

# Wildland Fire Interface Protection Plan

Gospel Rock Village  
Gibsons, BC

Aug 27, 2018



**DIAMOND HEAD**

3559 Commercial Street  
Vancouver, BC 604.733.4886



# Table of Contents

**1.0 INTRODUCTION .....1**

1.1 Site Planning Documents Reviewed .....1

**2.0 METHODOLOGY .....4**

**3.0 PROJECT OVERVIEW.....5**

**4.0 FUEL DESCRIPTIONS AND WILDFIRE THREAT ASSESSMENT .....7**

4.1 Summary of Fuel Types .....7

4.2 Summary of Wildfire Threat from surrounding forest .....8

**5.0 WILDFIRE THREAT MITIGATION RECOMMENDATIONS .....9**

5.1 Buildings setback from hazardous fuels ..... 10

5.2 Buildings and Construction..... 13

5.3 Access and Servicing..... 15

5.4 Firesmart Landscaping and Fuel Mitigation ..... 15

5.5 Ongoing Maintenance ..... 16

**6.0 FINAL REMARKS.....17**

**APPENDIX 1 WILDLAND URBAN INTERFACE PLOTS .....18**

**APPENDIX 2 DESCRIPTION OF FOREST FUEL TYPES .....21**

**APPENDIX 3 GENERIC DESCRIPTION OF COASTAL FUEL TYPES .....24**

**APPENDIX 4 RESOURCES AND LINKS .....27**

**APPENDIX 5 DESCRIPTION OF TERMINOLOGY .....28**

**APPENDIX 6 FIRE RESISTANT PLANTS FOR LANDSCAPING .....30**

**LIMITATIONS .....31**

List of Figures

Figure 1. Showing Gospel Rock NPA on OCP Land Use Map.....2

Figure 2. Approximate site boundaries and development area.....3

Figure 3. Concept site plan .....4

Figure 4. Development phasing plan for the site .....6

Figure 5. Location of the fuel types relative to project site .....7

Figure 6 - Wildfire Threat Mapping .....8

Figure 7. Minimum standards for wildfire mitigation within the wildland interface..... 11

Figure 8. Ideal recommended standards for wildfire mitigation within the wildland interface ..... 12

Figure 9. Plot locations ..... 20

List of Tables

Table 1. Requirements for community design and construction ..... 13

Table 2. Recommendations prior and during construction for water supply and vehicle access. .... 15

Table 3. Requirements for Landscaping ..... 16

Table 4. Requirements for ongoing maintenance ..... 16

Table 6. Stand characteristics for fuel type C5 ..... 21

Table 7. Stand characteristics for fuel type M2..... 22

Table 8. D1 general stand characteristics..... 23

## 1.0 Introduction

Diamond Head Consulting Ltd. (DHC) was retained to prepare an assessment of wildfire interface risks and mitigation measures for the following proposed development.

Civic address:	Gospel Rock Village, Gibsons B.C.
Client name:	Greenlane Homes/Modus
Date of site visit:	May 22, 2018

This project is a residential townhouse development within the Gospel Rock Neighbourhood located in Gibsons BC. Part F within the Official Community Plan: Gospel Rock Neighbourhood Plan requires all major developments to have a Wildland Fire Interface Protection Plan:

- 3.4.27. The preparation of a Wildland Fire Interface Protection Plan will be required for all major developments. The Plan shall address forest fire protection measures such as: non-combustible roofing and siding material, green spaces and landscape vegetation, perimeter protection buffers, evacuation routes and water supplies. At the time of rezoning or subdivision, restrictive covenants will establish specific requirements for building within Wildland Interface areas and will be implemented during the subdivision and/or building permit approval process

Standards to achieve these objectives are identified, and reference NFPA-1144 (Standard for Reducing Structure Ignition Hazards from Wildland Fire). In some cases, these standards can be difficult to achieve for developments, and can result in more stringent restrictions than intended. This assessment report considers both NFPA standards and Canadian FireSmart standards to assess hazard and guide recommendations for the design and construction of buildings and structures located within the boundaries of the Wildfire Development Permit Area.

### 1.1 Site Planning Documents Reviewed

Diamond Head Consulting was provided with the following documentation from the client that provides the basis for all comments and recommendations:

1. Gospel Rock Village – Park and Open Space Design – 170804
2. COMPREHENSIVE DEVELOPMENT AREA - Zone 4 - Gospel Rock Village – Phasing Plan – April 2018 – MODUS
3. Gospel Rock Village – Site Plan – Block 7 – Proj. No. 1603 – JYW Architecture Inc. - DRAFT

Any changes to these site plans should be provided to Diamond Head Consulting so that this wildfire report can be updated accordingly.

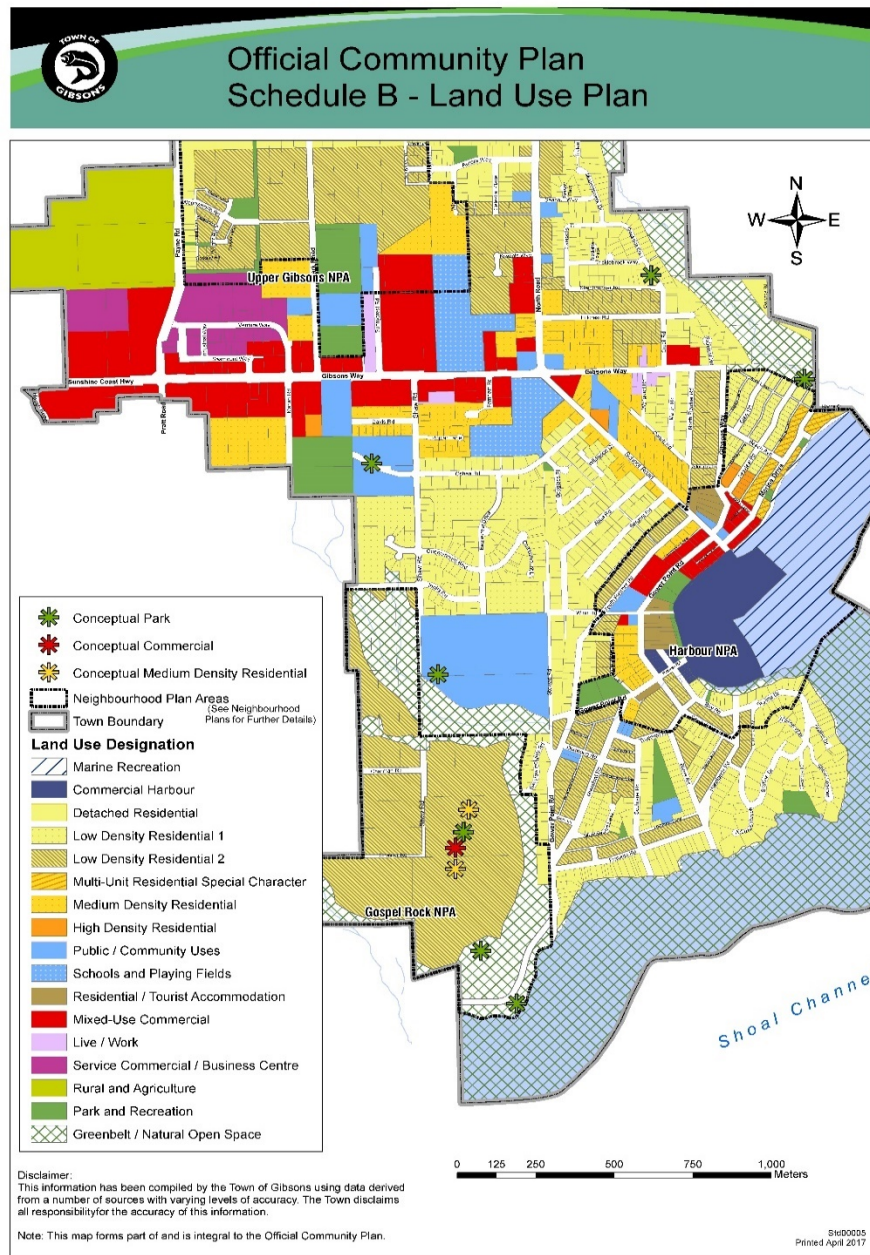


Figure 1. Showing Gospel Rock NPA on OCP Land Use Map.





Figure 2. Approximate site boundaries and development area.

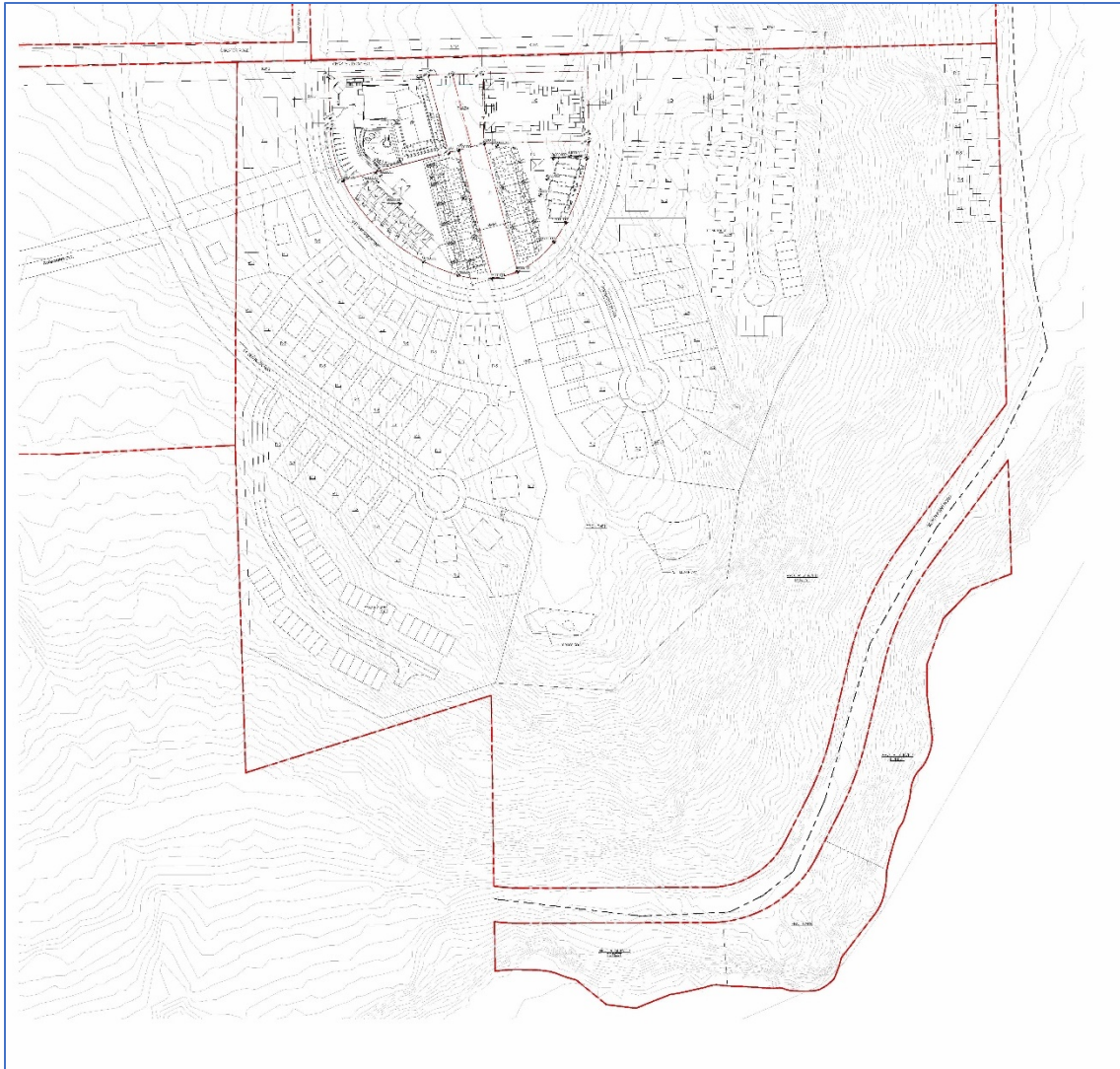


Figure 3. Concept site plan

## 2.0 Methodology

The forest stands surrounding the planned development site were classified into fuel types. There are no fuel classifications specific to the coastal region in the Canadian Fire Behaviour Prediction System; instead, the site has been classified as the fuel type that best represents the fire behavior potential of the forest types most accurately. Fuel type interpretations can be reviewed in Appendix 2.

Detailed fuel hazard assessments were completed within 500m of the lot using the provincial assessment system, “Wildfire Threat Assessment Guide and Worksheets – Ministry of Forests, Lands and Natural Resource Operations - BC Wildfire Service – Version2 -2017”

These plots are shown on Figure 6. Data collected at each fuel plot included:

- Soil and humus characteristics;
- Slope, aspect and terrain classification;
- Forest stand composition by layer (species, density, age, diameter, height, etc.);
- Vertical and horizontal stand structure;
- Quantity and distribution of ladder fuels;
- Composition and coverage of understory brush, herbs and grasses; and
- Quantity and distribution of ground fuels by size class.

A Wildfire Hazard Assessment has been completed using:

1. Current forest fuel threat in and adjacent to the proposed development using the [2017 Wildfire Threat Assessment Guide and Worksheets](#) (MFLNRO, 2017); and,
2. Future structural hazard of the proposed development using the [FireSmart Homeowners Manual](#) (Partners in Protection and Province of BC, 2016).

### 3.0 Project Overview

The parcel is Block 7 of the Gospel Rock Village in the town of Gibsons. A proposed mix of residential, commercial and park space will occupy approximately half of the 47acre block. The subject site supports a large open space that is generally flat where the development will occur. This area was cleared of trees sometime before 2004 (the oldest air photo available on Google Earth). This areas now supports widely spaced conifers, smaller deciduous trees, dense deciduous brush and invasive species.

To the south and on all sides surrounding the development area are steep slopes supporting mature Douglas-fir forest and natural open spaces created by large rocky outcroppings. This forest has been recognized as an important ecological value to the town and surrounding area. Much of the existing mature forested area within the 47acre block will be retained as a protected park including well know lookout points and natural open spaces.

The Gospel Rock Village is a phased development plan; however, this report is a preliminary overview applied to the first phase with no specific building or landscape material available for review. The preliminary nature of this report will allow the principals within to be applied to all future phases. If the recommendations and principals within this report are followed, all future phases will be considered 'Firesmart' following Firesmart BC guidelines and current industry standards.



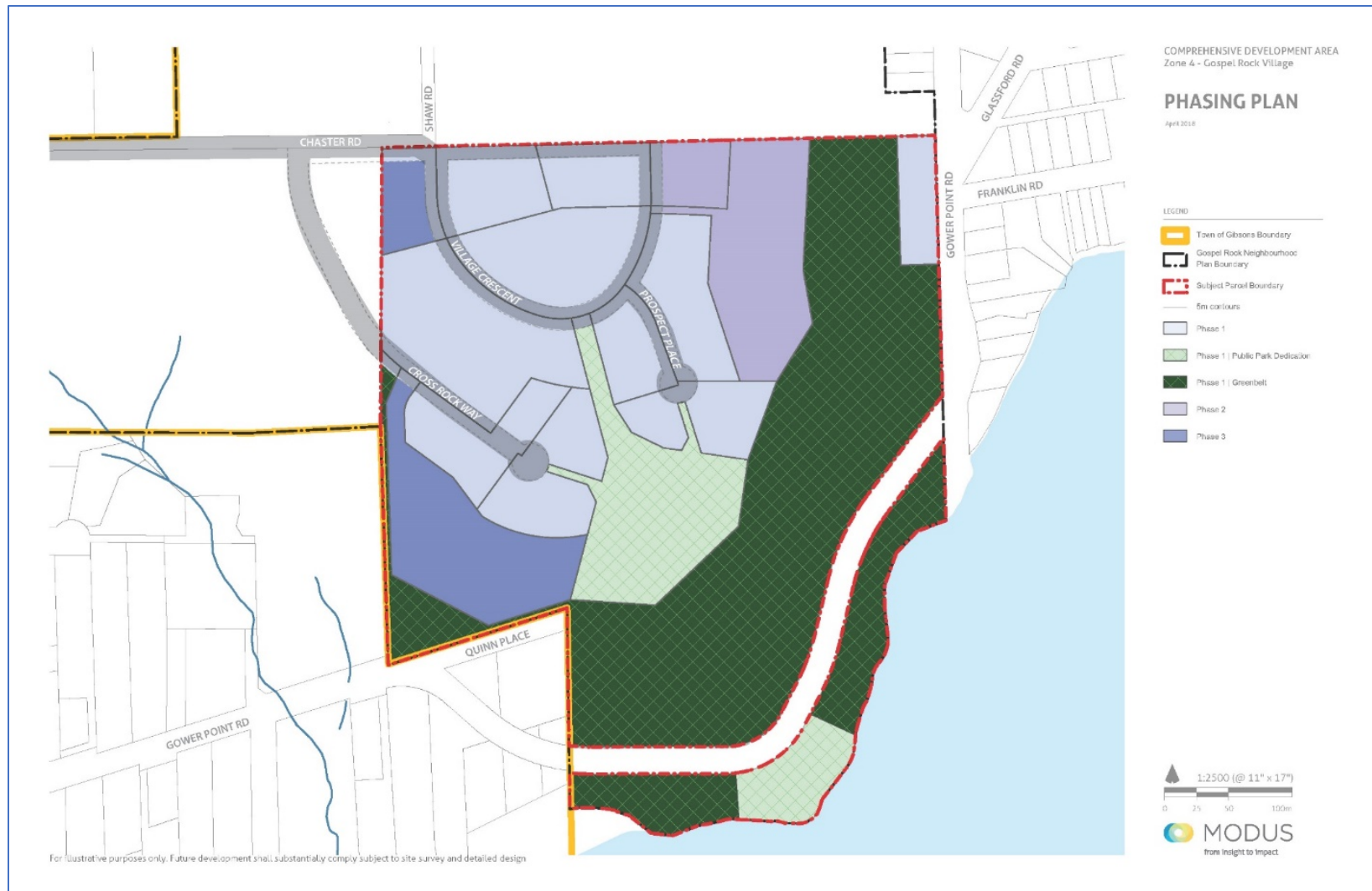


Figure 4. Development phasing plan for the site

## 4.0 Fuel Descriptions and Wildfire Threat Assessment

### 4.1 Summary of Fuel Types

Forested areas nearby the proposed development site were classified into the fuel types mapped in Figure 5. The fuels have been divided into classifications based on the sixteen national benchmark fuel types that are used by the Canadian Fire Behaviour Prediction System (Appendix 3). Three fuel types were identified. Descriptions of these forest areas are provided in Appendix 2.

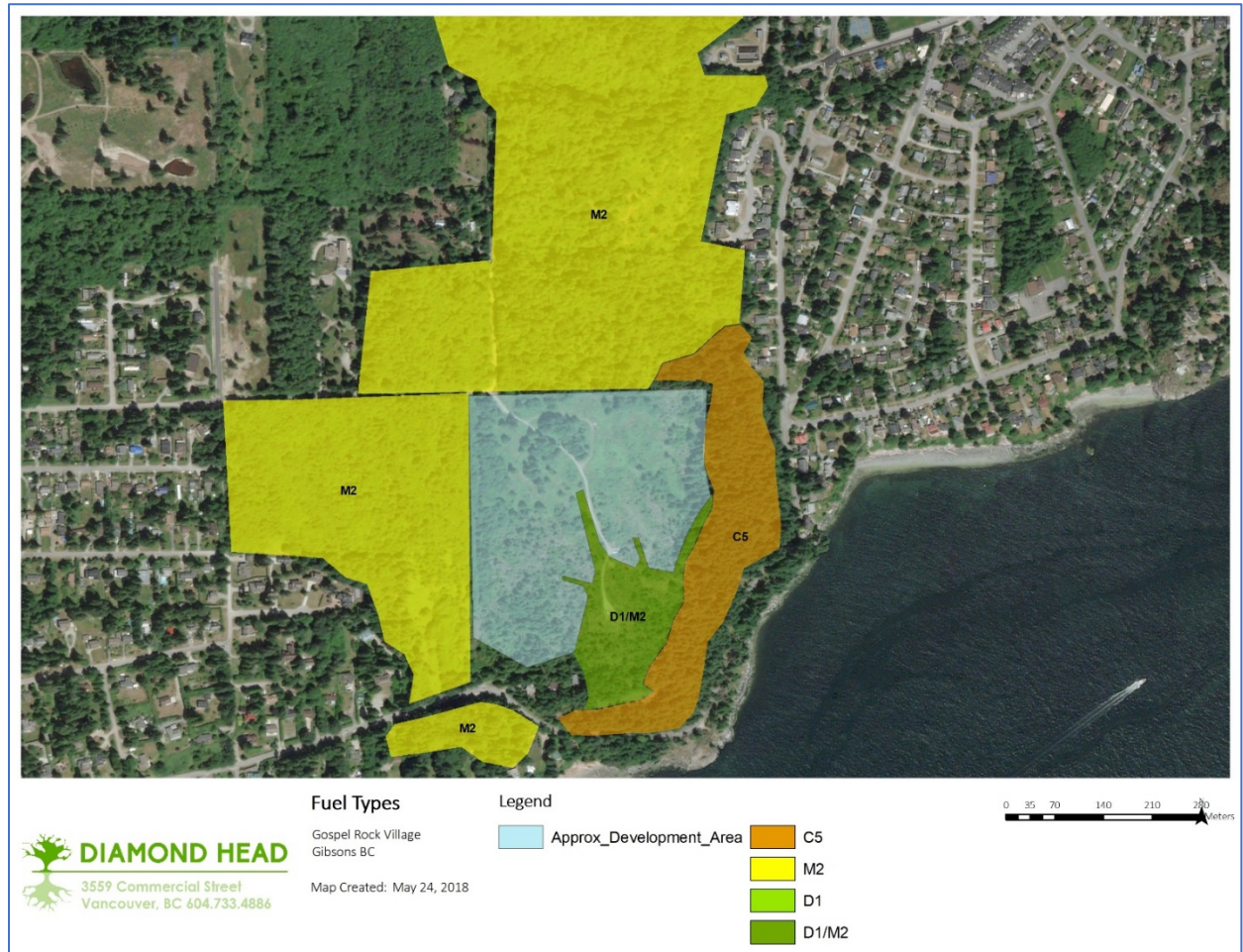


Figure 5. Location of the fuel types relative to project site



#### 4.2 Summary of Wildfire Threat from surrounding forest

Each fuel type and distinct stand was assessed for wildfire threat using the Wildfire Urban Interface worksheet. Figure 6 outlines the wildfire threat. Wildfire plot locations and Wildfire Urban Interface (WUI) ratings are summarized in Appendix 1. This assessment accounts for the fire behavior potential of these stands but does not consider plans for future structures. The subject site was assessed to have an overall moderate risk from wildfire. This is from the continuous forest surrounding the subject site.

The M2 mixes stands generally have approximately 75% conifer species; however, this is variable throughout the stands. The C5 conifer dominated stands on the slopes to the south and east of the site have a high composition of conifer trees however have lower ladder fuel loading and the crowns are broken up by rocky outcrops. In most areas the conifer species have high crown heights. A crown fire could generate in these stands however would likely require drought weather conditions combined with high winds. The risk is also increases with the steepness of the slope. The mature forested areas to the east and south of the site support sensitive and high value ecosystems and will become protected natural areas. The treatments to trees in these areas to reduce wildfire risk must be clearly justified and done in a very sensitive way. Creating a firesmart landscape and buildings is recommended as the primary defense against the wildfire risk to this development site.

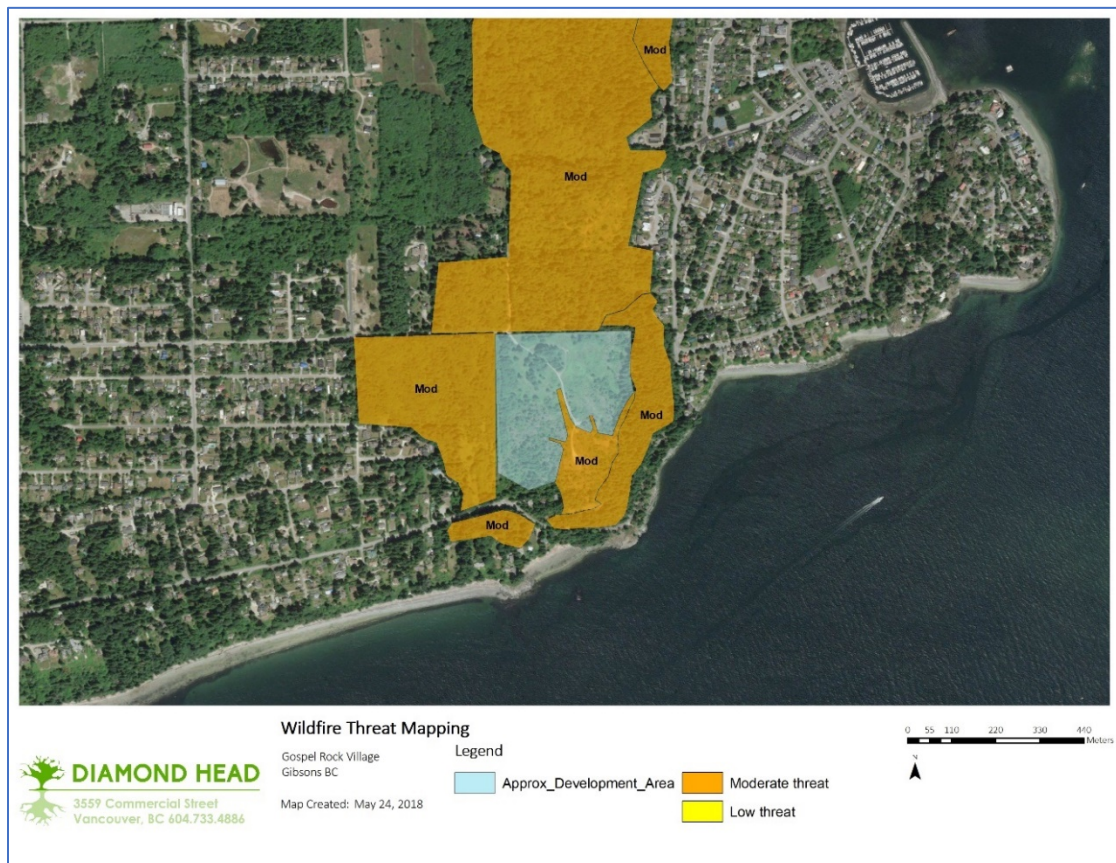


Figure 6 - Wildfire Threat Mapping



Photo 1: View of vegetation growing within the development area. Widely spaced conifers, smaller deciduous trees, dense deciduous brush and invasive species such as Himalayan blackberry and Scotch broom occupy the majority of the development site.



Photo 2: Natural rock bluff lookout and view of Howe Sound. This area will become part of the protected natural area and public park where several hiking trails will be created.

## 5.0 Wildfire Threat Mitigation Recommendations

This section provides recommendations to mitigate the risk of wildfire to the proposed development based on the current condition of hazardous fuels and wildfire threat, site planning documents, FireSmart standards within the prioritized zones defined in the FireSmart Homeowners Manual (Partners in Protection and Province of BC, 2016).

During a wildfire event, 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.

In the event that a wildfire, suppression capability is improved with good access, defensible space between the structures and the forest as well as adequate and accessible water supply. The following are recommendations to mitigate risk to the development. These are factors that provide long term mitigation against a wildfire event.

Areas to the east and south of the development will be protected parks and those north and west are on adjacent private lands. Many of these are highly sensitive ecosystems in which trees



removal is difficult to justify. Also, the plant community composition will change over time and require maintenance. Recommendations for wildfire mitigation focus on structural design and landscaping recognizing the limitations of altering these natural areas.

At the time this assessment was completed, detailed architectural structural plans and landscape plans were not available for review. It is the responsibility of the owner and their project team to understand the following restrictions and to comply with them.

### **5.1 Buildings setback from hazardous fuels**

Firesmart recommends that a 10m fuel free zone be established and maintained between structures and hazardous fuels. This is to create a barrier to keep radiant heat from a fire away from the structure and to provide a defensible space where suppression resources can fight a wildfire. There is an onsite wildland interface that will be created along the south and east sides of the development. Development will extend up to the edge of the existing slope break which is where the site has previously been cleared of mature forest. The natural forested area downslope of this interface is an environmentally sensitive area. An emphasis has been made during the planning of this project to protect the integrity of this natural area.

There will be single family detached and multifamily units built up against this interface zone. The zoning is expected to specify a 7.5m back yard setback to the property line. This is less than the recommended of a 10m fuel free zone. However, removing trees beyond the property line in the protected natural area will cause impacts to the integrity of this ecosystem. A compromise between environmental protection and wildfire risk mitigation is required in these situations. It is recommended that structures be placed as far back as possible from the forested edge.

If possible, some of the conifer trees along this interface should be selectively pruned and thinned to reduce the wildfire behavior in this zone while considering the environmental integrity of the forest. If possible, ground fuel accumulations should also be removed by hand.

Figure 7 illustrates the minimum standard that will be established between the protected natural area and the structures. In these cases when an ideal fuel free zone cannot be achieved, it is important that no other concessions be made to other wildfire mitigation measures including building construction, landscape design and irrigation.

Figure 8 illustrates the recommended standard to be achieved. This includes a 10m fuel free zone as well as a treated transition zone within the first 10-20m of the natural forest. Planning should strive to achieve this standard.

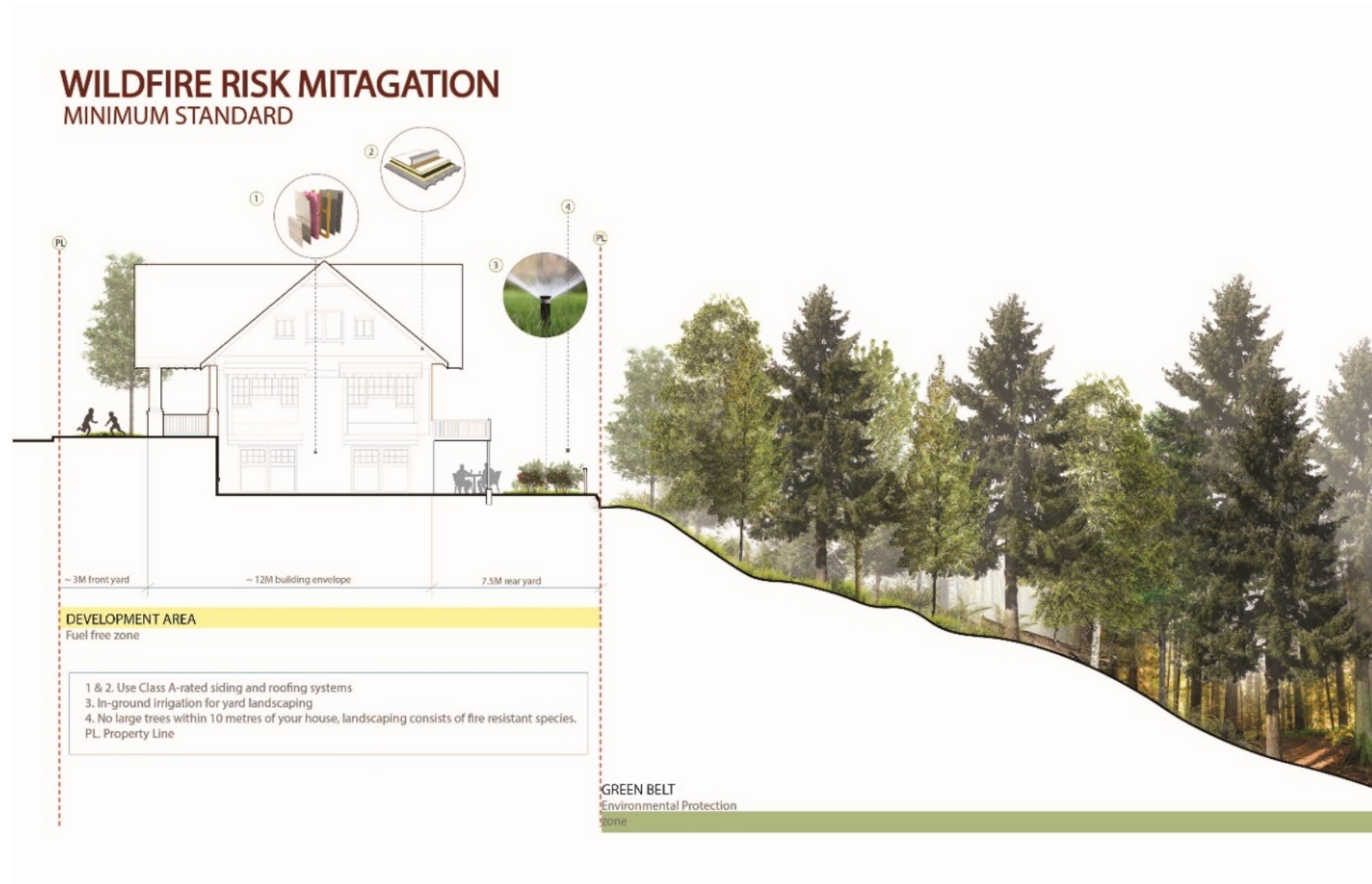


Figure 7. Minimum standards for wildfire mitigation within the wildland interface

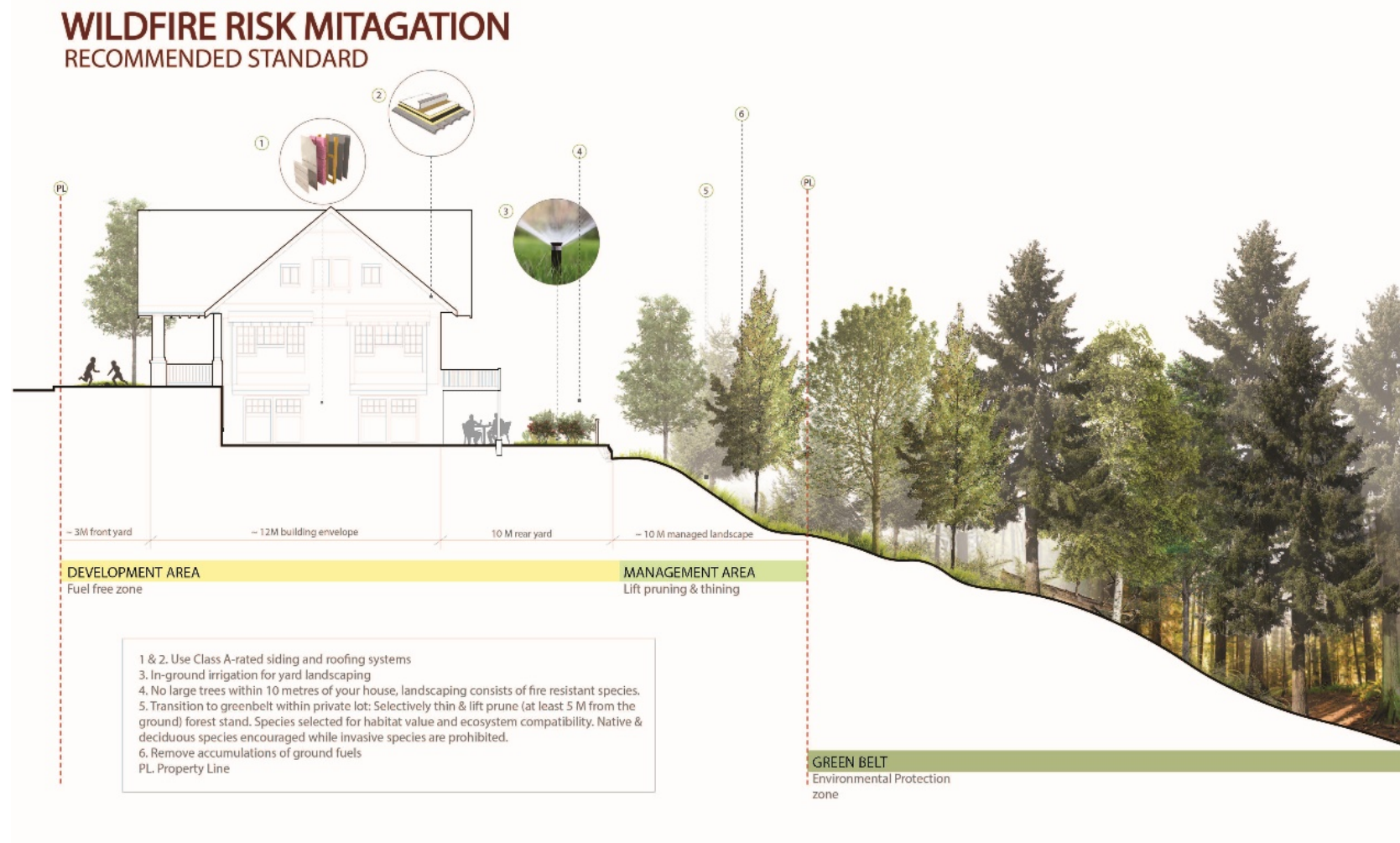


Figure 8. Ideal recommended standards for wildfire mitigation within the wildland interface

## 5.2 Buildings and Construction

Generally, during a wildfire, homes are ignited as a result of 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 and, if the resulting fire is near the home, it could create enough radiant heat to ignite the walls of the home. Small fires in the yard can also spread towards the structures, beneath porches or under homes. Therefore, the building material and construction techniques are a paramount concern for homes in the interface. Following Firesmart building guidelines should be applied to the development.

**Table 1. Requirements for community design and construction**

Feature	Requirements for building materials
<b>Roofing</b>	<ul style="list-style-type: none"> <li>Class A or B rated roofing material* should be used, and asphalt or metal roofing should be given preference.</li> <li>Any spaces between roof decking and covering should be blocked.</li> <li>Screen or enclose rain gutters to prevent accumulation of plant debris.</li> </ul>
<b>Siding</b>	<ul style="list-style-type: none"> <li>Exterior vertical walls should be clad with non-combustible materials*. Preference should be given to stucco, metal, brick and concrete cladding.</li> <li>Ensure that fire resistant materials extend from the foundation to the roof.</li> <li>Flame resistant coatings that require ongoing maintenance or reapplication are not acceptable.</li> <li>Exterior wall assemblies that have exterior wood that is untreated and rely on the interior wall for fire resistance are not acceptable.</li> </ul>
<b>Vents, openings, eaves, attics, overhanging projections, soffits</b>	<ul style="list-style-type: none"> <li>Vents should be screened using 3mm, non-combustible wire mesh, and vent assemblies should use fire shutters or baffles.</li> <li>Eaves, soffits, attics, overhanging projections and underfloor openings should be protected with non-combustible covers.</li> </ul>
<b>Exterior windows and doors</b>	<ul style="list-style-type: none"> <li>All windows should be double glazed, or of glass block. Radiant faces exposed to the forest edge should be multi-paned with one pane glazed with annealed or tempered insulating glass.</li> <li>Limit the size and number of windows that face large areas of vegetation.</li> <li>Window screens should be non-combustible.</li> <li>Exterior doors on radiant faces exposed to the forest edge should be of fire resistant materials.</li> </ul>
<b>Decks, porches, balconies</b>	<ul style="list-style-type: none"> <li>Decks, porches and balconies should be sheathed with fire-resistant or non-combustible materials.</li> <li>Slotted deck surface allows needle litter to accumulate beneath the deck. Provide access to this space to allow for removal of this debris.</li> <li>Any covers should be built of the same ignition-resistant materials as a roof.</li> </ul>
<b>Exterior sprinklers</b>	<ul style="list-style-type: none"> <li>Irrigation sprinklers should be installed on private property and in landscaped parks to keep plants healthy and fire-resistant. The switch for these should be made accessible to turn on in the case of a wildfire.</li> </ul>
<b>Fences</b>	<ul style="list-style-type: none"> <li>Where fencing is within 10 m of the building or accessory buildings, use fire-resistant or non-combustible materials.</li> </ul>



Feature	Recommendations during construction
<b>Combustible materials</b>	<ul style="list-style-type: none"> <li>During construction of houses, all waste construction materials including brush and land clearing debris; needs to be cleaned up on a regular basis, to minimize the potential risk. No combustible materials should be left at the completion of construction.</li> </ul>
<b>Hydrants</b>	<ul style="list-style-type: none"> <li>Prior to construction of any wood frame buildings, there must be fire hydrants within operating range.</li> </ul>
<b>Fire Suppression</b>	<ul style="list-style-type: none"> <li>The contractor should be familiar with the BC Wildfire Act and the current provincial standards for wildfire suppression and have the appropriate tools on-site for the duration of the project.</li> </ul>

\* **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)

**Fire-resistant materials:** means that a material meets the acceptance criteria of CAN/ULC-S101, (Fire Endurance Tests of Building Construction and Materials)

**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.

The following specification are very important to comply with. Roofing must be fire retardant. These have a Class A flame spread rating defined as "Class A roof coverings are not readily flammable, are effective against severe fire exposures, and do not carry or communicate (i.e., spread) fire". ANSI/UL 790, "Tests for Fire Re-sistance of Roof Covering Materials," and ASTM E 108, "Standard Test Methods for Fire Tests of Roof Coverings," are the fire-resistance capacity tests used to determine a product's or roof assembly's classification. Any products that are certificated as Class A with an "Assembly" requirement must have a project engineer or architect provide signed proof that the product has been installed as per the specifications of the manufacturer.

Exterior siding must be fire resistant. (Stucco, brick, fibre cement boards/panels and poured concrete). Untreated wood products do not meet this standard. Flame resistant coatings that require ongoing maintenance or reapplication are not acceptable. Exterior wall assemblies that have exterior wood that is untreated and rely on the interior wall for fire resistance are not acceptable. Wood products that have permanent treatments or are naturally fire resistant can be accepted as long as product specifications and certified testing is provided.

**It is critical that the structures be designed and built to these standards in order to meet the guidelines of Firesmart BC.**

Planned building materials have not been confirmed as no detailed architectural plans have been developed yet for this project. All building within the development are recommended to be constructed with fire resistant exterior materials. Wooden accents should not total more than 20% on any one wall. All buildings immediately adjacent to the forest edge should be constructed entirely of fire resistant materials.

### 5.3 Access and Servicing

Access and services affects both the fire resistance of the development and, in the event a wildfire does occur, the suppression capability and safety of first responders. Recommendations for access and servicing are provided in table 2.

**Table 2. Recommendations prior and during construction for water supply and vehicle access.**

Feature	Recommendation
<b>Access</b>	<ul style="list-style-type: none"> <li>It is anticipated the construction site will create adequate turn-around space for municipal fire engines. Two means of access are preferred with adequate passing and turn-around space. Currently the site is accessed by one narrow road (Chaster Rd) that meets Shaw Rd at the development site. Shaw Rd currently dead ends, however, there are plans to extend this road in the future which will create two means of vehicle access.</li> </ul>
<b>Water supply</b>	<ul style="list-style-type: none"> <li>Prior to construction, the proposed development will be serviced by a hydrant system</li> </ul>
<b>Utilities - Electric</b>	<ul style="list-style-type: none"> <li>All new hydro servicing within the subdivision should be underground.</li> </ul>

### 5.4 Firesmart Landscaping and Fuel Mitigation

Landscaping and maintenance for the site should follow FireSmart principals (Ministry of Forests Wildfire Management Branch, Firesmart Program). For single residential lots the entire lot is generally within 10m of the structure and will be landscaped. Within a larger scale developments it is recommended that the whole development apply Firesmart landscape guidelines. Planning and maintenance of this area should follow the requirements of priority zone 1 (<10m from structures) outlines in the Firesmart program. The goal in this zone is to remove hazardous fuels and convert vegetation to fire resistance species to produce an environment that does not support combustion. These recommendations include strategic selection of fire resistant replacement trees as well as landscaping and maintenance standards are summarised in Table 3.

No detailed landscape plans were available for review. The landscape architect should be made aware of the recommendations within this report and ensure no conifers or long ornamental grasses are planted within 10m of any building.

Table 3. Requirements for Landscaping

Feature	Recommendations
<b>Planting</b>	<ul style="list-style-type: none"> <li>Remove all highly flammable vegetation and other combustibles from around the building. This includes all conifer hedging.</li> <li>No conifer trees species should be planted within 10m of any buildings.</li> <li>Landscaping should incorporate species that are fire resistant. These types of plants tend to have moist, supple leaves with low amounts of sap or resin. They also have a tendency not to accumulate dead material. A list of fire resistant plants and trees can be found at the Firesmart Canada website<sup>1</sup>. A list of suitable species has also been provided in Appendix 6.</li> <li>Ensure that vegetation will not grow to touch or overhang buildings.</li> <li>Irrigation sprinklers should be installed in landscaping.</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Annual grasses within 10 meters of buildings should be kept mowed to 10 centimeters or less and watered regularly during the summer months;</li> <li>Ground litter and downed trees should be removed regularly and prior to the fire season.</li> </ul>

### 5.5 Ongoing Maintenance

To ensure that FireSmart standards are maintained on the property, periodic re-treatment or maintenance is recommended in Table 4

Table 4. Requirements for ongoing maintenance

Owner	Recommendation
Homeowners responsibility	<ul style="list-style-type: none"> <li>Regularly remove debris from roofs, gutters and beneath overhanging projections.</li> <li>Grass and landscaping should be kept mowed to 10 cm or less and watered regularly during the summer months.</li> <li>Landscape sprinkler systems should be installed and maintained by the homeowner.</li> <li>Remove any local accumulations of woody or combustible material (e.g., no woodpile or yard waste accumulations).</li> <li>Remove any over mature, dead or dying shrubs and trees.</li> <li>Plant only fire resistant trees and shrubs. A list of fire resistant plants and trees can be found at the fire smart canada website (<a href="https://www.firesmartcanada.ca/images/uploads/resources/FireSmart-Guide-to-Lanscaping.pdf">https://www.firesmartcanada.ca/images/uploads/resources/FireSmart-Guide-to-Lanscaping.pdf</a>).</li> </ul>

## 6.0 Final Remarks

The Town of Gibsons requires that a Wildland Fire Interface Protection Plan be developed for this proposed development. Planners, engineers, and landscape architects should refer to this report and the FireSmart manual during the design phase of this development. All construction operations should be conducted according to the Wildfire Act and the regulations. Following these regulations will help reduce liability and protect the development.

This project has been planned with the protection of sensitive forested ecosystems as a priority. Considering the sensitivities of these natural areas, some concessions have been made related to tree removal within the wildland interface. Because of this the project will not meet all of the Firesmart standards, however if the other recommendations made within this report are complied with, wildfire risk to life and property will be substantially reduced.

If there are any questions or concerns as to the contents of this report, please contact us at any time.

Sincerely,

Supervisor:



Mike Coulthard, R.P.Bio., R.P.F.  
Senior Forester, Biologist  
Certified Tree Risk Assessor (46)

Project Staff:



Kristian Short, Cert. Horticulture  
ISA Certified Arborist (PN-8029 A)  
ISA Qualified Tree Risk Assessor (TRAQ)  
BC Parks Wildlife and Danger Tree  
Assessor (P2229)



## Appendix 1 Wildland Urban Interface Plots

Wildfire Threat Assessment Worksheet - Fuel Setting Scoring

Location	Plot 1	Date	22-May
Assessor	KS		
Crown species composition (species %)	Cw,Dr,Mb,Fd		

Component/subcomponent	PULLDOWNS	SCORE
Depth of organic layer	5-<10	5
Surface and ladder fuel (.1-3m in height)		
Surface fuel composition	deciduous shrubs	4
Dead and down material continuity (<7cm)	Scattered <10% coverage	4
Ladder fuel composition	Mixedwood	3
Ladder fuel horizontal continuity	Patchy 40-60% coverage	8
Stems/ha (understory)	<900	2
Stand structure and composition (dominant and co-dominant)		
Overstory composition/CBH	Mixwood 75%	7
Crown closure	41-60%	2
Fuel strata gap	3-6	7
Stems/ha (overstory)	601-900	3
Dead and dying (% of dominant and co-dominant stems)	Standing dead/partial down <20%	2
Comments:	TOTAL	47
	RATING	MODERATE

Wildfire Threat Assessment Worksheet - Priority Setting Scoring

Location	Plot 2	Date	22-May-18
Assessor	KS		
Crown species composition (species %)	Fd, Ra, Cw		

Component/subcomponent	PULLDOWNS	SCORE
Depth of organic layer	1-<5	3
Surface and ladder fuel (.1-3m in height)		
Surface fuel composition	deciduous shrubs	4
Dead and down material continuity (<7cm)	10-25% coverage	8
Ladder fuel composition	Mixedwood	3
Ladder fuel horizontal continuity	Scattered 10-30% coverage	5
Stems/ha (understory)	<900	2
Stand structure and composition (dominant and co-dominant)		
Overstory composition/CBH	Conifer with moderate CBH (6-9 m)	12
Crown closure	41-60%	2
Fuel strata gap	6-9	3
Stems/ha (overstory)	601-900	3
Dead and dying (% of dominant and co-dominant stems)	Standing dead/partial down <20%	2
Comments:	TOTAL	47
	RATING	MODERATE

## Wildfire Threat Assessment Worksheet - Priority Setting Scoring

Location	Plot 3	Date	22-May-18
Assessor	KS		
Crown species composition (species %)	Fd, Mb, Cw		

Component/subcomponent	PULLDOWNS	SCORE
Depth of organic layer	5-<10	5
Surface and ladder fuel (.1-3m in height)		
Surface fuel composition	deciduous shrubs	4
Dead and down material continuity (<7cm)	10-25% coverage	8
Ladder fuel composition	Mixedwood	3
Ladder fuel horizontal continuity	Scattered 10-30% coverage	5
Stems/ha (understory)	<900	2
Stand structure and composition (dominant and co-dominant)		
Overstory composition/CBH	Mixwood 75%	7
Crown closure	41-60%	2
Fuel strata gap	6-9	3
Stems/ha (overstory)	601-900	3
Dead and dying (% of dominant and co-dominant stems)	Standing dead/partial down <20%	2
Comments:	TOTAL	44
	RATING	MODERATE

## Wildfire Threat Assessment Worksheet - Priority Setting Scoring

Location	Plot 4	Date	22-May-18
Assessor	KS		
Crown species composition (species %)	Fd, Mb, Cw, Dr		

Component/subcomponent	PULLDOWNS	SCORE
Depth of organic layer	5-<10	5
Surface and ladder fuel (.1-3m in height)		
Surface fuel composition	deciduous shrubs	4
Dead and down material continuity (<7cm)	10-25% coverage	8
Ladder fuel composition	Mixedwood	3
Ladder fuel horizontal continuity	Scattered 10-30% coverage	5
Stems/ha (understory)	<900	2
Stand structure and composition (dominant and co-dominant)		
Overstory composition/CBH	Mixwood 50%	5
Crown closure	20-40%	1
Fuel strata gap	<3	10
Stems/ha (overstory)	<400	0
Dead and dying (% of dominant and co-dominant stems)	Standing dead/partial down <20%	2
Comments:	TOTAL	45
	RATING	MODERATE

Low	Moderate	High	Extreme
0 - 43	44 - 59	60 - 72	73 - 110

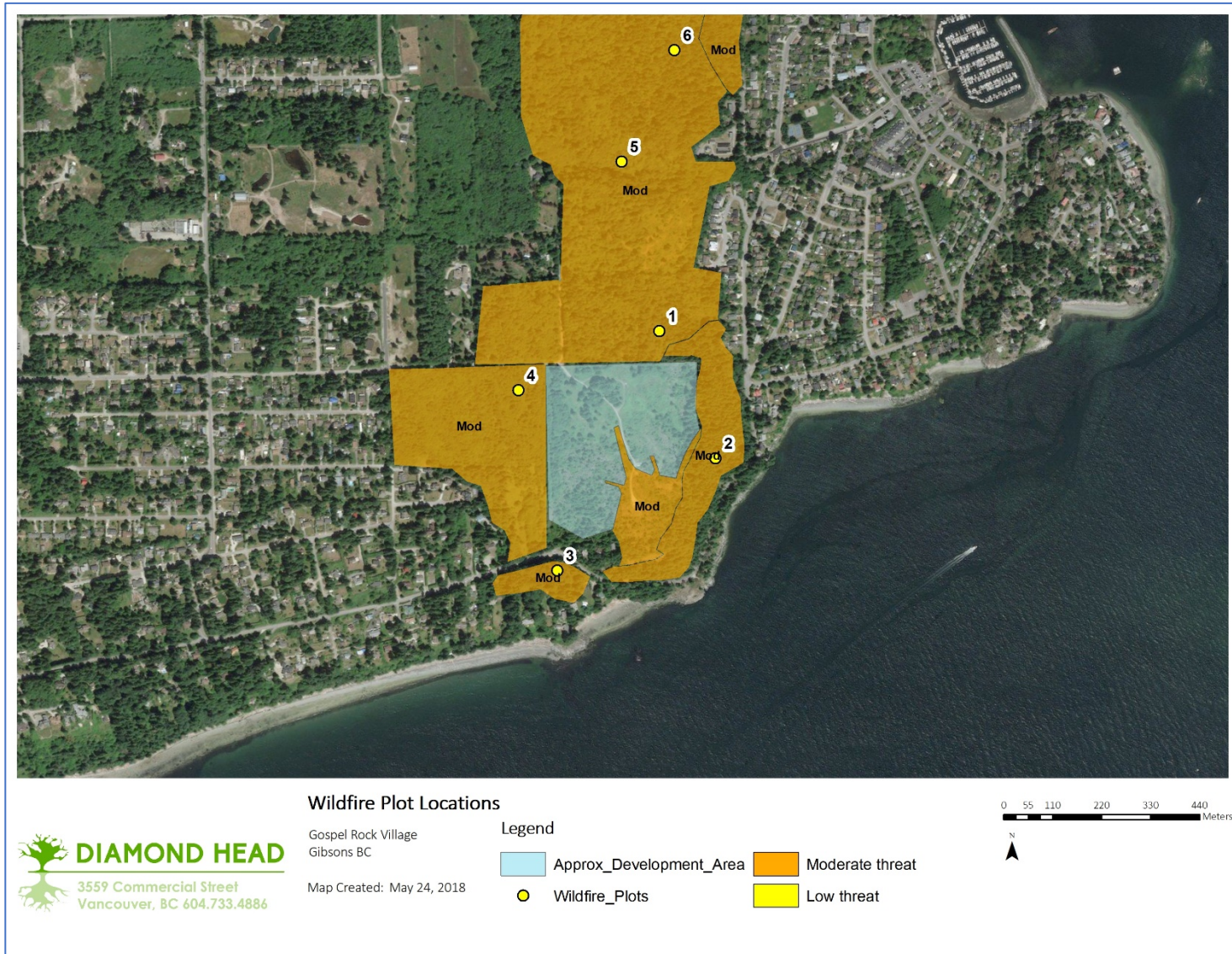


Figure 9. Plot locations



## Appendix 2 Description of Forest Fuel Types

### Fuel Type C5 – Coniferous dominated stand

The forested area to the south of the development area on a southerly aspect with steep grades has been identified as a C5 stand. The C5 fuel type consists of a mature second growth canopy of even aged, moderately stocked (500 – 800 stems per hectare) conifers. The stand is dominated by Douglas-fir (*Pseudotsuga menziesii*) with lesser amounts of Western Redcedar (*Thuja plicata*). This fuel type potentially poses a moderate wildfire threat. It takes a large amount of energy to create a crown fire in this fuel type. In order for a crown fire to generate it would likely require extreme fire weather conditions brought on by higher degrees Celsius than relative humidity (Rh) described as “crossover” in fire weather. Table 5 outlines the general stand characteristics of a C5 stand.

Table 5. Stand characteristics for fuel type C5

Characteristic	Risk Level	Description
Surface fuel continuity (% cover)	Low	20-40 % cover
Vegetation fuel composition	Low	Herbs and deciduous shrubs
Fine woody debris continuity (<=7cm) (% cover)	Med	10-25% coverage
Large woody debris Continuity (>=7cm) (% cover)	Low	<10% coverage
Live conifer canopy closure (%)	Med	41-60% crown closure
Live deciduous canopy closure (%)	High	<20% crown closure
Live and dead conifer crown height (m)	Low	3-5m
Live and dead suppressed and understory conifer (stems/ha)	Low	<500 stems/ha



Photo 3. View of conifer stand to south of development area



Photo 4. View of crown closure within conifer stand.



### Fuel Type M2 – Mixed conifer and deciduous stand

Most of the forest within 500m of the development site has been classified as mixed. These areas consist mostly of Red alder, Western redcedar and Douglas-fir. Stand density is variable ranging from 600 to more than 1,000 stems per hectare.

The fire behavior potential in these stands varies depending on the percentage content of coniferous species. Most of the stands adjacent to the site have a coniferous component of approximately 75% and pose a moderate risk to the site. There are isolated groups of conifers that pose a moderate risk. The M2 stand poses a moderate wildfire risk to the subject site, but if a surface fire did start it would be unlikely to become a crown fire. Table 6 outlines general stand characteristics.

Table 6. Stand characteristics for fuel type M2

Characteristic	Risk Level	Description
Surface fuel continuity (% cover)	Low	20-40 % cover
Vegetation fuel composition	Low	Herbs and deciduous shrubs
Fine woody debris continuity ( $\leq 7$ cm) (% cover)	Low	Scattered, <10% coverage
Large woody debris Continuity ( $\geq 7$ cm) (% cover)	Low-Med	10-25% coverage
Live conifer canopy closure (%)	Low-Med	20-40% crown closure
Live deciduous closure (%)	Med	20-40% crown closure
Live and dead conifer crown height (m)	Med	2-<3 m
Live and dead suppressed and understory conifer (stems/ha)	Very Low	0-500 stems/ha



Photo 5. View of mixed stand



Photo 6. View of crown closure within mixed stand

### Fuel Type M2/D1 – Deciduous dominated stand

There is an area to the south of the development site that has many deciduous shrubs and small trees but also has widely spaced conifers and long grass that will likely become cured in the summer months and can pose a moderate wildfire risk. This small area although dominated by deciduous species likely has a higher fire potential than most deciduous stands which is why it has been labeled as M2/D1 and given a ‘moderate’ risk of wildfire opposed to ‘low’ which deciduous generally has.

D1 fuel types typically have less than 20% coniferous component and are dominated by even aged native deciduous trees such as Red Alder (*Alnus rubra*), Bigleaf Maple (*Acer macrophyllum*), and/or Black Cottonwood (*Populus balsamifera* ssp. *Balsamifera*). D1 fuel types have a low flammability and would not support a fast spreading, high intensity wildfire. D1 stands pose a low wildfire risk and are expected to act as fuel breaks decreasing the overall wildfire threat to the site. Table 7 outlines general characteristics of D1.

**Table 7. D1 general stand characteristics**

Characteristic	Risk Level	Description
Surface fuel continuity (% cover):	Low	20-40 % cover
Vegetation fuel composition	Low	Herbs and deciduous shrubs
Fine woody debris continuity (<=7cm) (% cover)	Low	Scattered, <10% coverage
Large woody debris Continuity (>=7cm) (% cover)	Low-Med	10-25% coverage
Live conifer canopy closure (%)	Very low	< 20% crown closure
Live deciduous canopy closure (%)	Very low	>80% crown closure
Live and dead conifer crown height (m)	Very low	5m+ or <20% conifer crown closure
Live and dead suppressed and understory conifer (stems/ha)	Very Low	0-500 stems/ha



**Photo 7. View of stand classified as M2/D1.**



**Photo 8. M2/D1 stand bordered by coniferous stand.**

---

## Appendix 3      Generic Description of Coastal Fuel Types

The current Canadian Forest Fire Behavior Prediction (FBP) System does not include coastal forests in their fuel type descriptions. These fuel types reflect stand conditions that were modeled to predict fire behavior potential. On the coast the fuel type that most closely represents forest stand structure and conditions has been used. The following fuel types are the most common interpretations used on the coast.

### C5 – Uniform Second Growth Conifer Stand – Moderate Risk

This fuel type is characterized by mature second growth stands dominated by Western Red Cedar (*Thuja plicata*) and Western Hemlock (*Tsuga heterophylla*). There can be small component of dominant Douglas-fir (*Pseudotsuga menziesii*) in the overstory. This fuel type is moderately dense (500-1000 stems per ha) and has a high crown base height of 10 to 15m. The understory is of moderate density, usually consisting of Western Redcedar and Western Hemlock regeneration. The ground fuel component consists of moderately dense fine fuel layer (>7cm) and a low percent cover of large woody debris (>7cm). It takes a large amount of energy to create a crown fire.

#### C5 Fuel Type



### C3 – Multistoried Second Growth Conifer Stand – High Risk

This fuel type is characterized by a uniform mature second growth conifer dominated stand. This stand consists of mature Western Red Cedar (*Thuja plicata*) and Western Hemlock (*Tsuga heterophylla*). There is also a minor component of dominant Douglas-fir (*Pseudotsuga menziesii*) in the stand. Compared to a C5 stand, a C3 stand is more densely stocked (1000-2000 stems per ha) and there is a lower crown base height (usually 4-8 m). The understory is more densely stocked with Western Redcedar and Western Hemlock. The ground fuel component consists of moderately dense fine fuel layer (>7cm) and a low percent cover of large woody debris (>7cm). A crown fire in a C3 stand takes less energy to create than a C5 stand.



---

### C3 Fuel Type



### M2 - Mature Stands Consisting of a mix of Conifer and Deciduous Trees – Low to Moderate Risk

This fuel type consists of a mixed conifer and deciduous tree type. This stand is not uniform in structure and is composed of a wide variety of species. These may include and not limited to:

Western Red Cedar (*Thuja plicata*), Western Hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), Red Alder (*Alnus rubra*), Bigleaf Maple (*Acer macrophyllum*), and Paper Birch (*Betula papyrifera*).

These stands usually consist of less than a 70% of conifer trees, reducing the wildfire risk. There is usually a low crown height (5m) and a high percentage of ladder fuels. There is a high percent cover of suppressed trees, but they are usually composed of deciduous species.

### M2 Fuel Type

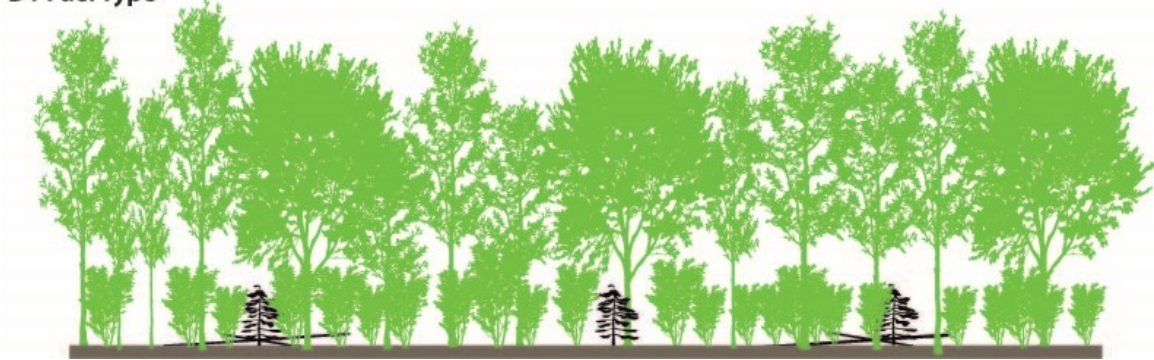


### D1 - Deciduous Dominated Stands – Low Risk

This fuel type is dominated by deciduous trees consisting mostly of Red Alder (*Alnus rubra*), Bigleaf Maple (*Acer macrophyllum*), and Paper Birch (*Betula papyrifera*). D1 stand structure is not uniform with a wide variety of tree ages. There is a well-developed shrub layer, but is mostly composed of low-flammable species. Crown fires are not expected because of the deciduous fuel type. D1 stands on the coast can be used as fuel buffers as they present a low wildfire risk.

---

#### D1 Fuel Type



#### C4 - Uniform Densely Stocked Conifer Stand

This fuel type is rare within the lower mainland as it is mostly defined by densely stocked Lodgepole pine (*Pinus contorta*). This fuel type can be found more towards Squamish and Pemberton. Some small densely stocked Western Red Cedar (*Thuja plicata*), Western Hemlock (*Tsuga heterophylla*), and Sitka Spruce (*Picea sitchensis*) can be found in the Lower Mainland, but these stands are often isolated and small. Stands are densely stocked, (approximately 10,000-30,000 stems/ha) with a large quantity of fine and large woody debris. These stands are characterized as having vertical and horizontal fuel continuity. The shrub community in this stand is of very low density.

---

## Appendix 4      Resources and Links

- Agee, James K. 1993. Fire Ecology of the Pacific Northwest. Island Press. Covelo, California.
- Agee, J.K. 1996. The influence of forest structure on fire behavior. Presented at the 17th Annual Forest Vegetation Management Conference, Redding CA, January 16-18, 1996.
- Agee, J.K., G. Bahro, M.A Finney, P.N. Omin, D.B. Sapsis, C.N. Skinner, J.W. van Wagtendonk, and C.P. Weatherspoon. 2000. The use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management 127 (2000):55-66
- Agee, J.K. and M.H. Huff. 1986. Structure and process goals for vegetation in wilderness areas. Pages 17-25 in Lucas, R.C. compiler. Proceedings-National wilderness research conference: current research, 23-26 July 1985, Fort Collins, Colorado, USA. USDA Forest Service General Technical Report INT-212.
- Arno, S.F., 1980. Forest fire history in the northern Rockies. Journal of Forestry. 78: 460-465.
- Brown, R. 2000. Thinning, Fire and Forest Restoration: A science-based approach for national forests in the interior northwest. for Defenders of Wildlife. West Linn, Oregon.
- Graham, Russel T., Dr. Sarah McCaffrey, and Dr. Theresa B. Jain. 2004. Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity. U.S. Department of Agriculture Forest Service. RMRS-GTR-120.
- Graham, Russel T., A. Harvey, T.B. Jain and J.R. Tonn. 1999. The Effects of Thinning and Similar Stand Treatments on Fire Behavior in Western Forests. USDA Forest Service General Technical Report PNW-GTR-463.
- Ingalsbee, Timothy. 2004. American Lands proposal for fuels reduction and restoration.
- URL: <http://www.kettlerange.org/salvagelogging/ingalsbee-restoration.html>.
- Meidinger, D. Pojar, J.1991. Ecosystems of British Columbia. BC Ministry of Forests, Research Branch. Victoria, BC.
- URL: <http://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/SRseries.htm>
- Morrow, B., K. Johnston and J. Davies. 2013. Wildland Urban Interface Wildfire Threat Assessments in BC. Online <http://fness.bc.ca/wp-content/uploads/2015/09/swpi-WUI-WTA-Guide-2012-Update.pdf>
- National Fire Protection Association. 2013. NFPA 1141. Standard for Fire Protection Infrastructure for Land Developments in Suburban and Rural Areas.
- National Fire Protection Association. 2013. NFPA 1144. Standard for Reducing Structure Ignition Hazards from Wildland Fire.
- National Fire Protection Association. 2013. NFPA 1141. Standard for Fire Protection Infrastructure for Land Developments in Suburban and Rural Areas.
- Pacific Northwest Research Station. Science Update. Issue 7. June 2004. Retrieved Nov. 2004.
- URL: <http://www.fs.fed.us/pnw/pubs/science-update-7.pdf>
- Partners in Protection and Province of British Columbia. 2016. FireSmart Homeowner's Manual: FireSmart Begins at Home. Online <http://bcwildfire.ca/prevention/docs/homeowner-firesmart.pdf>



## Appendix 5      Description of Terminology

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

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

## Appendix 6 Fire Resistant Plants for Landscaping

Fire resistant and drought tolerant ground covers	Fire resistant and drought tolerant perennials
<ul style="list-style-type: none"> <li>• Achillea species (when mowed, turf alternative)</li> <li>• Ajuga reptans</li> <li>• Arctostaphylos uva-ursi</li> <li>• Autennaria rosea</li> <li>• Aubrieta detoidea</li> <li>• Ceanothus prostratus</li> <li>• Cerastium tomentosum</li> <li>• Dianthus species</li> <li>• Delosperma nubigenum and the less cold hardy cooperi</li> <li>• Fragaria species (turf alternative)</li> <li>• Phlox subulata</li> <li>• Sedums</li> <li>• Sempervivums</li> <li>• Thymus praecox turf alternative)</li> <li>• Veronica species</li> </ul>	<ul style="list-style-type: none"> <li>• Achillea species</li> <li>• Armeria maritima</li> <li>• Aquilegia</li> <li>• Aurinia saxatilis</li> <li>• Coreopsis</li> <li>• Echinacea purpurea</li> <li>• Epilebium angustifolium</li> <li>• Gaillardia varieties</li> <li>• Geranium species</li> <li>• Helianthemum</li> <li>• Hemerocallis</li> <li>• Kniphofia uvaria</li> <li>• Iris - bearded</li> <li>• Lavendula</li> <li>• Lupinus</li> <li>• Penstemon</li> <li>• Oenothera species</li> <li>• Papaver orientale</li> <li>• Perovskia atriplicifolia</li> <li>• Ratibida columnifera</li> <li>• Salvia species</li> <li>• Stachys byzantina</li> </ul>
Fire resistant and drought tolerant shrubs:	Fire resistant and drought tolerant trees:
<ul style="list-style-type: none"> <li>• Amelanchier alnifolia</li> <li>• Caryopteris x clandonensis</li> <li>• Ceanothus</li> <li>• Cistus</li> <li>• Cotoneaster species</li> <li>• Euonymus alatus</li> <li>• Fremontodendron californicum</li> <li>• Fuchsia (dieback)</li> <li>• Gaultheria shallon</li> <li>• Holodiscus discolor</li> <li>• Lagerstroemia indica</li> <li>• Mahonia</li> <li>• Pachystima myrsinites</li> <li>• Philadelphus speciosus</li> <li>• Paxistima myrthifolia</li> <li>• Pyracantha species</li> <li>• Ribes species</li> <li>• Rhus species</li> <li>• Rosa species and hardy own root shrub</li> <li>• Spiraea bumalda</li> <li>• Symphoricarpos albus</li> <li>• Syringa vulgaris, spiroduglasii</li> <li>• Yucca species</li> </ul>	<ul style="list-style-type: none"> <li>• Acer circinatum, glabrum, macrophyllum, plantanoides, rubrum</li> <li>• Aesculus hippocastanum</li> <li>• Alnus rubra tenuifolia</li> <li>• Betula species</li> <li>• Catalpa speciosa</li> <li>• Celtis occidentalis</li> <li>• Cercis canadensis</li> <li>• Cornus florida, stolonifera, nuttallii</li> <li>• Crataegus species</li> <li>• Fagus species</li> <li>• Fraxinus species</li> <li>• Ginkgo biloba</li> <li>• Gleditsia triacanthos</li> <li>• Gymnocladus dioica</li> <li>• Juglans</li> <li>• Liquidambar styraciflua</li> <li>• Malus species</li> <li>• Populus species</li> <li>• Prunus cherry</li> <li>• Quercus agrifolia, rubra, palustris, garryana</li> <li>• Robinia pseudoacacia</li> <li>• Salix species</li> <li>• Sorbus aucuparia</li> </ul>

Source: Master Gardeners Association of BC. <http://mgabc.org/node/1514>.

---

## Limitations

1. Except as expressly set out in this report and in these Assumptions and Limiting Conditions, Diamond Head Consulting Ltd. (“Diamond Head”) makes no guarantee, representation or warranty (express or implied) with regard to: this report; the findings, conclusions and recommendations contained herein; or the work referred to herein.
2. This report has been prepared, and the work undertaken in connection herewith has been conducted, by Diamond Head for the “Client” as stated in the report above. It is intended for the sole and exclusive use by the Client for the purpose(s) set out in this report. Any use of, reliance on or decisions made based on this report by any person other than the Client, or by the Client for any purpose other than the purpose(s) set out in this report, is the sole responsibility of, and at the sole risk of, such other person or the Client, as the case may be. Diamond Head accepts no liability or responsibility whatsoever for any losses, expenses, damages, fines, penalties or other harm (including without limitation financial or consequential effects on transactions or property values, and economic loss) that may be suffered or incurred by any person as a result of the use of or reliance on this report or the work referred to herein. The copying, distribution or publication of this report (except for the internal use of the Client) without the express written permission of Diamond Head (which consent may be withheld in Diamond Head’s sole discretion) is prohibited. Diamond Head retains ownership of this report and all documents related thereto both generally and as instruments of professional service.
3. The findings, conclusions and recommendations made in this report reflect Diamond Head’s best professional judgment in light of the information available at the time of preparation. This report has been prepared in a manner consistent with the level of care and skill normally exercised by arborists and foresters currently practicing under similar conditions in a similar geographic area and for specific application to the trees subject to this report as at the date of this report. Except as expressly stated in this report, the findings, conclusions and recommendations set out in this report are valid for the day on which the assessment leading to such findings, conclusions and recommendations was conducted. If generally accepted assessment techniques or prevailing professional standards and best practices change at a future date, modifications to the findings, conclusions, and recommendations in this report may be necessary. Diamond Head expressly excludes any duty to provide any such modification if generally accepted assessment techniques and prevailing professional standards and best practices change.
4. Conditions affecting the trees subject to this report (the “Conditions”, including without limitation structural defects, scars, decay, fungal fruiting bodies, evidence of insect attack, discoloured foliage, condition of root structures, the degree and direction



---

of lean, the general condition of the tree(s) and the surrounding site, and the proximity of property and people) other than those expressly addressed in this report may exist. Unless otherwise stated: information contained in this report covers only those Conditions and trees at the time of inspection; and the inspection is limited to visual examination of such Conditions and trees without dissection, excavation, probing or coring. While every effort has been made to ensure that the trees recommended for retention are both healthy and safe, no guarantees, representations or warranties are made (express or implied) that those trees will remain standing or will not fail. The Client acknowledges that it is both professionally and practically impossible to predict with absolute certainty the behaviour of any single tree, or groups of trees, in all given circumstances. Inevitably, a standing tree will always pose some risk. Most trees have the potential for failure and this risk can only be eliminated if the risk is removed. If Conditions change or if additional information becomes available at a future date, modifications to the findings, conclusions, and recommendations in this report may be necessary. Diamond Head expressly excludes any duty to provide any such modification of Conditions change or additional information becomes available.

5. Nothing in this report is intended to constitute or provide a legal opinion, and Diamond Head expressly disclaims any responsibility for matters legal in nature (including, without limitation, matters relating to title and ownership of real or personal property and matters relating to cultural and heritage values). Diamond Head makes no guarantee, representation or warranty (express or implied) as to the requirements of or compliance with applicable laws, rules, regulations, or policies established by federal, provincial, local government or First Nations bodies (collectively, "Government Bodies") or as to the availability of licenses, permits or authorizations of any Government Body. Revisions to any regulatory standards (including bylaws, policies, guidelines and any similar directions of a Government Bodies in effect from time to time) referred to in this report may be expected over time. As a result, modifications to the findings, conclusions and recommendations in this report may be necessary. Diamond Head expressly excludes any duty to provide any such modification if any such regulatory standard is revised.
6. Diamond Head shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.
7. In preparing this report, Diamond Head has relied in good faith on information provided by certain persons, Government Bodies, government registries and agents and representatives of each of the foregoing, and Diamond Head assumes that such information is true, correct and accurate in all material respects. Diamond Head accepts no responsibility for any deficiency, misinterpretations or fraudulent acts of or information provided by such persons, bodies, registries, agents and representatives.

- 
8. Sketches, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.
  9. Loss or alteration of any part of this report invalidates the entire report.