

1. Raising knowledge and awareness of wildfire risk and prevention
2. Developing and encouraging stewardship opportunities for individuals and community-based volunteer organizations.

This can be achieved through a variety of strategies:

- Establish neighbourhood specific interest groups as discussed in section 5.3. Including a Village representative and/or Fire Rescue liaison in these groups will facilitate engagement and education on FireSmart initiatives.
- Provide educational material and promote wildfire awareness during large public events of festivals.
- Organize an open house to accompany any FireSmart treatments.
- Update the Village's website to contain direct links to important FireSmart resources, such as this CWPP and the FireSmart Begins at Home Manual. If possible, include local FireSmart buildings and landscaping as examples.
- Distribute a summary of this CWPP and accompanying maps to all residents. The Village should explore online means of presenting the information contained in this CWPP in an attractive, engaging format, such as ESRI's StoryMaps.

- Install additional wildfire awareness signs around the Village. These should indicate the current Fire Danger level, restrictions during the fire season and the emergency number to call when a fire is detected (1-800-663-5555 or *5555 from a mobile phone). Signs should be bold and placed in clear view. Desirable locations are beside each exit from Highway 99 both north and southbound. The Village should coordinate with MOTI to erect and maintain these signs.
- Completed FireSmart projects, including any building changes or vegetation and fuel management, should be showcased on the Village's website and potentially with interpretive signage in the field.

Youth Engagement

Youth engagement is sometimes overlooked as a public education strategy. 26% of the Village's population is under the age of 25. By actively engaging youth, the Village can encourage the next generation of citizens to be active in wildfire planning and management. In addition, educated youth will often pass on this information to older generations in their family. Opportunities to engage younger residents of the Village include:

- A representative of Lions Bay Fire Rescue or the Village can conduct events at schools with wildfire-specific programming. Field trips with school groups can be organized to raise awareness of wildfire risk and strategies for its mitigation.
- A "Young Wardens" program can be initiated to connect younger children with FireSmart information. FireSmartBC publishes curricula and activities for children as young as four years old.
- For older youth, stewardship events in public parks and trails can be opportunities to demonstrate and educate about FireSmart principles while simultaneously achieving hazard reduction.

Digital Engagement Tools

Technology is an important avenue to communicate ideas and information. This is particularly true of on-line and electronic media. The Village can use technology to promote wildfire awareness by providing online media releases on wildfire and FireSmart programming, typically near the beginning of fire season. A website can be hosted to contain comprehensive wildfire information. The Village's webpage should be updated regularly to include notices of wildfire risk, planned FireSmart stewardship, outreach, and educational events, and to showcase completed FireSmart projects with photos and video. The webpage should also promote the FireSmart assessment service, and provide links to the Regional, Provincial and Federal websites on wildfire awareness and the FireSmart program. Webpages can function as a virtual open house giving residents information, and the flexibility to participate on their timeline.

Online tools can present technical information, such as the CWPP and wildfire risk mapping, in an engaging, interactive format. Online engagement is the most effective means of communicating with individuals who do not have time or cannot physically participate in open house and local events, or for those with public health concerns. On-line sources of education that should be considered include videos that can be linked to the webpage. YouTube is a free and effective means to distribute educational material. A variety of videos can be posted to update the public of upcoming events and to showcase successes in the Village.

5.4 Other Prevention Measures

Sources of ignition can be human- or lightning-caused. Lightning-caused ignition is difficult to predict or manage and is relatively rare on the Coast. Human-caused ignitions, however, can be prevented and are the source of half of all wildfires in BC and most fires in coastal interface areas. The most common sources of human caused fires include:

- Campfires
- Commercial and industrial activities
- Discarded cigarettes and matches
- Vehicles
- Railways
- House-related fires
- Power lines
- Vandalism

Predicting and preventing human-caused ignitions is a critical component of a wildfire prevention program. This is best achieved through public education campaigns. Roadside ditches and medians that contain grasses should be mowed periodically throughout the fire season. This will reduce fuel loading (standing cured grass) and reduce the ignition potential associated with vehicles, heavy machinery, and cigarettes during the fire season. Signs should be posted at recreation areas and high-use trail heads during the summer showing the fire danger rating and emphasizing the need to fully extinguish campfires, properly dispose of cigarettes, and avoid parking on grass or other vegetation.

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

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

Photo 14. Power lines adjacent to forests are sources of ignition as trees or branches fail onto the lines. (Image: Google Maps)

5.5 Summary of Recommendations

Number	Action Item
Rec 2	Develop fuel treatment prescriptions for proposed fuel treatment areas. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #9 Fuel and Vegetation Management).
Rec 3	Assess the condition of fuels immediately surrounding their facilities and treat fuels to establish a 30m defensible spaces around them. (CRI Activity #9 Fuel and Vegetation Management).
Rec 4	Develop a partnership with Metro Vancouver to pursue treatment of provincial crown lands adjacent to the Village (CRI Activity #9 Fuel Management).
Rec 5	Train a staff member from the Village of Lions Bay as a Local FireSmart Representative through the Local FireSmart Representative workshop. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 FireSmart Training & Cross Training)
Rec 6	Develop neighbourhood level FireSmart plans for the above priority neighbourhoods. This should include neighbourhood level FireSmart committees with the Village, Fire Rescue, BCWS, and resident representatives. Participating communities should apply for FireSmart Community Recognition status and funding for mitigation projects through FireSmart Canada. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education and #8 FireSmart Activities for Residential Areas).
Rec 7	Apply FireSmart design principles to any changes to municipal buildings or properties. Showcase FireSmart building and landscape design through a “FireSmart Day” with neighbourhood FireSmart committees. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education & #7 FireSmart Projects for Critical Infrastructure).
Rec 8	Develop and distribute FireSmart brochures to all residences within the Village. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 9	Develop and distribute a list of ecologically suitable fire-resistant landscape plants (Appendix 4) to residents by mail and through local nurseries. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #1 Education).
Rec 10	Establish community chipping days in the spring to encourage residents to reduce vegetation fuel loads on private land. Provide a location where woody debris can be dropped off for chipping and request tree companies volunteer as a promotional event, similar to Christmas tree chipping events. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #8 FireSmart Activities for Residential Areas).
Rec 11	Review the Fire Bylaw to determine if building materials can be required by the Building Inspector under the justification of wildfire risk reduction. Update the bylaw so that new construction must use materials meeting NFPA 1144 standards. Funding for this review may be accessible through the UBCM Community Resiliency Investment Program (CRI #3 Development Considerations).

Number	Action Item
Rec 12	Engage the community and explore options for regulating landscaping through zoning or potential Development Permit Areas as part of the next Official Community Plan renewal. (CRI #3 Development Considerations).
Rec 13	During community events have Village and/or Fire Rescue staff on hand to provide educational material.
Rec 14	Include Open House components to FireSmart treatments on public property to encourage outreach and education.
Rec 15	Conduct visits by Village and/or Fire Rescue staff into the local elementary school to discuss wildfire prevention and preparedness.
Rec 16	Update the Village's digital media, including video and web content, to reflect this CWPP update. Explore new digital methods of engagement, including interactive content and geospatial content.
Rec 17	Ensure all road edges are clear of vegetation and debris during the summer months
Rec 18	Post wildfire danger signage along Highway 99 and at high use trail heads. Signage should address current fire danger, how to report a wildfire and, when relevant, emphasize the need to fully extinguish campfires, properly dispose cigarettes, and avoid parking on grass or other low vegetation.
Rec 19	Develop an annual fire season social media campaign to raise awareness of individual responsibility to prevent ignitions and of the enforcement of fire bans.
Rec 20	Work with BC Hydro to ensure that distribution lines, transmission corridors and substations are assessed regularly for tree risk and that the associated fuel hazards are abated, including removal of slash.

Section 6 Wildfire Response Resources

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

The BC Wildfire Service is responsible for wildfire detection. Fires are located using a lightning locator system, aerial patrols, and public observation. During periods of elevated wildfire risk, Metro Vancouver performs aerial patrols in the adjacent watershed. These patrols would likely detect a wildfire in the more remote portions of the AOI. In urban centers a wildfire is most likely to be detected and reported quickly by the public. Wildfire awareness signs should be posted at strategic locations (major transportation corridors, recreation areas and high use trail heads) that specify how to report a wildfire in the Village.

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

- The exact location of the fire
- The estimated size
- The type of fuel burning
- The speed and direction of spread
- The colour of the smoke
- The location of any structures or lives at risk from the fire.

Contact details as well as the requirement for this information should be included in any public education campaigns. 911 can also be used to report wildfires, however this will require an operator redirect to the reporting centre in Victoria.

6.1 Local Government Firefighting Resources

6.1.1 Fire Departments and Equipment

The Village is serviced by Lions Bay Fire Rescue. Metro Vancouver coordinates fire protection within the protected watershed lands. Village resources for suppression in that are currently available are provided in Table 22.

Metro Vancouver and BC Wildfire Services Resources

The BCWS has an initial attack fire base in Squamish, approximately 30 km north of the AOI. There are several Initial Attack crews stationed here. Metro Vancouver operates its own wildfire suppression and response organization that is distinct from the BCWS. This exists primarily to respond to wildfires within the Metro Vancouver watershed adjacent to the AOI. However, the crews and officers that form the Metro Vancouver Watershed will be engaged into the BCWS organization structure during periods of high wildfire hazard. These crews are the most likely to be the first responders to a wildfire in the AOI.

Table 22. Summary of Fire Suppression Resources

Agency	Full-time Staff, Level of certification	Volunteer staff, minimum certifications	Equipment
Village of Lions Bay Fire Rescue	• 1 FT Fire Chief	• 30 Volunteer Firefighters	2 engines

6.1.2 Water Availability for Wildfire Suppression

Water is the single-most important resource for suppression activities. Fire hydrants are the main source of water delivery for fire suppression inside the Village, with most of the community serviced by hydrants. Although the Village has a complex water delivery system, there is typically good supply and pressure available for fire suppression. The only exception is during periods of extreme summer drought, where an extended suppression operation could reduce water supply to the Village. Extensive water monitoring occurs to prepare for this possibility.

In the event of a wildfire in either watershed, the emergency procedure would require turning off the intakes for the affected watershed. Turning off the intakes is required to ensure no damage occurs to the sensitive equipment in the treatment facilities. This could result in reduced water supply for wildfire suppression. Water operators from the Village should be included in incident management during any wildfire that occurs in the AOI to ensure water supply is adequately managed.

6.1.3 Access and Evacuation

The primary concern when dealing with a wildfire is public safety and if necessary, their evacuation. The Village currently is developing an updated evacuation plan to address various emergency scenarios. Wildfires have the potential to impact evacuation by compromising evacuation routes. Highway 99 north and south are the only escape routes for evacuation and are surrounded by forest. There is potential for this route to be closed by wildfire, further complicating evacuation. The evacuation plan should explicitly address and plan for this scenario.

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

6.1.4 Training

Early response time to an ignition is critical to controlling its spread. Lions Bay Fire Rescue will likely be the first responders to a wildfire within Village boundaries. Lions Bay Fire Rescue currently has several initiatives that promote wildfire response. All firefighters are ICS-100 (Incident Command System) trained. Most firefighters receive S100 Basic Fire Suppression and Safety training as well as additional training for wildland urban interface wildfires (S-185 Fire Entrapment Avoidance and Safety). These initiatives should be continued.

6.2 Structure Protection

With a small volunteer fire rescue service, Lions Bay does not have the resources to respond to an interface wildfire involving multiple homes. Many homes are built with materials that have no established fire-resistance rating, and landscaping in the village includes a high density of conifers. As a small community, Lions Bay lacks a Structure Protection Unit. It is expected that a large wildfire response would require support from Metro Vancouver and/or the BCWS. Both of these organizations have a large amount of resources to protect structures in the event of a fire.

6.3 Summary of Recommendations

Number	Action Item
Rec 21	Water operators should receive ICS-100 training.
Rec 22	Lions Bay water operators and Metro Vancouver wildfire suppression units should be included as emergency contacts in the event of wildfire.
Rec 23	Incorporate wildfire and potential road closures into the evacuation plan.
Rec 24	Train all Village firefighters in S100 Basic Fire Suppression and Safety training and S185 Fire entrapment avoidance and safety training. Funding is available for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).
Rec 25	Conduct annual training exercises with Metro Vancouver to enhance response in the event of wildland urban interface fire. Apply for funding for this initiative through the UBCM Community Resiliency Investment Program (CRI Activity #6 Cross training).

Appendix 1: Local Wildfire Threat Process

A1.1 Fuel Type Attribute Assessment

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

The PSTA fuel typing layer is not shown on private lands. It can also be inaccurate in areas that have not been recently inventoried for forest activities. Fuel typing was updated based on field verification and air photo interpretation. Field plots provided direct observations for the classification of fuels. The locations of field plots are provided in

Figure 14. Air photo interpretation was used to identify land use changes such as cleared areas for development or areas with changes in fuel type through natural regeneration, planting, or initial misidentification. Four fuel type polygons within the AOI were changed. In each of the four polygons, field observation indicated that the coniferous component of the stand had been underestimated by landscape scale PSTA analysis. Three polygons were changed from M-1/2 (mixed fuels) to C-5 (coniferous) and one polygon was changed from D-1/2 (deciduous) to M-1/2 (mixed fuels).

Fuel types were determined based on the provincial fuel type layer overview report (Perrakis & Eade, British Columbia Wildfire Fuel Typing and Fuel Type Layer Description, 2015), and the decisions made for the provincial layer were replicated where possible. These are summarized below:

a) C-3: Young, dense, coniferous stands, generally aged 30-80 years and with heights ranging between 15 and 30 metres.

b) C-5: Mature stands of the native coastal conifers Douglas-fir, western redcedar, and western hemlock older than ~80 years. Heights in this fuel type are generally greater than 30m. These stands have low to moderate densities with large fuel strata gaps.

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

d) D-1: These include stands of varying ages that are dominated by deciduous trees.

Fuel type M-1/2 – Mixed stands

This fuel type is found throughout the study area, often around riparian areas or areas historically disturbed. They are characterized by stands comprised of a mix of coniferous and deciduous species. The conifer component in these stands is mostly a mix of Douglas-fir, western redcedar and western hemlock. The deciduous component varies and includes bigleaf maple and red alder. In a few locations, the broad-leaved evergreen tree arbutus contributes to the deciduous component of the stand. Fire behaviour potential in these stands increases with and is highly dependent on the number of coniferous trees present.

Photo 15. Example of a stand classified as M1/2 fuel type.

Fuel type D-1/2 - Deciduous

This fuel type consists of stands that are generally moderately stocked and dominated by deciduous trees. Within the AOI, there is little area classified as this fuel type. These stands occur primarily in areas that have historically been disturbed. They can include a small amount of conifer trees, usually in patches or as single trees. Dead and down round wood fuels are a minor component of this fuel complex. During the summer months, the principal fire-carrying surface fuel consists chiefly of deciduous leaf litter and cured herbaceous material. Areas dominated by shrubs are also included in this type. These are dense plant communities with few trees and a variety of shrub species. These deciduous stand and shrub communities will all have a relatively low fire behavior potential.

Photo 16. Pure deciduous stands are rare in the AOI, and mostly occur in small patches where land disturbance has occurred. (Photo: Jeff Silzer via Google Maps)

C3 and C5 - Conifer Fuel Types

Two of the Canadian FBP system's conifer fuel types exist within the AOI: C3 and C5. Both represent second growth coniferous stands. C3 includes a higher density stand with lower crown heights, while C5 is lower in density and has higher crown heights.

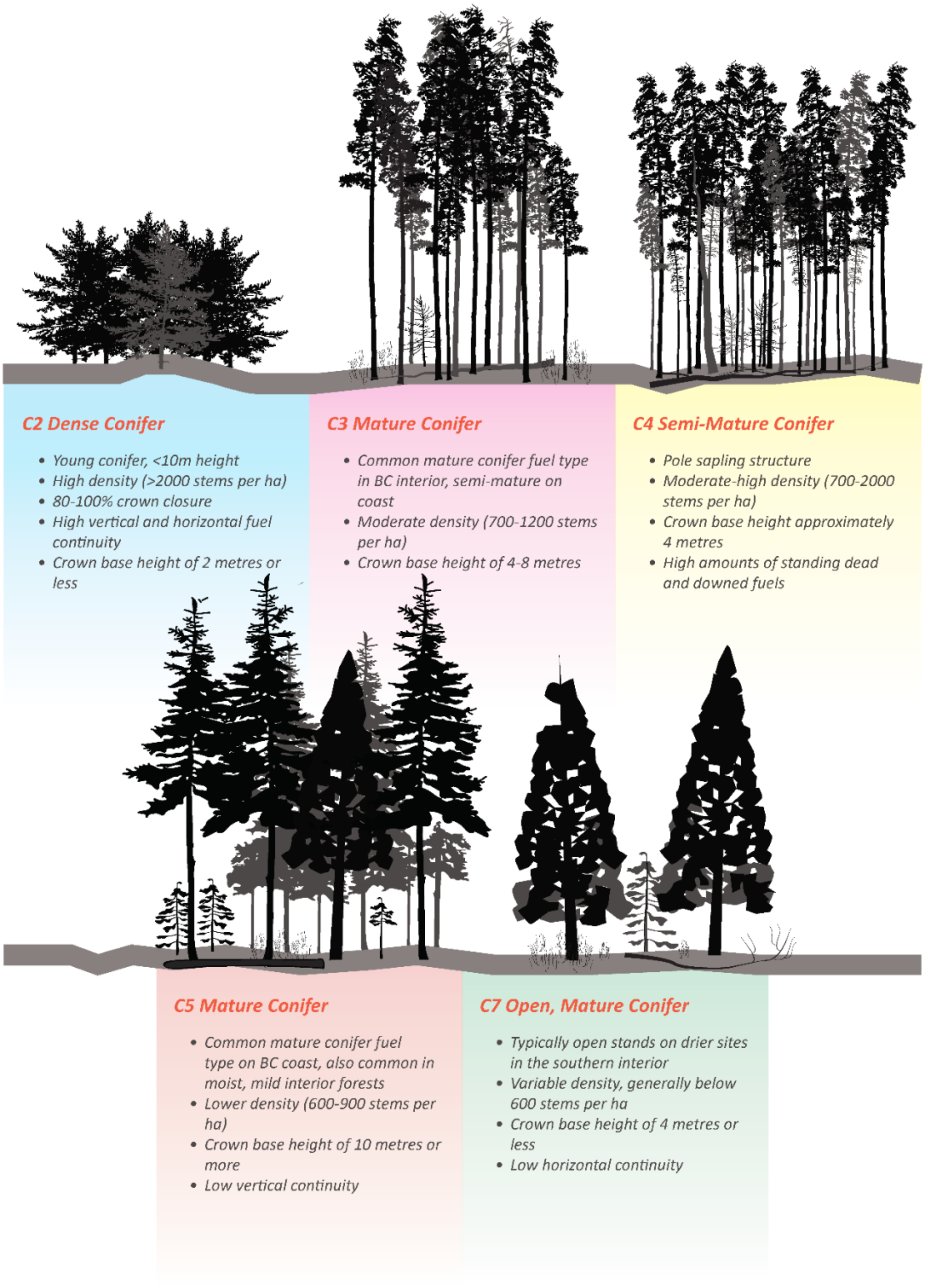


Figure 19. Characteristics of the five most-common conifer fuel types. C3 and C5 are found within the AOI.

The majority of fuels within the AOI were classified as C5 which is a common stand condition on the coast. The project area also includes almost 170 ha classified as C-3, representing coniferous stands with higher density and more ladder fuels. These stands are located at higher elevations outside the Village boundary. Within the Village boundary, there are also areas of M2 and D1/2 stands.

Table 23. The fuel types and representative areas found within the AOI

Fuel Type Classification	Total Area (ha)	% of land area
C-3 - Mature Conifer	169.5	9%
C-5 – Mature Conifer	1221.3	64%
M-1/2 - Mixed stands	267.5	14%
D-1/2 - Deciduous/swamp/shrub	245.1	13%
Non-Fuel Areas	18.3	1%
Water	1532.0	NA

Field work included ground-truthing the fuel layers. Polygons adjacent to values were visited by foresters and the accuracy of the fuels layer confirmed. The final findings from the fuel typing are summarized in the table below.

Table 24 Fuel Type Categories and Crown Fire Spot Potential.

Fuel Type Classification	Total Area (ha)	% of area	Crown Fire Spot Potential
C3	169.5	8.8%	Moderate
C5	1,221.3	63.6%	Low
D1	245.1	12.8%	Very Low
M2	267.5	13.9%	Low
Non-Fuel Areas	18.3	1.0%	N/A

*Figures exclude area occupied by the ocean

A1.2 Proximity of Fuel to the Community

Fuel closest to the community usually represents the highest hazard. To capture the importance of fuel proximity in the local wildfire threat assessment, the WUI is weighted more heavily from the value or structure outwards. Fuels adjacent to the values and/or structures at risk receive the highest rating followed by progressively lower ratings moving out.

The local wildfire threat assessment process subdivides the Wildland Urban Interface (WUI) into 3 areas (Table 25):

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

Table 25 Proximity to the Interface

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

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

WUI threat classes of High or Extreme are depicted in Figure 15. These are identified through a combination of both wildfire behaviour and proximity to communities or values. High WUI Threat Class areas are those with High or Extreme wildfire behaviour and are within 500 m of a value or community. Extreme WUI Threat Class areas are those with High or Extreme wildfire behaviour and are directly adjacent a value or community.

A1.3 Fire Spread Patterns

Initial Spread Index (ISI) is a rating of the expected rate of spread of a fire. ISI and wind speed and direction data is recorded at local BCWS weather stations and are used to understand the predominant summer fire spread patterns. This data is illustrated as ISI Wind Roses (Figure 20 and Figure 21). Each rose shows the frequency of counts by wind direction with the frequency of the ISI values during that time period.

During fire season, the prevailing winds are southwesterlies, with southeasterlies and southerlies only slightly less frequent. The topography of Howe Sound has significant influence on wind direction and speed, and therefore landscape winds should not be used to guide wildfire management without consideration of local topography.

The dominant wind pattern in the AOI is southerly winds flowing from the Georgia Depression up Howe Sound. The village is oriented parallel to these prevailing winds in steep mountain terrain. The mountains can contribute orthographic lift which may increase windspeed upslope. There are too few large fires within the AOI from provincially available data to assess the relationship between prevailing winds and patterns of spread. The outlines of the two large historic fires suggest movement upslope from southwest to northeast, which would be consistent with prevailing winds during the fire season.

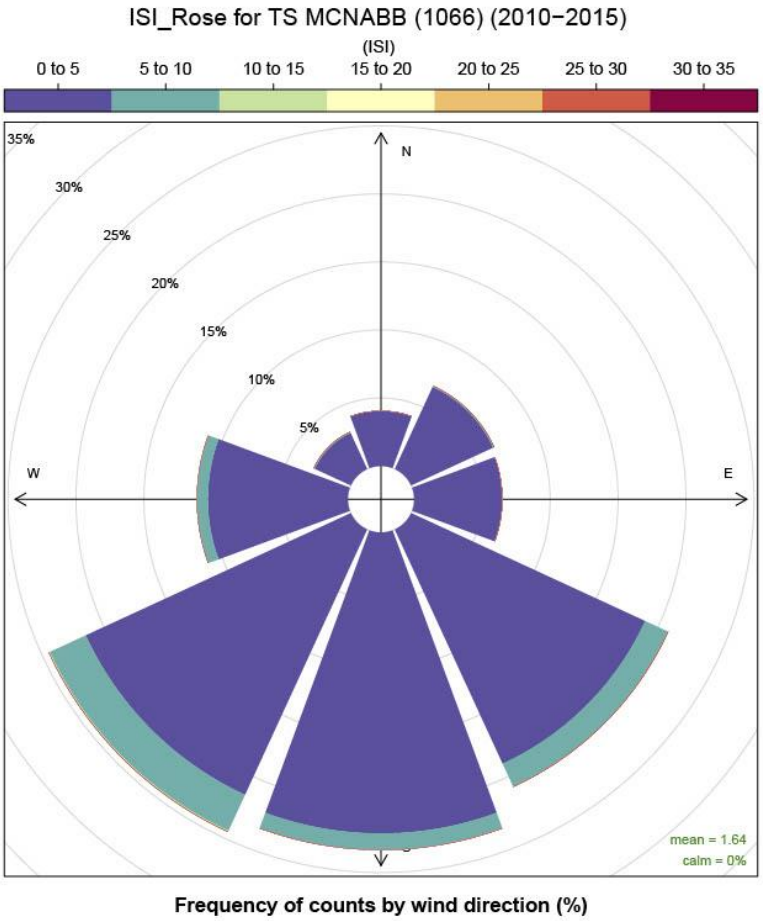


Figure 20. Initial Spread Index (ISI) Rose from TS McNabb Weather Station. (BC Wildfire Service, 2019)

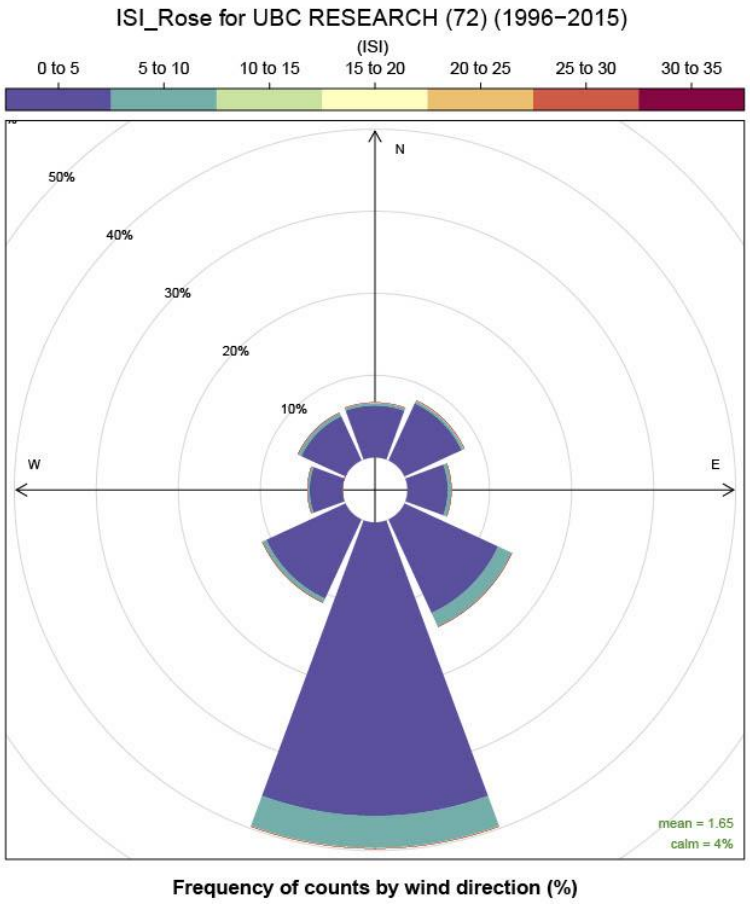


Figure 21. Initial Spread Index (ISI) Rose from UBC Research Weather Station. (BC Wildfire Service, 2019)

A1.4 Topography

Steep slopes significantly increase wildfire spread by increasing radiant and convective heat on fuels upslope of the fire. This acts to "pre-heat" or dry upslope fuels, making ignition more likely as the fire head approaches. Aspect on steep slopes will also affect wildfire spread, as south facing slopes will be much warmer and drier than other aspects. Areas with steep, vegetated slopes below them are at higher risk than flat areas with similar fuel loading. West aspects tend to support hotter and drier conditions than east or north aspects.

The Village occupies moderately steep slopes and is surrounded by very steep terrain on warm west aspects. Winds are most frequently out of the south. Structures at the edge of continuous forest cover, where a developing crown fire would spread, are at higher risk than structures near isolated forest patches.

Table 26 Slope percentage and fire behaviour implications.

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

Development is concentrated on the alluvial fans of Harvey, Alberta, and Magnesia Creeks and on the lower slopes between these riparian areas. While development is generally located on areas of lower relief (grades 0-30%), steep forested slopes (>30%) are found adjacent to and among the community's homes. Much critical water supply infrastructure occupies places of steeper relief east of the built-up areas, where slopes of greater than 45% are common.

Table 27 Slope position of value and fire behaviour implications.

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

A1.5 Local Wildfire Threat Classification

The areas that have a high wildfire threat include fuel types that are dominated by conifer tree species and on steep slopes. These areas have high fuel loading that with both winds and the effects of slope will burn at a high intensity. Conifer dominated fuel types constitute almost 75% of the study area (excluding water). These are found primarily on Crown land adjacent to the Village on all sides. Wildfire threat generally increases with elevation in these mountains, as higher elevation conifer stands inside the AOI will have higher density. Specific areas of note with higher risk polygons include areas of C3 fuel type at middle to high elevations in the community's watersheds. The areas within the AOI by fire intensity class is summarized below.

Table 28 Wildfire behavior category based on fire intensity

Wildfire Behavior Threat	Total Area (ha)	% of area
Very Low*	1,550	44.9%
Low	4	0.1%
Moderate	647	18.7%
High	761	22%
Extreme	282	8.2%
Private	209	6%

***This figure includes water within the AOI**

A1.6 Local Wildfire Risk Classification

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

Table 29. Wildland Urban Interface Threat Class

Wildfire Behavior Threat	Proximity of High or Extreme Threat to Value	Total Area (ha)
Low	>2,000m	83
Moderate	500 – 2,000m	786
High	Within 500m	127
Extreme	Directly adjacent	47

A1.7 Summary of Fire Risk Classes

The above table summarizes the total area by WUI threat class. This the total area of high wildfire threat that is adjacent values. This is summarized in Figure 15, which shows the spatial distribution of the areas of highest wildfire risk.

Appendix 2 Wildfire Threat Assessment Worksheets and Photos

Threat worksheets and photos have been submitted separately to this report.

Appendix 3 Description of Terminology

Term	Definition
Co-dominant Trees	Defines trees with crowns forming the general level of the main canopy in even-aged groups of trees, receiving full light from above and partial light from the sides.
Coarse fuels (coarse woody debris)	Combustible material over 7cm in diameter
Crown base height	The height, above ground, where the live crown of coniferous trees begins. Measured in meters (m).
Crown closure	An assessment of the degree to which the crowns of trees are nearing general contact with one another. Commonly measured as the percentage of the ground surface that would be considered by a downward vertical projection of foliage in the crowns of trees.
Diameter at breast height	The diameter of a tree measured at 1.3m above the point of germination.
Dominant trees	Defines trees with crowns extending above the general level of the main canopy of even-aged groups of trees, receiving full light from above and significant light from the sides.
Fire-resistant materials	These meet the acceptance criteria of CAN/ULC-S101, (Fire Endurance Tests of Building Construction and Materials)
Fuel break	An area of non-combustible materials that inhibits the continuous burning of fuels.
Fuel load	The mass of combustible materials expressed as a weight of fuel per unit area.
Fuel moisture	Percent water content of vegetation. This is an important factor in rate of spread.
Fuel types	Classification of forested stands as described by Canadian Forest Fire Behavior Prediction (FBP) System. There are currently no fuel type classifications specific to coastal fuels.
Fine fuels (fine woody debris)	Combustible woody debris under 7cm in diameter.
Fire behaviour	The manner in which a fire reacts to the influences of fuel, weather, and topography.
Intermediate trees	Defines trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than the co-dominants. These

Term	Definition
	receive little direct light from above and none from the sides, and usually have small crowns that are crowded on the sides.
Ladder fuels	Live or dead vegetation that allows a fire to burn into the canopy (crown) of a forested stand.
Lift pruned	The removal of ladder fuels to increase the crown base height.
Litter layer	Surface buildup of leaves and woody material.
Live crown ratio	Is the percentage of the total stem length covered with living branches. It provides a rough but convenient index of the ability of a tree's crown to nourish the remaining part of the tree. Trees with less than 30 percent live crown ratio are typically weak, lack vigor, and have low diameter growth, although this depends very much on the tree's age and species.
Non-combustible materials	Means that a material meets the acceptance criteria of CAN/ULC S114, (Standard Method of test for determination of non-combustibility in Building Materials)
Open-grown	Defines trees with crowns receiving full light from all sides due to the openness of the canopy.
Rated roofing materials	Class A, B or C is a measure of the external spread of flame on a roof surface. Tests are conducted using CAN/ULC S107M methods of fire tests of roof coverings, or equivalent. The best rating achieved is Class A, which may be described as effective against severe fire exposure.
Spotting	Fire producing sparks or embers that are carried by the wind and start new fires.
Stems per hectare	The number or size of a population (trees) in relation to a unit of space (one hectare). Stems per hectare can be used to predict fire behavior in concert with additional forest characteristics and is also important in describing successional stages of forest development.
Suppressed trees	Defines trees with entirely below the general level of the canopy of even-aged groups of trees, receiving no direct light either from above or from the sides.
Wildfire	A wildland fire from natural or human causes. Wildfires may threaten identified values and be subject to control efforts.

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