S5 ENVIRONMENTAL

BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

197-201 Teviot Road, Greenbank

Client: Hatia Dalby Pty Ltd
Reference: S525001_BHAMP_v1.1
Date: 18 June 2025

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Disclaimer

S5 Consulting Pty Ltd trading as S5 Environmental has developed this Bushfire Hazard and Bushfire Attack Level Assessment, taking into consideration the Australian Standard (AS3959-2018) - Construction of Buildings in Bushfire-prone Areas, the State Planning Policy and relevant local authority policies and guidelines. However, there can be no guarantee that following the recommendations made in this assessment can guarantee safety of property and human life.

Fire is an element of nature, and as such fire events (small or large) can have disastrous outcomes even with the best planning in place. The authors of this report and S5 Consulting Pty Ltd accept no responsibility for any harm to property or human life caused by fire or any other cause to persons utilising property or structures.

Abbreviations

AS 3959-2018	*Australian Standard 3959-2018 Construction of Buildings in Bushfire-prone Areas*
BAL	Bushfire Attack Level
BCA	Building Code of Australia
BMP	Bushfire Management Plan
BMZ	Bushfire Management Zone
BPA	Bushfire Prone Area
BRC	Bushfire Resilient Communities (The State of Queensland 2019b)
CFA	Country Fire Authority
EPZ	Environmental Protection Zone
FFDI	Forest Fire Danger Index
ha	Hectares
LCC	Logan City Council
PDA	Priority Development Area
QFD	Queensland Fire Department
RE	Regional Ecosystem
RFS	Rural Fire Service
SEQ	South East Queensland
SPP	*State Planning Policy, 2017*
VHC	Vegetation Hazard Class

1.0 INTRODUCTION

S5 Environmental was commissioned by Hatia Dalby Pty Ltd, to undertake a Bushfire Hazard Assessment and Management Plan (BHAMP) as part of supporting documentation for a proposed Development Application for a Reconfiguration a Lot (1 into 43 plus Environmental Protection Zone (EPZ) and a bio basin) at 197-201 Teviot Road, Greenbank, refer to **Table 1**.

The aim of this BHAMP is to undertake a site-specific bushfire hazard assessment, determine any set back required between the proposed development and hazardous vegetation and prepare a Bushfire Management Plan to ensure the proposed development is not exposed to an unacceptable bushfire risk and can comply with the relevant legislative bushfire requirements.

Table 1. Site Description

Street Address	197-201 Teviot Road, Greenbank 4124	**Lot on Plan**	Lot 16 on SP343224
LGA/State	Logan City Council (LCC) Economic Development Queensland (EDQ)	**Area**	19,980 m^2
Zone	Priority Development	**Priority Development Area**	Greater Flagstone
Current State	Lot 16 on SP343224, herein referred to as the 'subject site' is currently zoned Priority Development Area (PDA) within the Greater Flagstone PDA. The subject site currently contains a single, unoccupied dwelling and associated infrastructure including multiple sheds, within the eastern extent of the property, surrounded by previously landscaped gardens. Canopy with maintained understorey is present to the east of the dwelling through to a dam which is located centrally within the lot. Unmaintained vegetation is present through the western extent of the lot. A waterway which presents as an ephemeral, unformed, overland flow path is present through the western extent, entering from the adjacent property to the north-west and exiting to Leanne Court in the south-western corner. Entry into the site is via driveway in the north-eastern corner off Teviot Road. The site is bounded by Teviot Road to the east, Leanne Court to the south and residential lots to the west and north. The surrounding area is undergoing urban densification with land to the east containing newly constructed residential subdivisions and large, cleared areas for further development. Teviot Road is undergoing major roadworks including widening from 2 to 4 lanes and the Leanne Court and Teviot Road intersection is be upgraded to a signalised intersection. The surrounding large, residential lots are within a PDA, with variable densities of vegetation from dense remnant vegetation through to largely cleared lots. A lot to the north has an approved PDA application for a subdivision and has been cleared. A lot to the south-east on the corner of Teviot Road and Leanne Court has an approved PDA application for a masterplan including		

	an approved commercial development and vegetation clearing. The lot further to the south contains a childcare centre which has approval for a small extension to its current footprint. Refer to **Figure 1**.
Proposed Development	A 1 into 43 lot residential subdivision is proposed for the subject site across two stages, an additional lot in the western extent will be preserved as an EPZ with a bio basin within its north-eastern corner. Vegetation within the western extent of the site will be retained. A new road will enter off Leanne Court, east of the balance lot, providing direct access to all lots with an easement to Teviot Road in the eastern extent between lots 37 to 41. The new road has been designed to link in two locations along the northern boundary, from the subject site to a future development on the lot to the north. See **Figure 2** for the proposed development footprint.
Potentially Hazardous Vegetation	Post development, potentially hazardous vegetation is situated to the north, east and south of the proposed development. This potentially hazardous vegetation was determined to reflect the Regional Ecosystems (RE) 12.9-10.2 and 12.9-10.12. These Regional Eecosystems are described as: **RE 12.9-10.2:** *Corymbia citriodora* subsp. *variegata* +/- *Eucalyptus crebra* open forest on sedimentary rocks **Equivalent to VHC 10.1:** *Spotted gum dominated open forests;* and **RE 12.9-10.12:** Mixed woodland usually containing *Corymbia intermedia*, *Angophora leiocarpa* and at least the presence of *Eucalyptus seeana* on sedimentary rocks. **Equivalent to VHC 9.2:** *Moist to dry eucalypt woodland on coastal lowlands and ranges.*

Figure 1. Site Aerial (source: Nearmap, date: 07/04/2025)

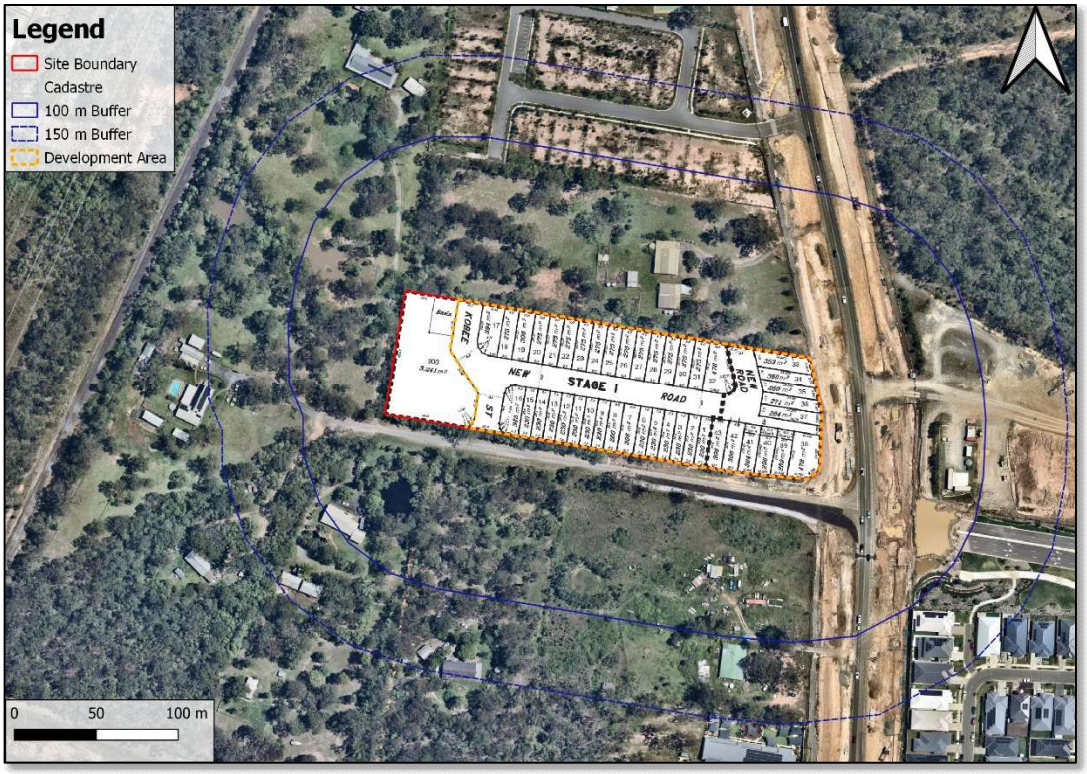

Figure 2. Proposed Site Plan (Source: East Coast Surveys, Ref: 10369, issue: A-1-E, date: June 2025)

2.0 STATUTORY REQUIREMENTS

2.1 Development Applications in Bushfire Prone Areas

Bushfire Prone Areas are identified at both the State and Local Government Level. The State Planning Policy (SPP) Bushfire Prone Area map was developed by CSIRO to map areas with Very High, High and Medium Potential Bushfire Intensity. The SPP also maps a 100 m Potential Impact Buffer. The site is located within a Priority Development Area and as such will be assessed under the SPP: Safety and Resilience to Hazards, including Natural Hazards, Risk and Resilience – Bushfire Prone Areas, noting that the *Logan Planning Scheme 2015* has integrated all aspects of the SPP. The SPP Bushfire Prone Areas Overlay map, was consulted to determine the preliminary bushfire hazard ratings of the site and locality (within 150 m).

The SPP maps the western extent of the subject site extending out to the north, a patch to the south, a small patch to the south-east and a patch to the north-east, as containing medium potential bushfire intensity, with the potential impact buffer across much of the balance of the subject site and assessment area (150 m buffer off the proposed development area) including the location of the proposed development footprint. The patches of medium potential bushfire intensity mapped to the north and south-east of the subject site are mapped over areas of recent urban development and a large area recently cleared for further urban development, with this vegetation no longer present, refer to **Figure 3**.

Due to potentially hazardous vegetation being mapped within and around the proposed development site, further investigation of the site-specific bushfire hazard characteristics has been undertaken to determine the actual hazard of the site.

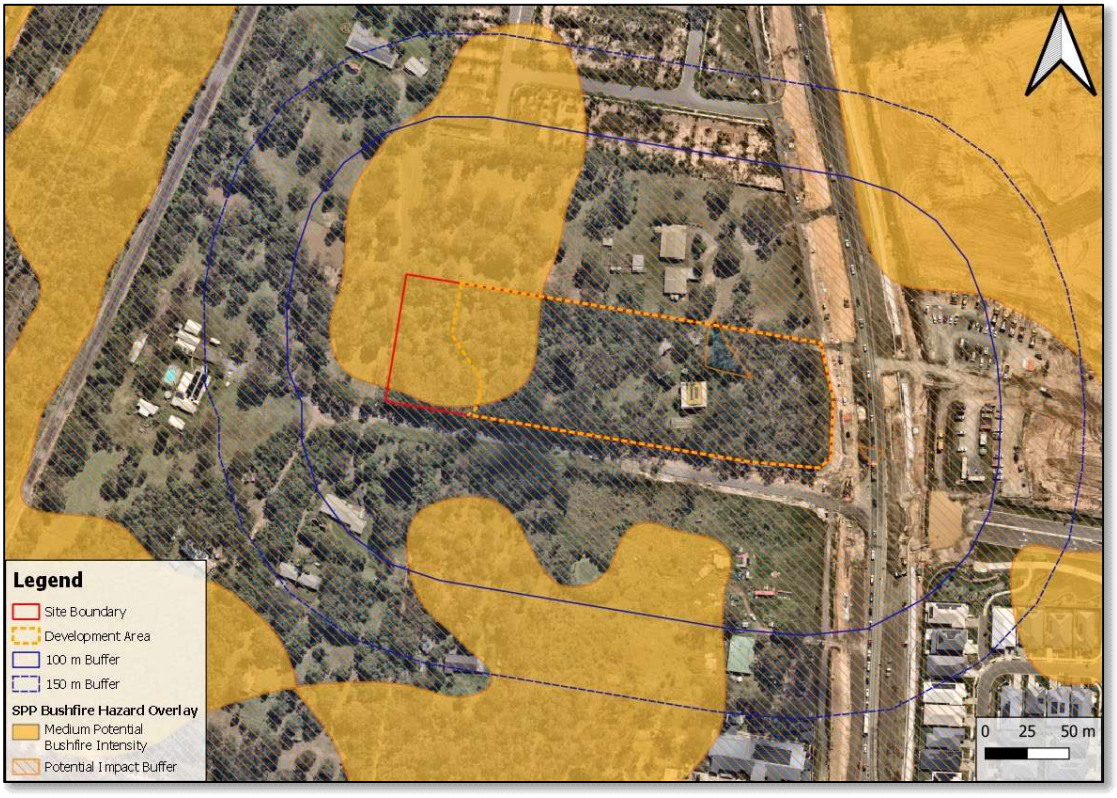

Figure 3. SPP Bushfire Prone Areas Mapping within and in Proximity to the Site

3.0 METHODOLOGY

3.1 Bushfire Hazard Assessment

The SPP Potential Bushfire Intensity classifications are based on the *New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland* (Leonard *et al.* 2014). This State-wide mapping methodology was developed to identify Bushfire Prone Areas in support of bushfire hazard provisions of Queensland's State Planning Policy. The new methodology scales bushfire hazard based on the Potential Fire-line Intensity (PFLI) of a severe bushfire and can be used to predict the radiation profile of areas located adjacent to potentially hazardous vegetation and an associated Potential Impact Buffer.

Accordingly, the classification of an area's PFLI is calculated as a combination of the following three metrics, using the below equation (Leonard *et al.* 2014):

- Total fuel load (W);
- The McArthur Forest Fire Danger Index (FFDI), and
- Maximum Landscape Slope (θ in °).

$$FI = 0.62\, W^2\, FFDI \exp(0.069\, \theta)$$

For the purposes of the bushfire hazard assessment, S5 Environmental have utilised data from the Queensland Fire Department (QFD) published to the Queensland Government's Queensland Spatial Catalogue (QSpatial) for fuel load and FFDI. PFLI is delineated into a number of hazard categories shown in **Table 2**, and each patch of hazardous vegetation can be classed as Very High, High, Medium, Grassland or low hazard according to the PFLI determined for that specific patch. Any patch of hazardous vegetation classed as Very High, High or Medium is buffered by 100 m called the Potential Impact Buffer.

The Potential Impact Buffer is also considered a Bushfire Prone Area, along with hazardous vegetation with a PFLI of Very High, High or Medium. Any development within a bushfire prone area requires further assessment of radiant heat exposure, assessment against the relevant local planning scheme bushfire code and/or an assessment against the SPP assessment benchmarks for Natural hazards, risk and resilience relevant to bushfire and the development of a site-specific bushfire management plan to ensure that the proposed development is exposed to an acceptable or tolerable bushfire risk.

Table 2. Potential Bushfire Intensity Classification

Potential Bushfire Intensity Class	Potential Fire-line Intensity (PFLI)
Very high	>40,000kW/m
High	20,000 – 40,000kW/m
Medium	4,000 – 20,000kW/m
Low	<4,000kW/m

3.2 Modification of Potential Intensity of Small Patches and Corridors

Using the Bushfire Resilient Communities (BRC) methodology in Section 4.2.6 (The State of Queensland 2019b), small patches and narrow corridors of hazardous vegetation were removed from the map of hazardous vegetation within 150 m of the proposed development. This is as small, isolated and/or narrow patches of hazardous vegetation are not large enough to support a fully developed fire. As stated in the BRC methodology (The State of Queensland 2019b), small, isolated or narrow patches are unlikely to reach a potential fire-line intensity greater than 4,000 kW/m^2 and as such, are considered to be low hazard and not classed as a Bushfire Prone Area. The *SPP Technical Reference Guide - Bushfire Resilient Communities* (2019) summarises research by Leonard and Opie (2017) outlines four steps to filter out small patches and narrow corridors of continuous fuel (see **Table 3** below).

Table 3. Steps to Downgrade Bushfire Intensity

Step	Description
1	Remove small, isolated patches of **continuous** fuel (< 1 ha) surrounded completely by either discontinuous fuel or no fuel. These patches must be further than 100 m from other continuous fuel patches greater than 2 ha in area.
2	Downgrade intensity of small patches (0.5 to 3 ha) of **continuous** vegetation surrounded completely by either discontinuous or no fuel, which is more than 100 m from other **continuous** fuel patches greater than 2 ha in area.
3	Remove narrow corridors of **continuous** fuel (less than 75 m in width). The process erodes, then dilates by 25 m in width all **continuous** fuel patches in relation to **discontinuous** areas.
4	Remove small fragments (< 0.5 ha) of shrub-dominated or hazardous tree vegetation.

3.3 Radiant Heat Exposure Assessment

Radiant heat exposure for the proposed development was calculated using a Method 2 from the AS 3959-*2018 Construction of Buildings in Bushfire-prone Areas*. This Method 2 calculates the Bushfire Attack Level (BAL) for a proposed development by determining the minimum distance between hazardous vegetation and the development to achieve each BAL level. As BAL directly correlates to radiant heat exposure, this calculation reflects the level of bushfire risk for a proposed development (see **Table 4 and Figure 4**).

To determine the radiant heat exposure for the proposed development, the online Flamesol Minimum Distance Calculator (FPA, 2023) was used to determine the required setbacks to hazardous vegetation to achieve an acceptable radiant heat exposure for the proposed development.

Currently, S5 Environmental understand there is one set of inputs for a Method 2 calculation in accordance with AS3959-2018 or Bushfire Resilient Communities (BRC), which are accepted by LCC. Accordingly, the inputs to the BAL/radiant heat exposure assessment used for the purposes of this assessment are

summarised in **Table 5** below. This approach and set of inputs are generally more conservative and accurate as they incorporate higher fuel loads and flame temperature, as well as a site specific FFDI.

Table 4. BAL and Radiant Heat Exposure

BAL Score	Radiant Heat Exposure
Low	-
12.5	12.5 kW/m^2
19	19 kW/m^2
29	29 kW/m^2
40	40 kW/m^2
Flame zone (FZ)	> 40 kW/m^2

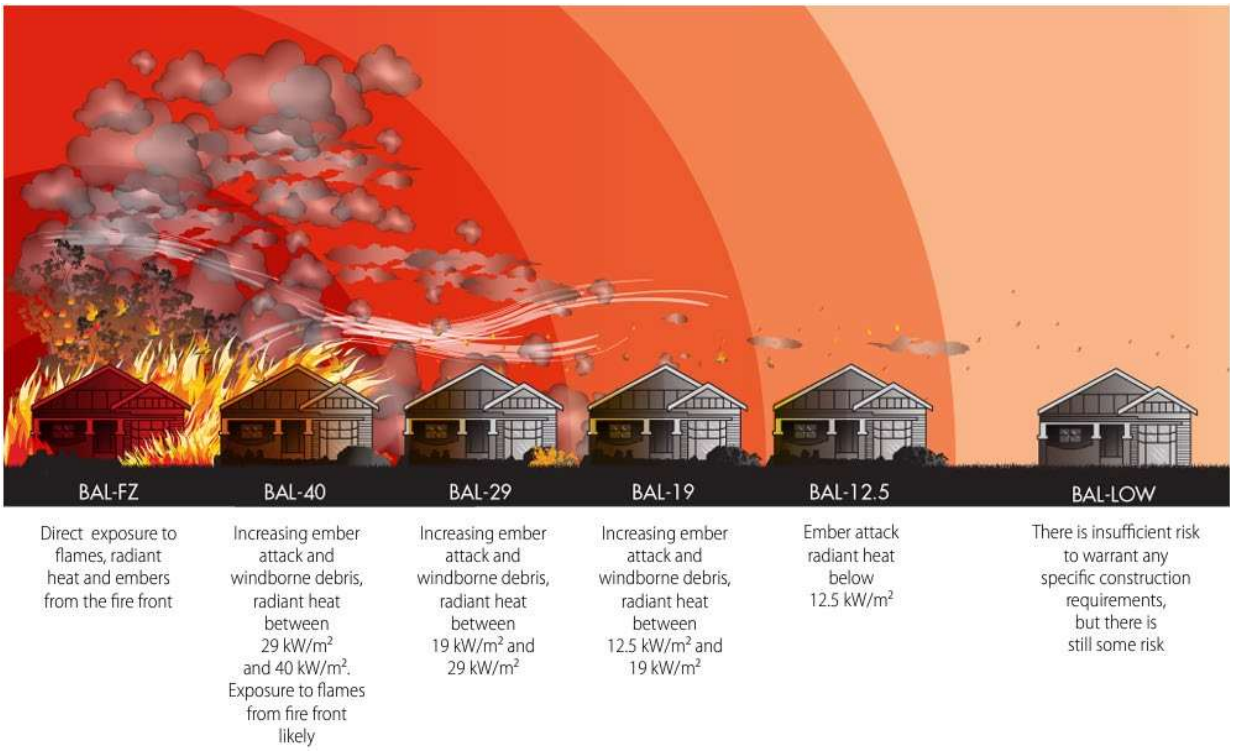

Figure 4. Bushfire Attack Levels (BAL) (Source: WAPC, 2024)

Table 5. Parameter inputs for Method 2 from AS3959-2018

Parameter	AS Method 2
Surface fuel load (t/ha)	Surface fuel load for identified VHC (surface + near surface)
Overall fuel load (t/ha)	Total fuel load for identified VHC
Flame temperature	1,200 K
FDI/FFDI	From BRC MapViewer/QSpatial
Standard inputs	Bushfire Resilient Communities (QG 2019b)
Effective slope	Measured as the slope under the hazardous vegetation. A minimum effective slope of 1 ° is utilised if vegetation slopes uphill or is at the same elevation (flat).
Site slope	Measured as the slope between the hazardous vegetation and the site. A minimum site slope of 1 ° is utilised if vegetation slopes uphill or is at the same elevation (flat).
Flame Width	Flame width is assumed to be 100 m (AS 3959-2018) unless a short-fire run.

3.4 Short Fire Run

Small or narrow patches of hazardous vegetation are unlikely to support a fully developed bushfire due to their limited size (see **Figure 5** for a schematic representation of how fire moves across a landscape, demonstrating this). As such, the flame width and height in these small patches will not reach the standard inputs for the Method 2 from AS3959-2018 as these standard inputs are based on a fully developed bushfire. In these cases, a short fire run calculation can be used. The short fire run methodology can only be applied when there is a maximum fire run of 150 m as measured on the effective slope. In these cases where a short fire run can be justified, and thus a reduced flame width and height for a Method 2 calculation, the method from the *Short Fire Run: Methodology for Assessing Bush Fire Risk for Low Risk Vegetation* (NSW Rural Fire Service, 2019) is adopted.

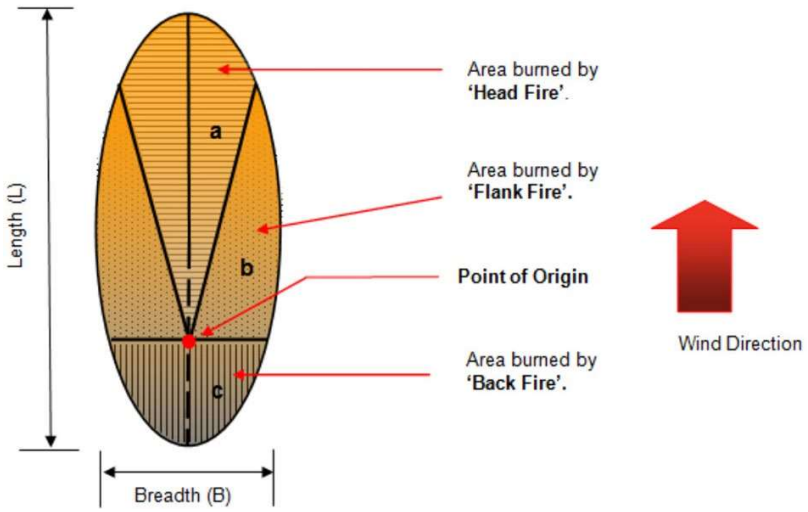

Figure 5. Schematic Diagram of Simple Elliptical Fire Growth Model (Van Wagner 1969) from NSW Rural Fire Surface (2019)

The Short Flame Run formula utilised to calculate the flame width is as follows:

$$\frac{Length\ of\ Vegetation\ along\ effective\ slope\ (xx\ m)}{1.0 + 0.0012\ (Wind\ speed\ (30km/hr)^{2.154}} = Flame\ Width\ (xx\ m)$$

4.0 BUSHFIRE HAZARD ASSESSMENT

4.1 Potential Fire-line Intensity Assessment

In accordance with *A New Methodology for State-wide mapping of bushfire prone areas in Queensland* (Leonard *et al.* 2014), fuel loads derived from ground-truthed Vegetation Hazard Classes (VHCs), effective slope and FFDI were used to calculate the PFLI of hazardous vegetation within 150 m of the proposed development and hazardous into the relevant PFLI category. The following sections discuss how these parameters were determined to calculate PFLI for hazardous vegetation in proximity to the proposed development.

4.1.1 Vegetation Hazard Class Mapping

In accordance with the *New Methodology for State-wide Mapping of Bushfire Prone Areas in Queensland* (Leonard *et al.* 2014), potential fuel loads are assigned to vegetation categories (Vegetation Hazard Classes – VHCs) formed by amalgamating land use and vegetation types with a moderately consistent fuel load and structure.

The potential fuel load assigned to each VHC is generally representative of the higher fuel load expected for the typical vegetation types, landscape and site conditions within each VHC and approximates the ***80th percentile (%) fuel load of the "long unburnt condition"*** for the class (generally greater than 10 years without burning).

Using the QFD BRC MapViewer, numerous VHCs were mapped within and adjacent to the subject site, an extract is shown below in **Figure 6.**

Figure 6. Extract of Vegetation Hazard Classes from the BRC MapViewer

4.1.2 Vegetation Hazard Class Verification

To ground-truth the State Government VHCs mapped within and adjacent to the subject site, S5 Environmental's Ecologists conducted a site visit on the 25th March 2025 and subsequently undertook a Reliability Assessment in accordance with BRC comparing available bushfire and vegetation mapping with on-ground conditions. The reliability assessment incorporated a comprehensive review of available aerial mapping of the site, including a 150 m buffered area, external to the proposed development.

The subject site has been state mapped with VHC 10.1 '*spotted gum dominated open forests*' in the western extent and along the eastern boundary, VHC 43.6 '*waterbodies or very low vegetation cover*' over the dam within the centre of the site and VHC 41.4 '*discontinuous low grass or tree cover*' making up the balance and extending out along Leanne Court to the south and along Teviot Road to the east. The retained vegetation within the western extent has been modified to VHC 9.2 '*moist to dry eucalypt woodland on coastal lowlands and ranges*' to reflect the ground-truthed Regional Ecosystem of 12.9-10.12, this area is likely to undergo a level of rehabilitation reflecting the ground-truthed RE. The bio basin is located in this area and although these are usually a low fuel area, often consisting of turf, for the purposes of the assessment it has been conservatively assessed as VHC 9.2 to allow for flexibility of layout.

The adjacent lot to the north continues the VHC 10.1 mapping through its western extent, with this also extending out further to the north and through the west and south-west of the assessment area, with small patches to the south of the subject site. On the adjacent lots to the north and west, this has been largely modified to VHC 41.4 to reflect the discontinuous nature of the remaining vegetation through the area which presents primarily as mown or maintained understorey with scattered canopy trees, a patch of VHC 10.1 has been retained adjacent to a dam on the lot to the west where the vegetation changes from scattered canopy to a denser patch of vegetation. Although the proposed development has allowed for road linkages to the adjacent lot to the north, with the expectation it will be developed similarly to the subject site, S5 environmental understand that this has yet to be submitted. In the northern extent of the assessment area, the mapped VHC 10.1 has been cleared for an approved subdivision. To the south, the large lot on the corner of Leanne Court and Teviot Road has an approved commercial centre facing Teviot Road and a larger master plan and vegetation clearing approval across the entirety of the site which has been subject to a level of clearing, it has been modified to VHC 42.6 to reflect the approved future development. To the south-west of the subject site the mapped VHCs have been retained but refined, to reflect the on-ground conditions and consist of VHC 10.1, 9.2, 41.4 and 43.6.

East of Teviot Road has been modified to VHC 42.6 from the mapped VHC 10.1, VHC 40.4 '*continuous low grass or tree cover*' and VH 41.4, reflecting the new residential developments constructed or currently under construction, with a patch of vegetation to the north-east recently cleared.

The VHC mapping has, therefore, been modified to reflect the on-ground conditions more accurately, and to reflect the post-development state of the subject site and locality (see **Figure 8**). As spatially indicated in **Figure 8**, the modified VHCs have been restricted to a 150 m buffer from the development area, as the more distant areas are not relevant for the purposes of this Bushfire Hazard Assessment.

Plates 1 to **6** below show the various areas and communities existing across the site and throughout the assessment area, corresponding to the locations indicated on **Figure 7**.

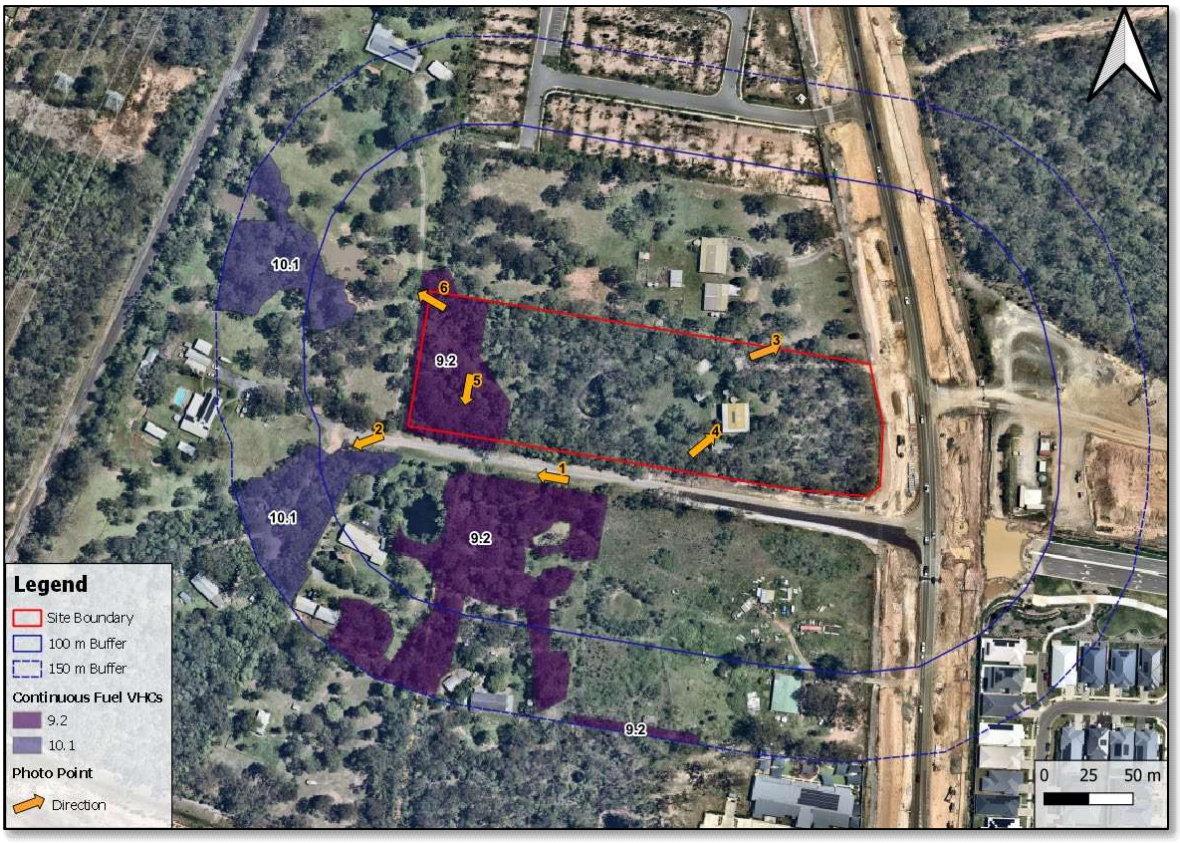

Figure 7. Assessment Area Photograph Locations.

Plate 1. West along Leanne Court, subject site to right (post-development VHC 42.6) and VHC 9.2 on left.

Plate 2. Leanne Court, VHC 10.1 (left) and 41.4 (right of picket fence).

Plate 3. View through to eastern portion of adjacent lot to the north VHC 41.4, an open, maintained grass area.

Plate 4. Existing dwelling, post-development VHC 42.6.

Plate 5. Vegetation through area to be retained VHC 9.2.

Plate 6. Adjacent lot to the west, VHC 41.4 with VHC 10.1 on the far side of the dam.

Figure 8. Ground-truthed and Post-development Vegetation Hazard Classes

4.1.3 Fuel Loads

Table 6 below, summarises the associated fuel loads of the final VHCs in relation to the proposed development.

Table 6. Summary of VHCs and their Associated Fuel Continuity and Loads

VHC	VHC Description	Fuel Continuity	Potential Fuel Load * (t/ha)
			Total
9.2	Moist to dry eucalypt woodland on coastal lowlands and ranges	Continuous	17.2
10.1	Spotted gum comminated open forests	Continuous	20.8
41.4	Discontinuous low grass or tree cover	Discontinuous	3
42.6	Nil to very low vegetation cover	Discontinuous	2
43.6	Water bodies or very low vegetation cover	Discontinuous	0

*CSIRO A Methodology for State-wide Mapping of Annual Fuel Load and Bushfire Hazard in Queensland. Glenn Newnham, Kimberley Opie, Justin Leonard CSIRO Land and Water, 2017.

After ground-truthing the VHCs within the assessment area, continuous VHCs were rasterized to undergo the processing stages. Continuous and discontinuous fuel VHCs are defined as:

- **Continuous**: Vegetation and land uses which possess generally consistent fuel loads which can develop a full flame front; and
- **Discontinuous**: Vegetation and land uses which possess fuel loads which are incapable of supporting a full flame front.

The rasterization process extracts the attribute value of the polygon which occupies the centre of the raster pixel (a 25 m by 25 m cell) and uses it to populate the same cell within a raster layer. This will result in continuous VHCs within the assessment area being rasterized whilst discontinuous VHCs remain un-rasterized. Refer to **Figure 9**.

4.1.4 Modification of Potential Intensity of Small Patches and Corridors

Following the rasterization of the continuous VHCs as outlined above (i.e., VHCs 9.2), S5 Environmental have applied Step 3 and 4 in accordance with the downgrading stages outlined within both Leonard and Opie (2017) and BRC (2019). Step 3 is separated into two parts:

A. the shrinking of continuous fuel load pixels adjacent to discontinuous fuel loads (i.e., continuous fuel pixels adjacent to discontinuous fuel are removed); and
B. the dilation of residual continuous fuel patches by one pixel (i.e., residual continuous fuel pixels are dilated back out one pixel).

This will result in the removal of narrow corridors less than 75 m in width (< 3 pixels), as following the initial shrinking of continuous fuel pixels adjacent to discontinuous vegetation (Step 3A), no residual pixels associated with the narrow corridor will remain and dilation cannot occur (Step 3B). Refer to **Figure 9** and **Figure 10**.

Following the implementation of the processing stages, A number of narrow corridors associated with the VHC 9.2 and 10.1 to the west, south and southwest, have been downgraded. A patch of VHC 9.2 to the south was identified as the potentially hazardous vegetation in the investigation area. The pixelated form of the finalised continuous vegetation is to be utilised within the PFLI calculations in **Section 4.1.7** and was smoothed to reflect ground-truthed conditions. Refer to **Figure 11** and **Figure 12**.

Figure 9. Shrinking of patches of continuous fuel at the interface with non-continuous fuel

Figure 10. Step 3b – Dilation of residual continuous fuel patches

Figure 11. Finalised pixelated hazardous vegetation within the assessment area (nearmap 8/12/24).

Figure 12. Smoothed hazardous vegetation to reflect ground-truthed conditions and vegetation

4.1.5 Slope Assessment

The slope of vegetated land over which a bushfire passes has a strong influence on both the intensity and rate of spread of the bushfire. From a bushfire hazard assessment perspective, the relevant slopes to consider are the slopes beneath areas of potentially hazardous vegetation, defined as "effective slope" in AS 3959-2018, that would be retained within or adjacent to the proposed development site. Also relevant, is whether the vegetated land is situated upslope or downslope of the proposed development. As fire travels faster upslope, there is a significant reduction in risk and fire-line intensity for sites that sit below the vegetation. The potentially hazardous vegetation to the south was determined to be slightly downslope of the proposed development with the slope underneath the hazardous vegetation to be slightly upslope. Several measurements were made for effective and site slope (the area between the development and the hazardous vegetation) for the BAL setback calculations, with the most conservative measurements adopted (refer **Figure 13** and **Appendix B**).

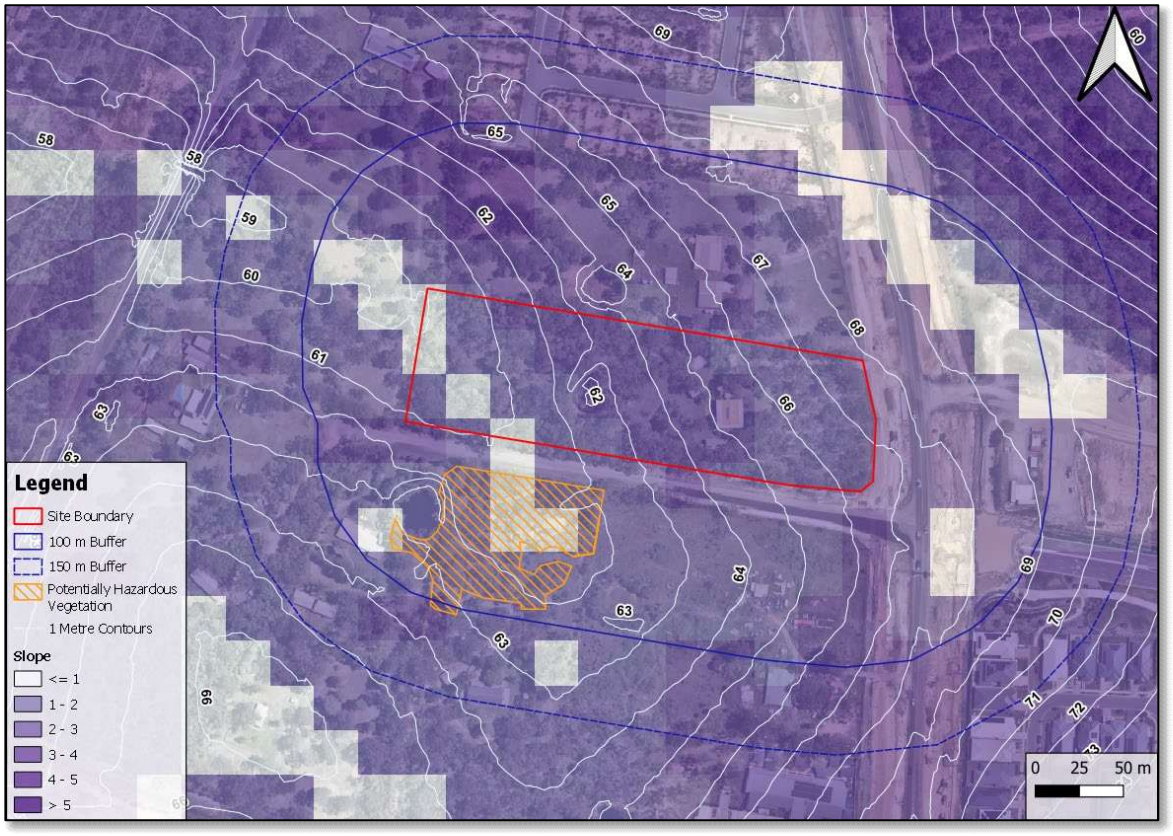

Figure 13. Slope within and in Proximity to the Proposed Development

4.1.6 Forest Fire Danger Index

In accordance with the Australian Standard (AS) 3959-2018, *Construction of Buildings in Bushfire Prone Areas*, the Fire Danger Index (FDI) indicates the chance of a fire starting, its intensity, rate of spread and the difficultly of its suppressions, according to several combinations of relative humidity, air temperature, wind speed as well as long- and short-term drought effects. The QFD BRC MapViewer indicates that the site-specific Forest Fire Danger Index (FFDI) for the subject site is split **55/56**. The higher value of **56** has been adopted for the setback calculations.

A final PFLI for patches of hazardous vegetation (determined in **Section 4.1**) has been calculated using the PFLI equation in **Section 3.1**. Based on this PFLI calculation, the potentially hazardous vegetation to the south of the proposed development was mapped to contain areas of medium potential bushfire intensity (i.e., 4,000 to 20,000 kW/m), associated with VHC 9.2. Refer to **Figure 14**.

4.2 Hazardous Vegetation

Vegetation mapped as VHC 9.2 to the south of the proposed development area was determined to be the only hazardous vegetation within the assessment area. As this vegetation is within 100 m of the proposed development area, the proposed residential subdivision is therefore within a Bushfire Prone Area. As such, a Bushfire Attack Level (BAL) assessment has been conducted to determine the radiant heat flux future Lots may be exposed to.

Figure 14. Potential Fire Line Intensity

5.0 BUSHFIRE ATTACK LEVEL ASSESSMENT

This BAL assessment has focused on the potential impact of a fire event in hazardous vegetation located within 100 m of the subject site. Hazardous vegetation in relation to the proposed development was determined to be the vegetation to the south of the development area (refer to **Figure 14**). A Method 2 assessment in accordance with AS3959-2018 utilising the online Flamesol Minimum Distance Calculator was undertaken to determine the required setbacks from hazardous vegetation to the south of the proposed development (see **Table 7** and **Figure 15** and **Figure 16**). Refer to **Appendix B** for inputs and outputs from the Flamesol Minimum Distance Calculator.

Table 7. Summary of Setbacks and Radiant Heat Exposure for the Proposed Development

Radiant Heat Exposure (kW/m^2)	BAL	Distance from Hazardous Vegetation
-	Low	100 m
12.5	12.5	30.7 m
19	19	21.6 m
29	29	14.7 m
40	40	10.8 m
> 40	FZ	< 10.8 m

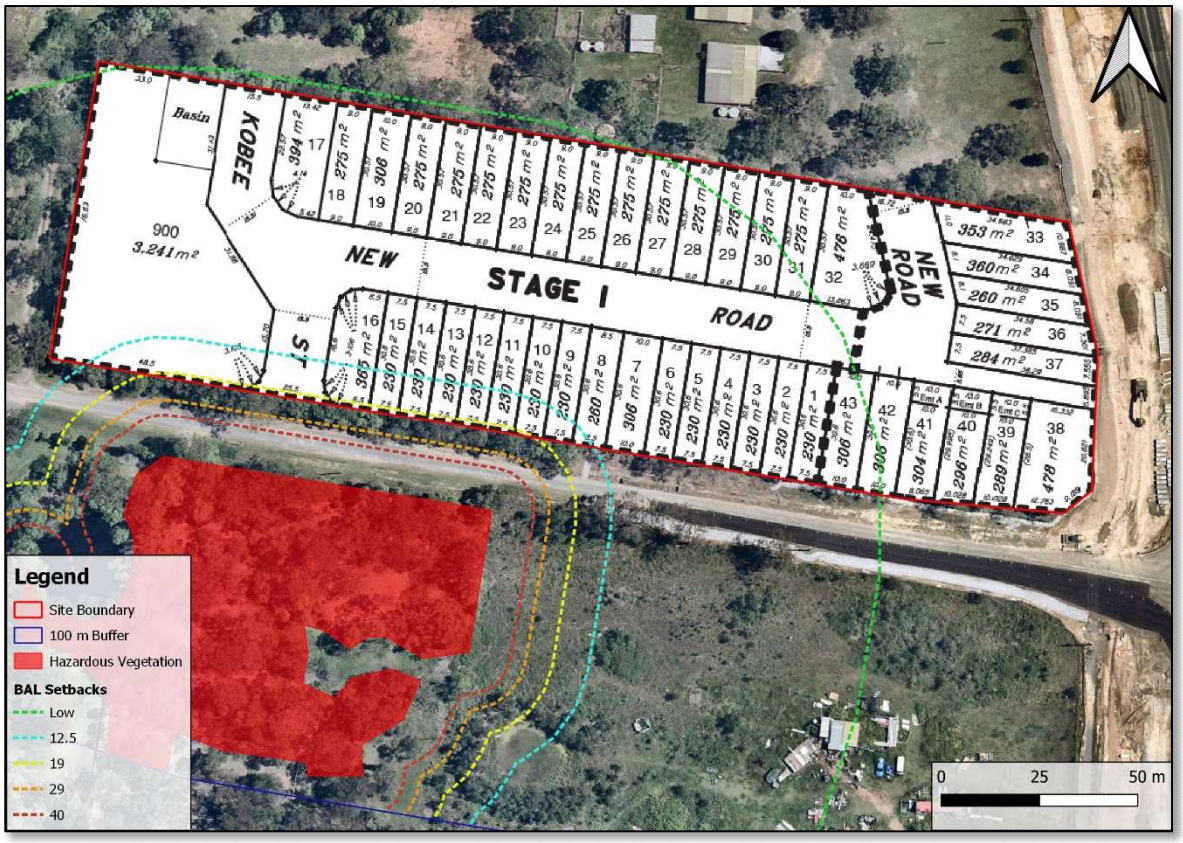

Figure 15. Radiant Heat Flux Setbacks

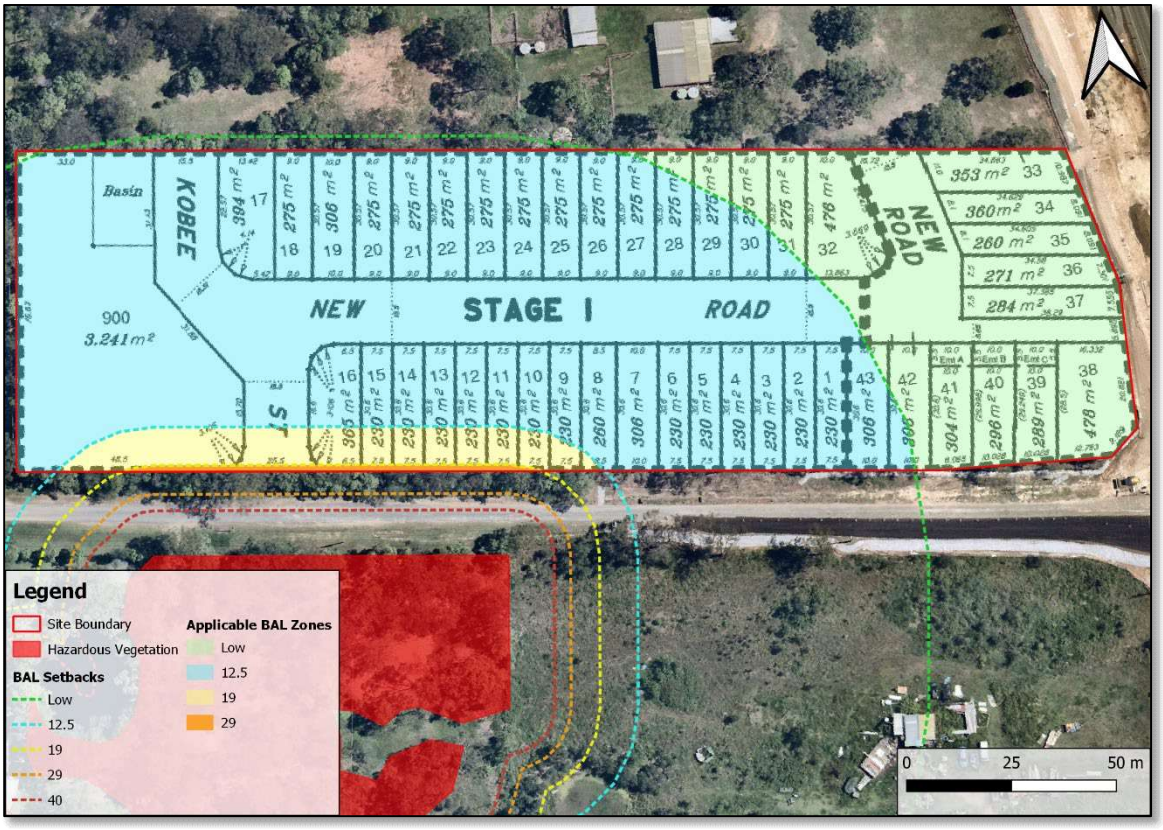

Figure 16. BAL as Applicable Over the Proposed Development

Based on the results of the radiant heat exposure assessment, for Stage 1 lots 10 to 16 achieve a maximum of BAL 29 however this extends only a maximum of approximately 1.6 m into the subject site from the southern boundary with these lots able to achieve a BAL 19 or 12.5 for a dwelling dependent on placement of the Building Location Envelope (BLE) within the lots. Lots 8 and 9 achieve a maximum of BAL 19, but again, may achieve BAL 12.5 depended on placement of the BLE within the lot. Lots 1 to 7 and 17 to 32 achieve BAL 12.5, with lot 32 able to accommodate a BLE outside of the bushfire prone area (BAL Low). For Stage 2, lots in the eastern extent of the site, Lots 42 and 43 achieve BAL 12.5, and the remaining lots 33 through to 41 are located outside of the bushfire prone area (BAL Low). The south-eastern boundary of the EPZ is exposed to a maximum of BAL 29 however, it is largely exposed to BAL 29, as is the bio basin. Refer to **Table 8**.

It is important to note that although a dwelling and associated structures (where a non-habitable structure has not achieved the appropriate setback from a habitable structure) may be straddle BAL contours, the highest BAL the structure is in, is the applicable BAL for construction purposes.

The BAL 29 contour lies outside of the subject site and as such a formalised Asset Protection Zone has not been prescribed for the site.

Table 8. BAL Requirements for Proposed Lots

Lot/s	Applicable BAL Score
33, 34, 35, 36, 37, 38, 39, 40, 41	**Low** *Outside of the Bushfire Prone Area.*
1, 2, 3, 4, 5, 6, 7 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32* 42, 43	**12.5** **With suitable siting of the BLE, Lot 32 may be located outside of the bushfire prone area (BAL Low).*
8 and 9	**19** *With suitable siting of the BLEs dwellings may potentially achieve BAL 12.5*
10, 11, 12, 13, 14, 15, 16	**29** *Dependent on placement of the BLE within each lot, a BAL of 19 or potentially, 12.5 may be achieved for these lots.*

As the development has been determined to be located within a bushfire prone area, a Bushfire Management Plan has been prepared and is presented in **Section 6.0**.

6.0 BUSHFIRE MANAGEMENT PLAN

This Bushfire Management Plan (BMP) identifies management measures that must be implemented to ensure that the risk of bushfire attack is reduced to an acceptable level. It is first important to understand the processes that influence bushfire behaviour (**Section 6.1**), and the sources of damage that threaten people, infrastructure and property (**Section 6.2**).

6.1 Bushfire Behaviour

Understanding bushfire behaviour is imperative when planning new development. There are three main factors which influence fire behaviour as follows:

1) Topography

Slope influences the speed and intensity of a fire. Fire is known to burn faster uphill as flames and radiant heat preheat the vegetation ahead of the fire, drying it out and making it increasingly flammable. As a rule of thumb, for every 10 degrees slope, fire doubles in speed. Refer to **Figure 17**, below.

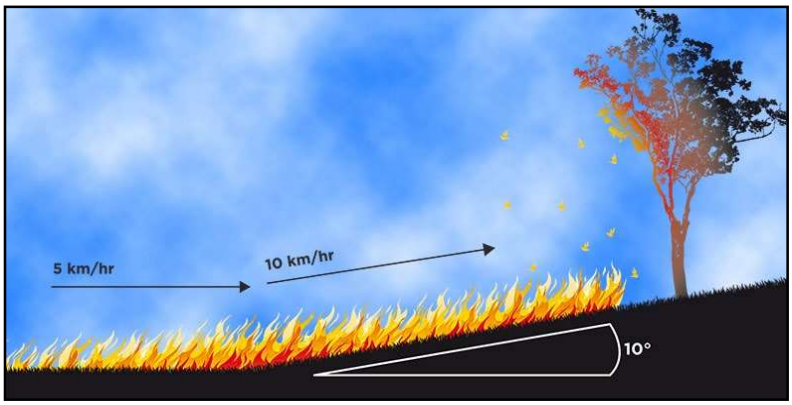

Figure 17. Effects of Topography on Bushfire (source: Country Fire Authority)

2) Weather Conditions

Bushfire weather conditions are fundamentally defined by temperature, humidity, wind, atmospheric conditions and past rainfall. For example, summer weather conditions increase the flammability of vegetation. Wind influences the speed and direction in which fire travels, fire intensity and possibility of spot fires from burning debris. A measure of weather conditions is the Forest Fire Danger Index (FFDI) and Grassland Fire Danger Index (GFDI). These measures are useful in determining the fire danger rating (refer to **Fire Danger Rating** in **Figure 18**).

3) Vegetation

Vegetation is the source of fuel for a bushfire. The amount of fuel surrounding a building can directly impact a buildings survival. Vegetation management, landscaping for bushfire and breaking the continuity of vegetation can limit the spread of fire.

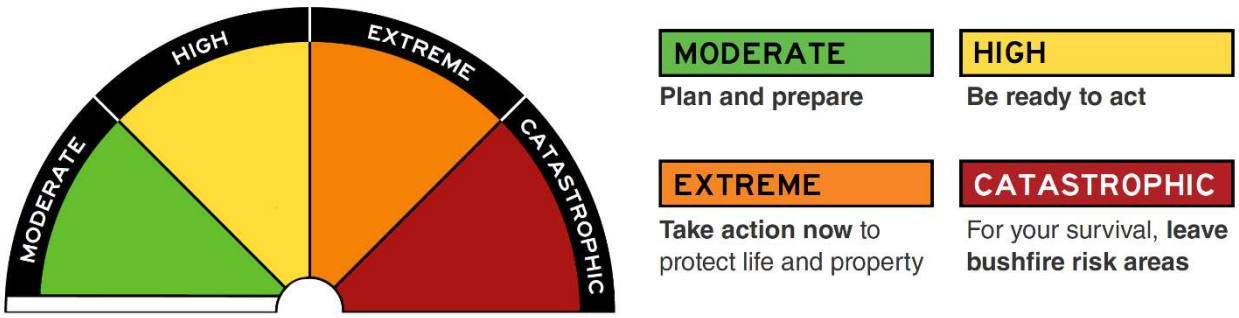

Figure 18. Australian Fire Danger Rating System (source: AFAC, 2025)

6.2 Bushfire Damage Sources

The Country Fire Authority (2012) states, "*Bushfires can vary in intensity and scale across the landscape*". As the past bushfire events throughout Australia have illustrated, bushfires can be devastating and lead to long-running fires which are difficult to suppress. Building survival is influenced by many interacting factors. The four main ways buildings are destroyed during a bushfire include:

- Ember attack;
- Radiant heat;
- Direct flame contact; and
- Fire-driven wind.

Ember Attack

Research indicates that the most common way buildings catch on fire is through ember attack (80% of house loss). Ember attack occurs when small burning twigs, bark, leaf are carried by wind and land in and around a building. Embers can ignite flammable plants, leaf litter, fences, outdoor furniture and sheds (refer to **Figure 19**, below). Ember attack is addressed within the AS 3959-2018 through Construction Standard requirements.

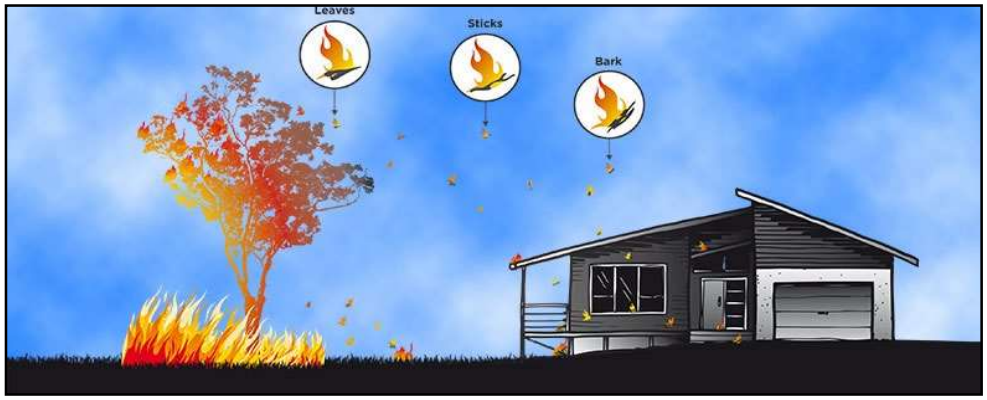

Figure 19. Ember Attack (source: Country Fire Authority)

Radiant Heat

Radiant heat is the heat created from burning fuel during a bushfire. Radiant heat can ignite surfaces without direct flame contact or ember attack, dry out vegetation ahead of the bushfire, crack glass (allowing embers to enter a building) and distort and melt materials (refer to **Figure 20**, below). The most common cause of loss of human life is via radiant heat (CFA, 2018).

Figure 20. Radiant Heat (source: Country Fire Authority)

Direct Flame Contact

Direct flame contact occurs when a fire front reaches a building, this is referred to as the 'Flame Zone'. Approximately 20% of house loss occurs when houses/buildings are directly adjacent to bushland.

Fire-driven Wind

Fire-driven wind can carry embers, cause trees to fall onto buildings, can break windows and destroy structures. The closer a building is to a fire front, the more severe the impact of fire-driven wind.

6.3 Management and Mitigation Measures – Permanent Buildings

Management and mitigation measures are generally outlined in relevant planning instruments at both the State and Local Government level.

Mitigation measures emphasize resilience to bushfire and are categorised into the following groups for the permanent structures within the site.

- Layout design;
- Building and construction requirements;
- Firefighting infrastructure;
- Bushfire emergency plan; and
- Vegetation management and landscaping.

6.3.1 Layout Design

Access and Egress

Access to the proposed residential subdivision will be achieved directly off Leanne Court to the south which connects with Teviot Road to the east. An internal road is routed through the centre of the development and has been designed to connect in two locations along the northern boundary, with potential future development on the adjacent lot. Additionally, access and egress can be achieved via a wide easement (5.85 m) between lots 37 and 38-41 through to Teviot Road to the east, away from the hazardous vegetation. Multiple modes of egress will assist with preventing entrapment during a bushfire event.

S5 Environmental recommend the internal road be constructed to satisfy QFD '*Fire Hydrant and Vehicle Access Guidelines for Residential, Commercial and Industrial Lots*', to be confirmed by the Project Town Planner or Engineer.

Leanne Court and Teviot Road are considered suitable to carry emergency fire-fighting appliances, provide emergency evacuation and to prevent entrapment during a bushfire.

Siting of Development

The proposed residential development is sited within an area of Low Potential Fire Line Intensity (> 4,000 kW/m^2) and is separated from the vegetation assessed as hazardous by Leanne Court. The maximum BAL score achieved by the proposed development is BAL 29 with the site largely exposed to BAL 12.5. Nine lots within the eastern extent of the site are located wholly outside of the Bushfire Prone Area. These setbacks were modelled utilising the Flamesol BAL Minimum Distance Calculator (refer to **Appendix B**). The siting of the development is considered to ensure the proposed development is exposed to an acceptable level of bushfire risk.

6.3.2 Building and Construction Requirements

In accordance with the BCA, the AS 3959-2018 requirements for construction of buildings applies to any new Class 1, 2, 3 or 10a Building (when ancillary to a Class 1, 2, or 3 Building). Therefore, any future habitable Class 1, 2 and/or 3 buildings and their ancillary Class 10a building/s within the development must adhere to the relevant BAL construction Standards based on their location. Advice on how to meet the applicable construction requirements may be sought from the project architect, builder and/or certifier.

Early Warning Systems

Smoke alarms should be installed in accordance with the Building Code of Australia and the AS 3786-1993 - *Smoke Alarms*. The Queensland Fire and Emergency Services recommends photoelectric smoke alarms (not ionization alarms). Photoelectric smoke alarms are generally more effective than ionization types as they detect visible particles of combustion.

6.3.3 Firefighting Infrastructure

The site is expected to be connected to a reticulated water supply network. It is expected that the reticulated water supply network within the area complies with the provisions outlined in the SEQ Water Supply, Sewage Design and Construction Code. Additionally, fire hydrants are to be designed, sited and installed within the subdivision in accordance with AS2419.1-2009.

6.3.4 Bushfire Emergency

In the event of a Bushfire Emergency, call triple zero (000)

The Greenbank Rural Fire Brigade is located approximately 850 m (by road) to the north of the subject site. The contact details for the Greenbank Rural Fire Brigade are:

- Address: 133 Teviot Road, Greenbank 4124
- Phone: (07) 3297 5896 *or* 0417 706 345

6.3.5 Vegetation Management and Landscaping

Bioretention Basin

The proposed bioretention basin was assessed as continuous fuel vegetation reflecting VHC 9.2 and the Regional Ecosystem ground-truthed within the site, to enable flexibility with the site layout.

Landscaping

S5 Environmental recommend that future lot owners are advised of the BAL applicable to their lot, and that they adhere to the following advice (outlined in the SPP Technical Reference Guide – Bushfire Resilient Communities) on low flammability landscaping, particularly for areas located within 100 m of hazardous vegetation.

Landscaping plays an important role in increasing a buildings' ability to endure bushfire attack. Landscaping for bushfire reduces the risk of ember attack which is the most common cause of building loss during bushfire. This includes utilisation of low flammability treatments such as rock mulches (gravel and fertilizer), concrete retaining blocks, and appropriate plantings.

Appropriate plant attributes to consider implementing in landscape design to reduce bushfire risk include:

- High leaf moisture content;
- Lower volatile oil content;
- Higher leaf mineral content;
- Broad-leaved species;
- Resilience to pruning;
- Low ignition likelihood;
- A low volume of persistent dead leaves/branches;
- Smooth or tightly held bark; and,
- Leaves and twigs that do not regularly fall.

Management of landscaped areas should ensure that there is no accumulation of litter and woody debris on garden beds and should ensure that there is horizontal and vertical separation of plants. Any grass within the proposed lots should never exceed 10 cm in height. Irrigation of garden and greenery areas could be considered to ensure a well-watered, low flammability landscape. In addition, trees should not overhang the roofline of the building, touch walls or other elements of a building and plants greater than 10 centimetres in height at maturity must not be placed directly in front of a window or other glass features.

The Victorian Country Fire Authority (CFA) have produced an online Plant Selection Key which facilitates landscape designers and property owners to select fire wise garden plants. The CFA have also produced the publication 'Landscaping for Bushfire: Garden Design and Plant Selection' (CFA, 2022). This publication, in conjunction with the 'Bushfire Resilient Building Guidance for Queensland Homes' (QLD Government and CSIRO, 2020), outlines planning, designing, choosing suitable plants, maintaining gardens and provides a Plant Selection Key, and can be obtained from their website.

7.0 CONCLUSION

This Bushfire Hazard Assessment concluded that the proposed development is within 100 m of potentially hazardous vegetation to the south. The AS 3959-2018 Method 2 radiant heat flux exposure assessment determined that the residential development will be exposed to a maximum radiant heat exposure of 29 kW/m^2, equivalent to BAL 29, however all lots can accommodate BLEs which will achieve BAL 19 or better, with most lots achieving BAL 12.5 and nine lots being located wholly outside of the bushfire prone area.

Accordingly, all buildings exposed to BAL 12.5 or greater will have to adhere to the relevant BAL construction requirements.

S5 Environmental have prepared a site-specific Bushfire Management Plan to support the proposed residential development, which recommends key mitigation measures to be implemented to ensure the risk to people, infrastructure and property is acceptable and minimised.

Overall, the proposed development complies with the SPP Bushfire Assessment Benchmarks, refer to **Appendix A**.

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APPENDIX A

SPP Bushfire Assessment Benchmarks

Assessment Benchmark	Response
Assessment Benchmark 3 **Development other than that assessed against (1) above, avoids natural hazard areas, or where it is not possible to avoid the natural hazard area, development mitigates the risks to people and property to an acceptable or tolerable level.**	The proposed development is for a reconfiguration of a lot (RaL), with more than 20 lots. It does not involve vulnerable uses and community infrastructure for essential services. S5 Environmental have undertaken a bushfire hazard and BAL assessment as above and determined that 7 of the 43 proposed new lots will be exposed to a maximum radiant heat flux no greater than 29 kW/m^2 (equivalent to BAL 29), as a narrow incursion into the site and a further two lots will be exposed to a maximum radiant heat flux no greater than 19 kW/m^2, equivalent to BAL 19, however these lots can accommodate a BLE which will be exposed to a 19 kW/m^2 and possibly 12.5 kW/m^2, equivalent to BAL 12.5, dependent on the siting of the BLE. Twenty-five lots are exposed to a maximum radiant heat flux no greater than 12.5 kW/m^2 or BAL 12.5, and nine lots are wholly located outside of the bushfire prone area (BAL Low). The layout therefore minimizes the number of lots and BLEs exposed to hazardous vegetation, and the site is separated from the vegetation assessed as hazardous by Leanne Court. A new internal road is proposed through the development with two links provided on the northern boundary to connect to future development that may occur on the adjacent lot to the north. The area is undergoing rapid densification of residential, urban land uses, with Teviot Road to the east currently undergoing major upgrades and widening. Leanne Court connects to Teviot Road and an easement between lots from the internal road will provide a secondary egress point directly to Teviot Road and away from the hazardous vegetation. Leannne Court and Teviot Road are suitable for emergency services vehicles. Following the implementation of recommendations as outlined within the Bushfire Management Plan, S5 Environmental are of the opinion that the risks to people and development will be at an acceptable level.

Assessment Benchmark 4 **Development supports, and does not hinder, disaster management response or recovery capacity or capabilities.**	The development will support, and not hinder, disaster management response or recovery capacity or capabilities. Proposed lots as part of a RaL (greater than 20 lots), 2,000 m^2 or less and connected to a reticulated water supply. Building envelopes have not been identified. All lots do not exceed a radiant heat flux level of 29 kW/m^2 at the lot boundaries. Access to the new internal road is via Leanne Court to the south, a two lane, sealed road, it connects with Teviot Road in the east (currently undergoing major upgrades to a four-lane sealed road) and a cul-de-sac in the west. The site has an additional pedestrian easement from the internal road, connecting to Teviot Road in the east. The road network and fire hydrants are to be designed and installed in accordance with The with *Fire hydrant and vehicle access guidelines for residential, commercial and industrial lots*, (QFD, 03/2025) and the *Road Planning and Design Manual 2nd edition* (DTMR, 2013), where applicable. The development will be connected to a reticulated water supply. As per the Bushfire Management Plan (BMP), it is recommended this complies with the provisions outlined in the SEQ Water Supply, Sewage Design and Construction Code. Additionally, fire hydrants are to be designed, sited and installed within the subdivision in accordance with AS2419.1-2009 and QFD Guidance.
Assessment Benchmark 5 **Development directly, indirectly and cumulatively avoids an increase in the severity of the natural hazard and the potential for damage on the site or to other properties.**	S5 Environmental are of the understanding that the proposed reconfiguration will not increase the bushfire risk to the subject site or surrounding properties. Vegetation Management has been recommended in **Section 6.0**. The identified hazardous vegetation is separated from the subject site by Leanne Court, a two-lane, sealed road.

	An EPZ within the western extent will likely undergo a level of rehabilitation and has been assessed as per its current status of mature vegetation for the bushfire hazard assessment, the proposed bio basin was incorporated into the patch for the assessment. The patch has been downgraded through the assessment as a narrow corridor. It is separated from lots by the internal road. As such the existing fuel load will be maintained and not increased. The BAL 29 contour is outside of the subject site and as such an Asset Protection Zone has not been prescribed for the development, therefore the APZ does not interfere with retained vegetation.
Assessment Benchmark 6 **Risks to public safety and the environment from the location of hazardous materials and the release of these materials as a result of a natural hazard are avoided.**	S5 Environmental understands the proposed development is for a residential subdivision and will not include the bulk storage of hazardous materials.
Assessment benchmark 7 **The natural processes and the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard are maintained or enhanced.**	S5 Environmental understands the proposed development will not increase the fuel load of vegetation considered hazardous to the development or surrounding area. A Bushfire Management Plan for the site including landscaping recommendations, has been prepared in **Section 6.0**.

APPENDIX B

Flamesol Inputs and Outputs

Summary of Input Parameters for Hazardous Vegetation to the South

Parameter	Input	Note
FFDI	56	Source: QFD BRC MapViewer. The hazardous vegetation is a 55/56 split, with the higher value of 56 adopted for the calculation.
Surface Fuel Load	14.9 t/ha	Surface and Near Surface Fuel Load – QFD VHC 9.2.
Overall Fuel Load	17.2 t/ha	Total Fuel Load – QFD VHC 9.2.
Effective Slope	1 °	The slope under the hazardous vegetation is sited slightly upslope of the proposed development. A minimum Effective Slope of 1 ° was utilised.
Site Slope	1.79 °	Hazardous vegetation is slightly downslope of the proposed development.
Flame Temperature	1,200 K	Standard input in accordance with the BRC.
Flame Width	100 m	Standard input, in accordance with AS 3959-2018.

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Calculated April 17, 2025, 3:49 pm (MDc v.4.9)

S525001

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	56	Rate of spread	1.07 km/h
Vegetation Classification	Forest	Flame length	9.029999999999999 m
Understorey fuel load	14.9 t/ha	Flame angle	66.78999999999999 °, 73.78999999999999 °, 78.78999999999999 °, 81.78999999999999 °, 82.78999999999999 ° & 86.78999999999999 °
Total fuel load	17.2 t/ha	Elevation of receiver	3.81 m, 3.87 m, 3.75 m, 3.51 m, 3.34 m & 1.72 m
Vegetation height	n/a	Fire intensity	9,533 kW/m
Effective slope	1 °	Transmissivity	0.873, 0.858, 0.837, 0.8129999999999999, 0.801 & 0.741
Site slope	1.79 °	Viewfactor	0.4087, 0.3002, 0.2026, 0.1371, 0.1115 & 0.0301
Flame width	100 m	Minimum distance to < 40 kW/m²	10.8 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	14.7 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	21.6 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	30.7 m

Flamesol Calculator Outputs for Required Setbacks from Hazardous Vegetation to the South

APPENDIX C

Slope Lines and Calculations

Project: 197-201 Teviot Road, Greenbank
Number: S525001

S5 ENVIRONMENTAL

BUSHFIRE SLOPE CALCULATOR

Vegetation to the South - Perpendicular to the development

Effective Slope					Site Slope				
Direction	Flat		1˚ minimum utilised		Direction	Flat		1˚ minimum utilised	
Top Elevation	62	m			Top Elevation	62	m		
Bottom Elevation	62	m	Slope %	0.00%	Bottom Elevation	62	m	Slope %	0.00%
Distance	65.5	m	**Slope (˚)**	**0.00**	Distance	20.1	m	**Slope (˚)**	**0.00**

Vegetation to the South - Slope direction

Effective Slope					Site Slope				
Direction	Upslope		1˚ minimum utilised		Direction	Downslope			
Top Elevation	63	m			Top Elevation	63	m		
Bottom Elevation	62	m	Slope %	1.04%	Bottom Elevation	62	m	Slope %	3.13%
Distance	96.4	m	**Slope (˚)**	**0.59**	Distance	32	m	**Slope (˚)**	**1.79**