Appendix K: Bushfire Hazard Assessment and Management Plan

Prepared by S5 Environmental Pty Ltd

S5 ENVIRONMENTAL

BUSHFIRE HAZARD ASSESSMENT AND MANAGEMENT PLAN

52-58 THORNBILL DRIVE, GREENBANK

Client:	Revival Pentecostal Church of Brisbane c/- VMS Town Planning
Reference:	S524231_BHAMP_v1.0
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Quality Control

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Date	17 June 2025

Version Control

Version	Description	Date	Author	Reviewer	Approver
1.0	For Submission	17 June 2025	JG (Env. Scientist)	RS (Director)	RS (Director)

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

APZ	Asset Protection Zone
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
BPA	Bushfire Prone Area
BRC	Bushfire Resilient Communities (The State of Queensland 2019b)
CFA	Country Fire Authority
DETSI	Department of Environment, Technology, Science and Innovation
FFDI	Forest Fire Danger Index
ha	Hectares
LCC	Logan City Council
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 VMS Town Planning on behalf of their client, Revival Pentecostal Church of Brisbane, to undertake a Bushfire Hazard Assessment and Management Plan (BHAMP) as supporting documentation for a Development Application for a Place of Workship at 52-58 Thornbill Drive, Greenbank. Refer to Table 1. Whilst it is acknowledged that the dwelling proposed to be used for the Church is existing, Logan City Council (LCC) have requested the conduct of this assessment as part of their Prelodgement Meeting advice.

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	52-58 Thornbill Drive, Greenbank	Lot on Plan	Lot 97 RP 857852
LGA	Logan City Council (LCC)	Area	12,790 m2
Zone	Rural Residential	Tenure	Freehold
Current State	Lot 97 RP857852, herein referred to as the 'subject site', currently contains a dwelling, area of hardstand and a water tank within the western extent of site. A gravel driveway enters the site along the western boundary off Thornbill Drive leading to the dwelling. A dam is present in proximity to the dwelling and adjacent to the northern boundary. Areas of mowed lawn surround the existing dwelling with dense vegetation lining the northern boundary and south-eastern extent of the site. Refer to Figure 1, below.		
Proposed Development	The proposed development is part of a Development Application for a Material Change of Use (MCU) to establish a Place of Worship within the existing dwelling at 52-58 Thornbill Drive, Greenbank, with minor alterations to the existing building. Additionally, a hardstand car parking (for 47 cars) is proposed along the northwestern extent of the site. Refer to Figure 2, for the proposed development area.		
Potentially Hazardous Vegetation	Post development, potentially hazardous vegetation is situated within the southern portion of the site as well as the southern portion of the assessment area, western and north-western assessment area. This potentially hazardous vegetation was determined to reflect the regional ecosystem (RE) 12.9-10.19a. These regional ecosystems are described as: RE 12.9-10.19a: *Corymbia henryi* and/or *Eucalyptus fibrosa subsp. fibrosa* open forest. Other commonly associated species include, *Corymbia citriodora subsp. variegata, E. carnea, E. siderophloia, E. crebra and E. major*. Occurs in coastal areas on Cainozoic and Mesozoic		

sediments. Not a Wetland.

Equivalent to VHC 10.1: *Spotted gum dominated open forests*

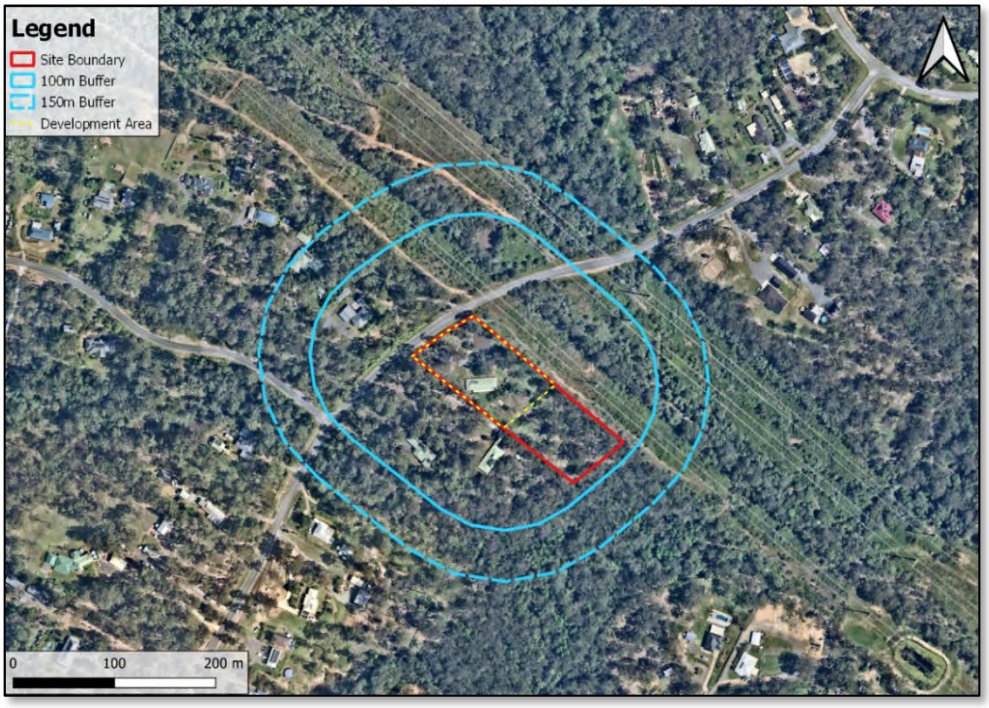

Figure 1. Site Aerial (source: Nearmaps, date: 12/03/25)

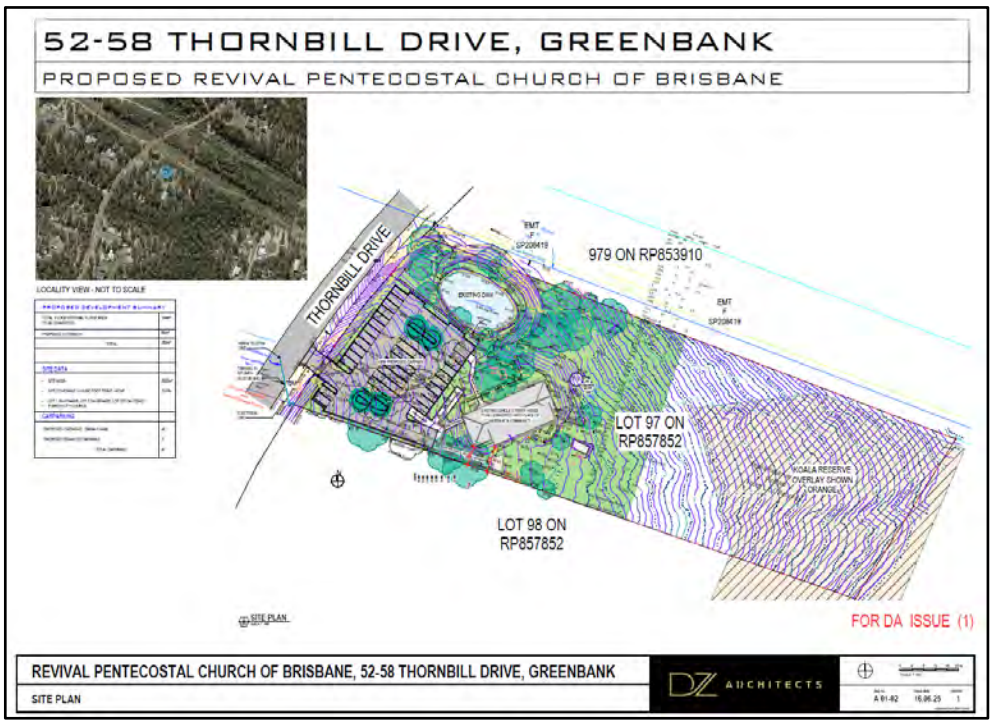

Figure 2. Site Plan (source: DZ Architects A 01-02, rev 1, dated: 16/06/24)

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 Logan City Council (LCC) *Planning Scheme 2015* implements the Bushfire hazard overlay code which acts as a development constraint within the LCC locality. It is understood that the *Planning Scheme 2015* has integrated all aspects of the SPP: Safety and Resilience to Hazards, including Natural Hazards, Risk and Resilience – Bushfire Prone Areas. As such, the LCC Bushfire Hazard Overlay map was consulted to determine the preliminary bushfire hazard ratings of the site and locality (within 150 m), refer to Figure 3.

The LCC Bushfire Hazard Overlay has mapped the subject site to contain very high potential bushfire intensity to the south of site, medium potential bushfire intensity within the southern corner and potential impact buffer across the northern third of the site, which is where the current and proposed development footprint is located. LCC mapped the balance of the assessment area (150 m buffer off the subject site) under a combination of three Bushfire Hazard categories (i.e., high potential bushfire intensity, medium potential bushfire intensity and potential impact buffer area), with high potential dominating the north-west and north-east, medium potential within the south-east and north-east, and potential impact buffer running from the north to south of the assessment area, 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.

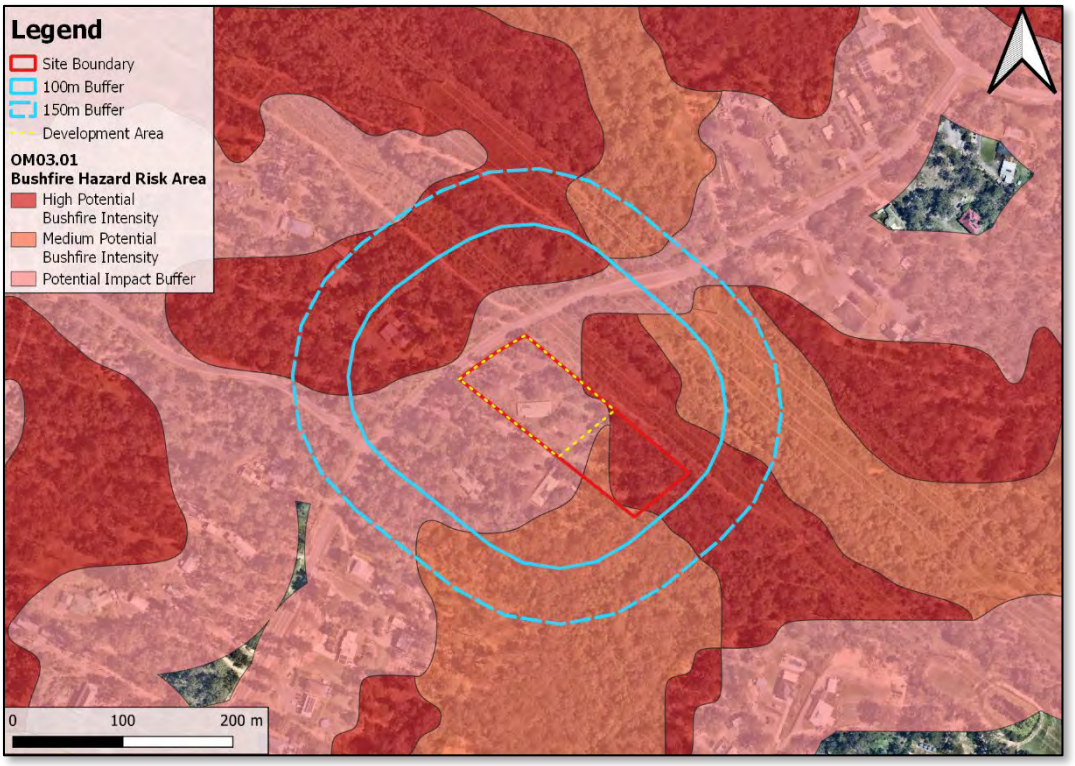

Figure 3. LCC Bushfire Hazard Mapping within and in Proximity to the Site

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 ^{o}).

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

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

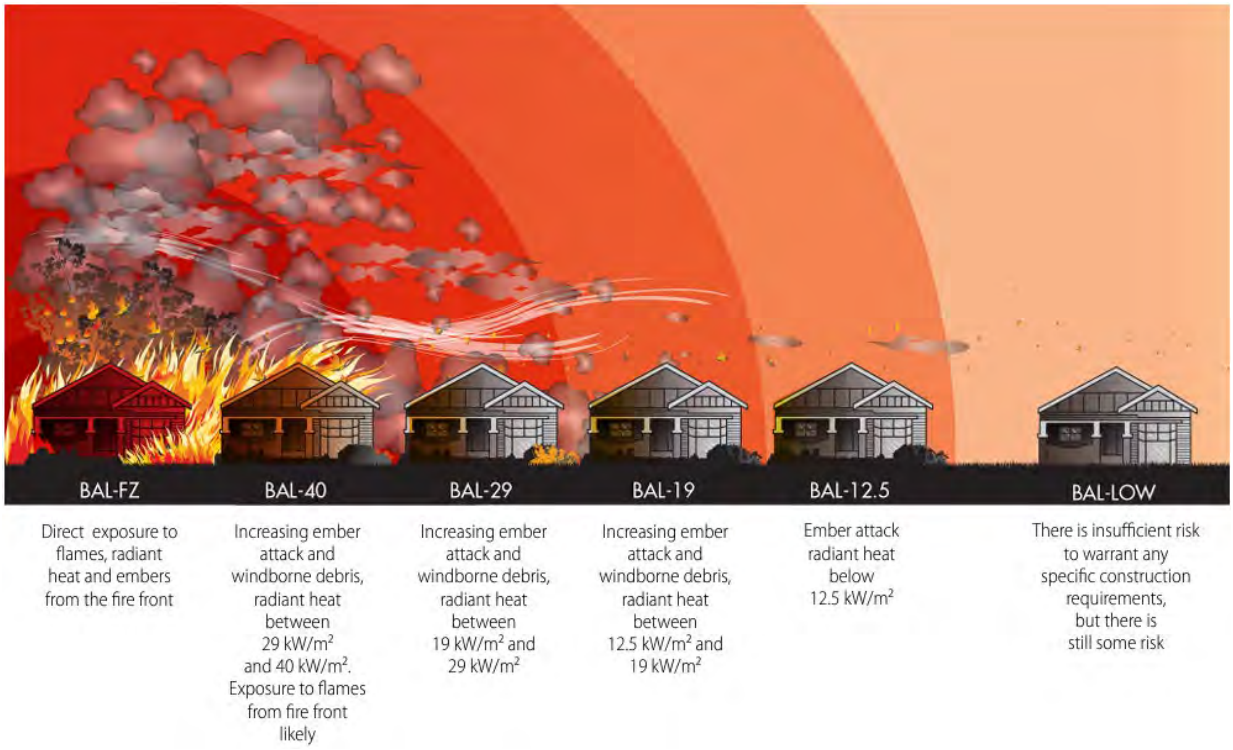

Figure 4. Bushfire Attack Levels (BAL) (Source: WAPC, 2024)

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.

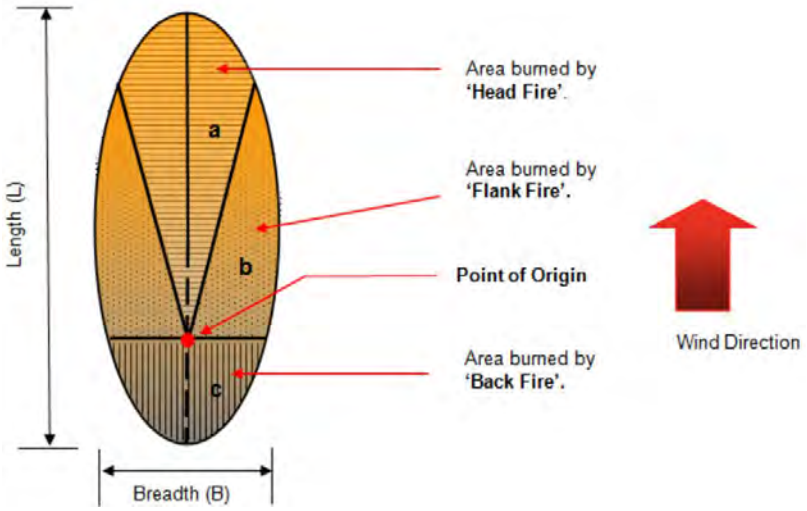

Figure 5. Schematic Diagram of Simple Elliptical Fire Growth Model (Van Wagner 1969) from NSW Rural Fire Surface (2019)

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.

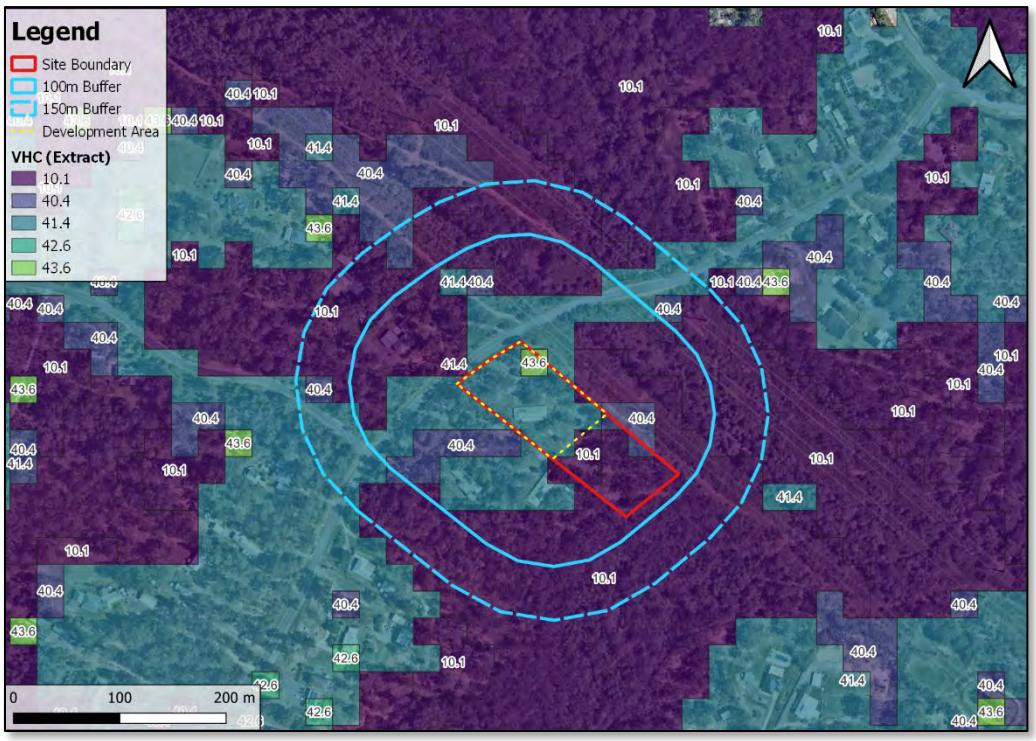

Figure 6. Extract of Vegetation Hazard Classes from the BRC MapViewer

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 17th of 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, surrounding the proposed development, referred to as the assessment area.

Post development, the western half of the subject site has been mapped to reflect VHC 41.4 '*Discontinuous low grass or tree cover*' as there will be scattered canopy trees over predominantly mown grass, with a limited shrub layer. A dam is located within the north-western corner of the site which is mapped as VHC 43.6 '*Water bodies or very low vegetation cover*'. The eastern half of the subject site has been mapped as VHC 10.1 '*Spotted gum dominated open forests*' to reflect the ground-truthed regional ecosystem mapping, which mapped this portion of the site and assessment area as RE 12.9-10.12a. Similar to the eastern half of the subject site, most of the south-eastern and south-western portions of the assessment area are mapped as VHC 10.1 due to the density of vegetation matching RE 12.9-10.12a. The lot directed adjacent to the southern boundary is mapped as non-remnant vegetation but was identified as VHC 40.4 '*Continuous low grass or tree cover'* as it contains dense canopy species and will not likely be managed in as 'low' bushfire state post-development. There is some historical clearing present and dwellings on site within this neighbouring lot. A strip of powerline easements run adjacent to the northern boundary as well as further north within the assessment area. These are mapped as VHC 41.4 '*Discontinuous low grass or tree cover*' and are to be maintained in a low-fuel state. Thornbill Drive runs along the western boundary of the subject site and continues to the north-west and south-west. This road was mapped as VHC 42.6 '*Nil to very low vegetation cover*'. Some smaller patches of VHC 10.1 are scattered within the west and north-western portion of the assessment area to reflect the dense vegetation patches mapped as RE 12.9-10.12a.

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 10 and Figure 7 below show the various areas and regional ecosystems existing across the site and within the surrounding vegetation.

Figure 7. Ground-truthed Vegetation within the Site

Plate 1 View facing west from Survey Point One into VHC 10.1 and VHC 41.4 in the distance.

Plate 2 View facing north from Survey Point One into VHC 10.1 and VHC 41.4 in the distance.

Plate 3 View facing east from Survey Point One into VHC 10.1.

Plate 4 View facing south from Survey Point One into VHC 10.1 and VHC 40.4 in the distance.

Plate 5 View facing south toward existing dwelling, VHC 41.4

Plate 6 View of south-western corner of site into VHC 41.4.

Plate 7 View of dense cassava east of the existing dwelling, within VHC 41.4.

Plate 8 View facing east along the northern boundary non-remnant area, within VHC 41.4.

Plate 9 View facing southern boundary within non-remnant area, VHC 41.4 entering VHC 10.1.

Plate 10 View facing southern boundary within non-remnant area, VHC 41.4 entering VHC 10.1.

Plate 11 View facing west from Survey Point One.

Plate 12 View facing north from Survey Point One.

Plate 13 View facing east from Survey Point One.

Plate 14 View facing south from Survey Point One.

Plate 15 View facing south toward existing dwelling.

Plate 16 View facing western boundary.

Plate 17 View of dense cassava east of the existing dwelling.

Plate 18 View facing east along the northern boundary non-remnant area.

Plate 19 View facing southern boundary within non-remnant area.

Plate 20 View facing east of interface of non-remnant and remnant area.

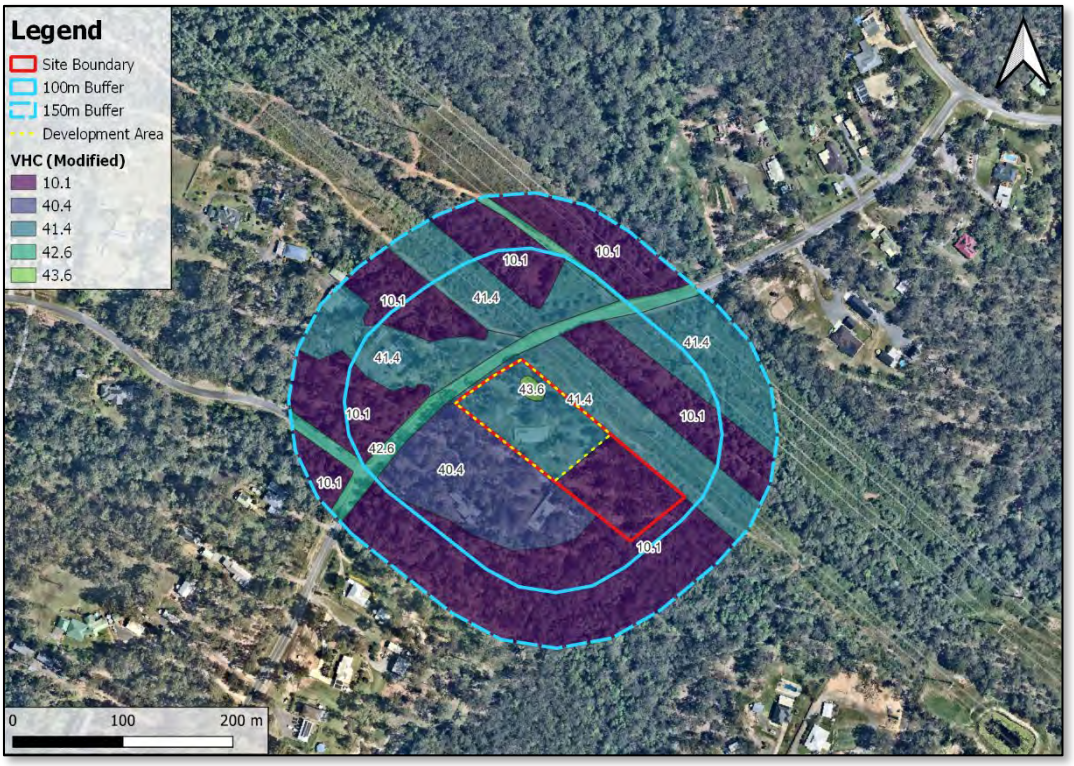

Figure 8. Ground-truthed and Post-development Vegetation Hazard Classes

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
10.1	Spotted gum dominated open forests	Continuous	20.8
40.4	Continuous low grass or tree cover	Continuous	5
41.4	Discontinuous low grass or tree cover	Discontinuous	3
42.6	Nil to very low vegetation cover	Discontinuous	2

*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 10.1 and 40.4), 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).

Several narrow corridors of VHC 10.1 to the north-east and north-west of the subject site have been downgraded through implementing Step 3 (eroded on all sides with no residual pixels remaining). Two small patches (< 0.5 ha) of VHC 10.1 were then removed utilising Step 4 to the north-east and north-west. These pixels are fairly located outside the 100 m buffer area. Refer to Figure 9. and Figure 10.

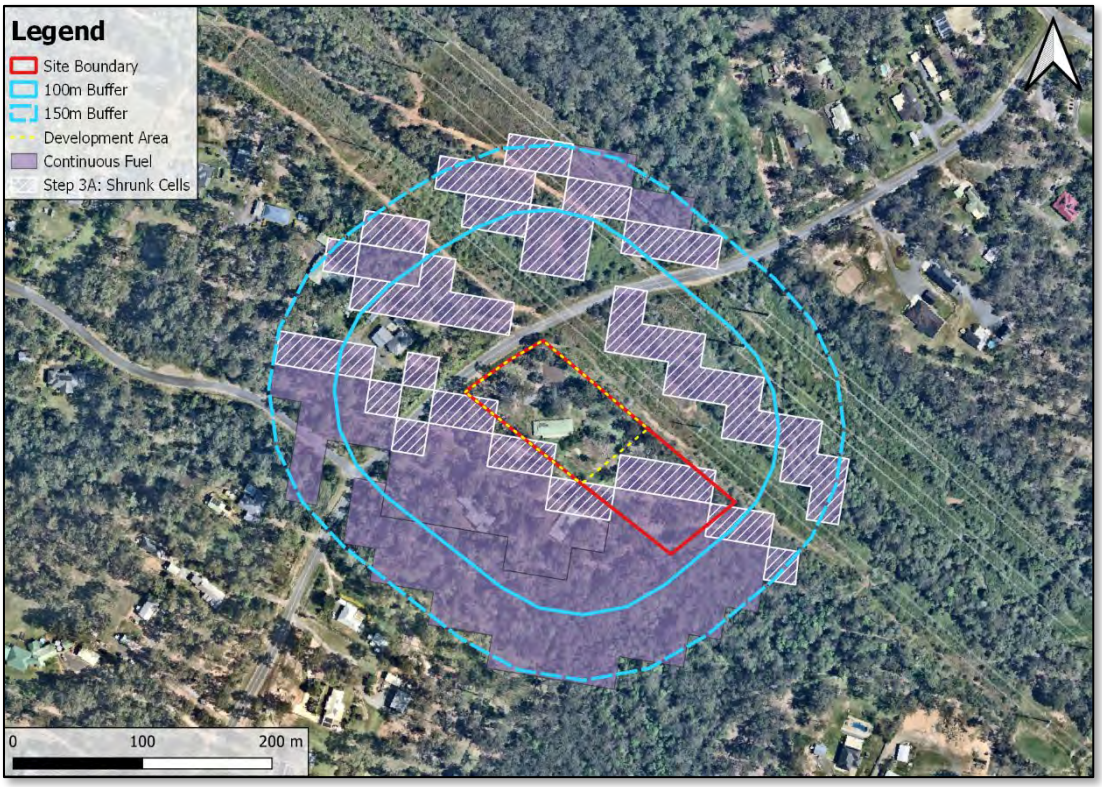

Figure 9. Shrinking of patches of continuous fuel at the interface with non-continuous fuel

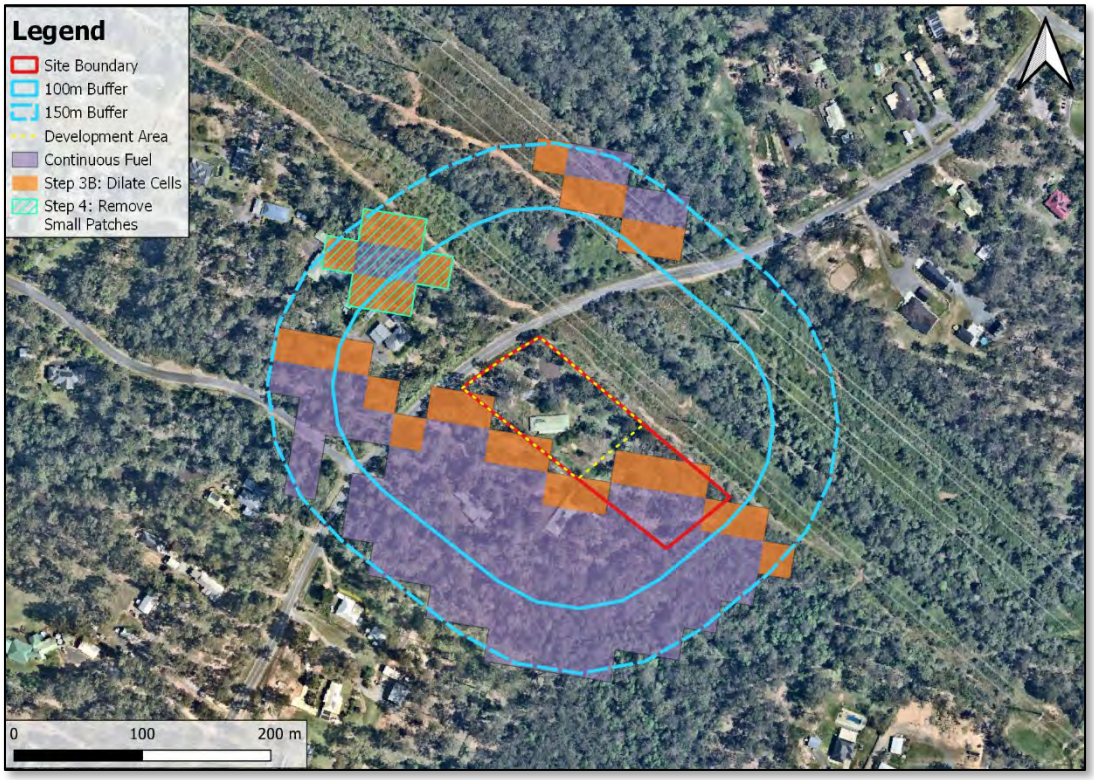

Figure 10. Step 3b – Dilation of residual continuous fuel patches

Figure 11. Finalised pixelated hazardous vegetation within the assessment area

Figure 12. Smoothed potential hazardous vegetation to reflect ground-truthed conditions and vegetation within 100m of the proposed works

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. Potentially hazardous vegetation to the south was determined to be on the same slope as the proposed development. Several measurements were made for effective and site slope (the area between the development and the hazardous vegetation), and the most conservative measurements for both the north and south were adopted for the PFLI and BAL Setback calculations (refer Figure 13 and Appendix B).

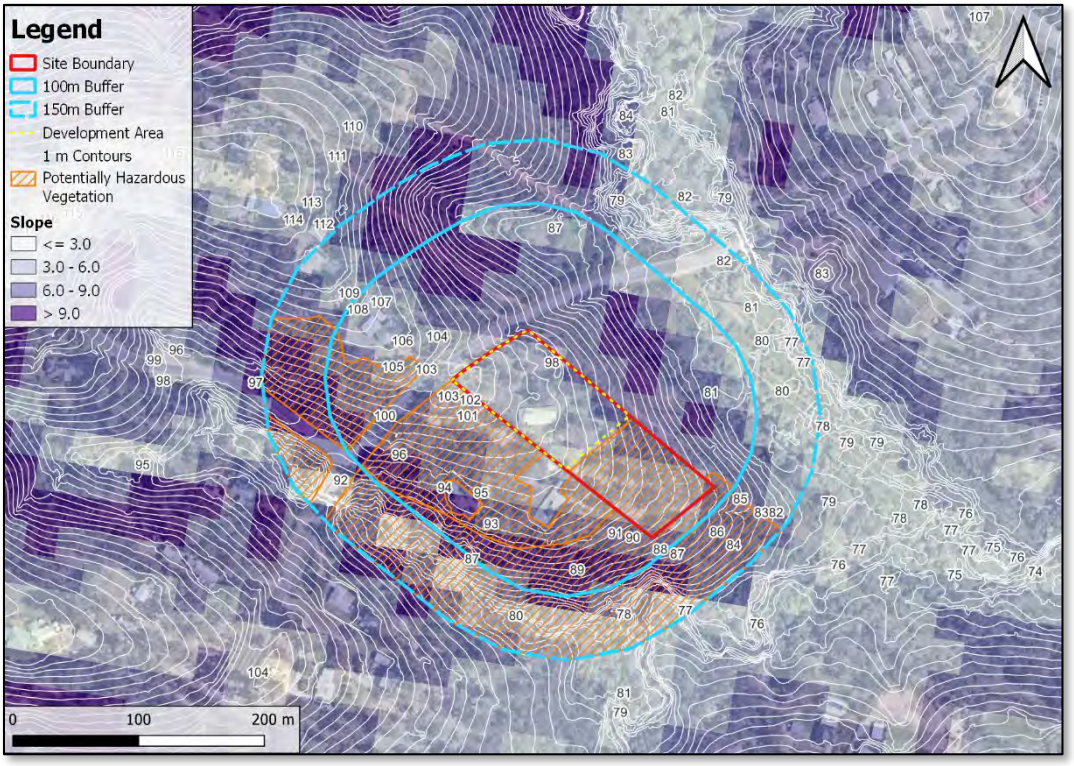

Figure 13. Slope within and in Proximity to the Proposed Development

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 56.

4.1.7 Final PFLI

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-west and south-east associated with VHC 10.1 are mapped to contain high potential bushfire intensity (i.e., 20,000 to 40,000 kW/m) and medium potential bushfire intensity (i.e., 4,000 to 20,000 kW/m). A portion of vegetation in the neighbouring lot directly adjacent to the southern boundary is associated with VHC 40.4, which was mapped to be low potential bushfire intensity (< 4,000 kW/m). Refer to Figure 14.

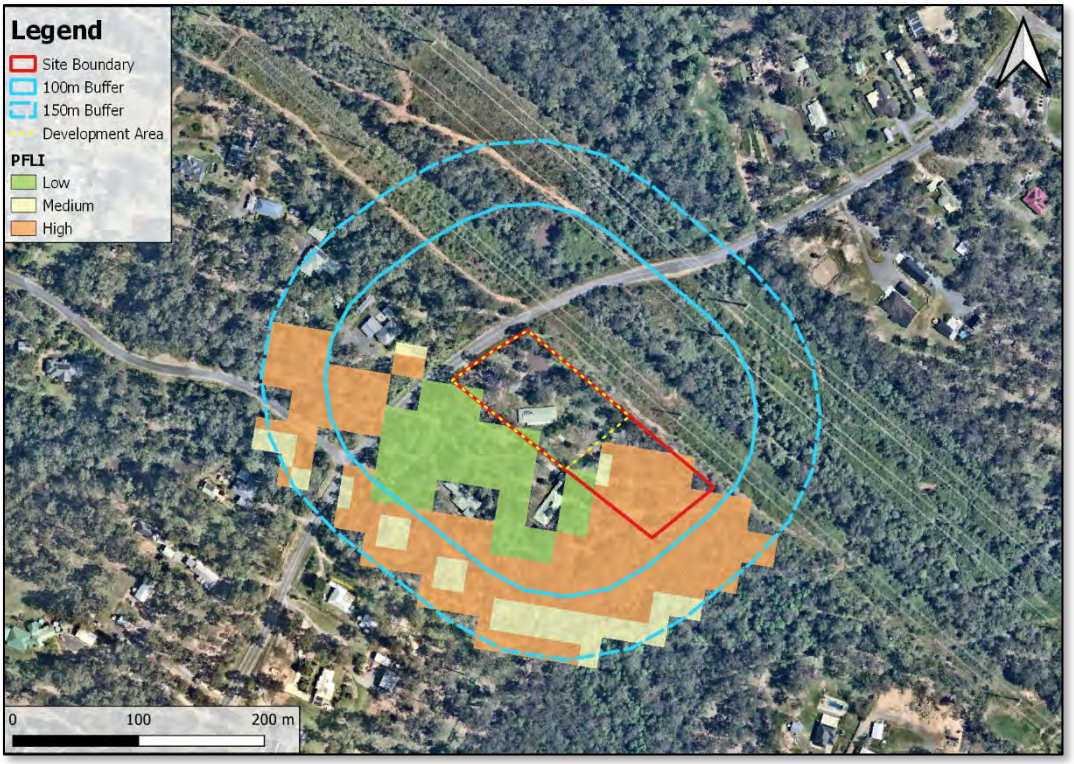

Figure 14. Potential Fire Line Intensity

4.2 Hazardous Vegetation

Vegetation mapped as VHC 10.1 to the south-west and south-east 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 15. Hazardous Vegetation

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 north and 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 north and 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		
		South-west	South	South-east
-	Low	100 m	100 m	100 m
12.5	12.5	41.1 m	12.2 m	42.5
19	19	29.8 m	8.2 m	30.9
29	29	20.8 m	5.4 m	21.6
40	40	15.5 m	4 m	16.1
> 40	FZ	< 15.5 m	< 4 m	< 16.1

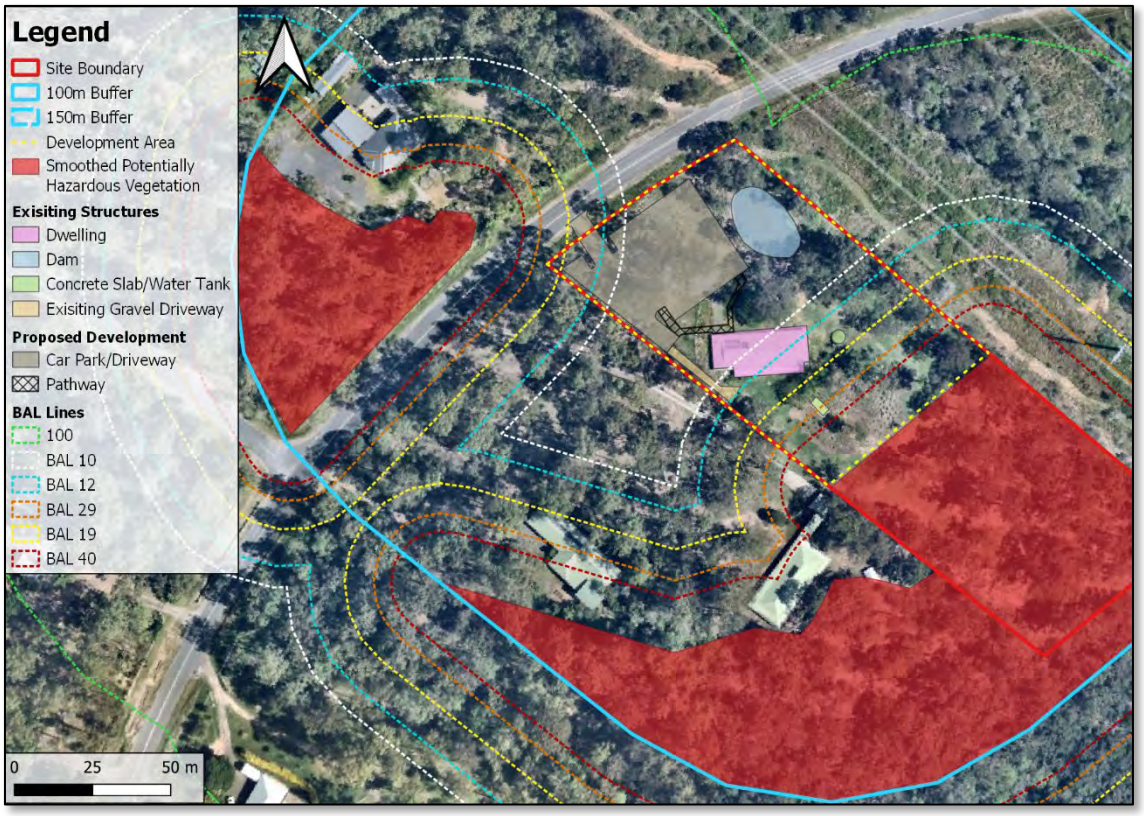

Figure 16. BAL Setbacks over Proposed Development

Based on the results of the radiant heat exposure assessment, the proposed habitat structure proposed to be refurbished achieves a maximum BAL score of 29. The proposed carpark/driveway and pathway are not habitat structures and achieve a maximum BAL score of 40, 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 straddle BAL contours, the highest BAL the structure is in, is the applicable BAL for construction purposes.

A Bushfire Management Zone is recommended for the area between the hazardous vegetation and the BAL 29 contour to assist in reducing risk and ensuring the maximum BAL for BLEs remains at BAL 29. This will be outlined as part of the recommendations of the bushfire management plan.

Table 8. BAL Requirements for Proposed Lots

Lot/s	Applicable BAL Score
Existing Dwelling	29
Proposed Driveway	FZ
Proposed Parkway	FZ

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 16, below.

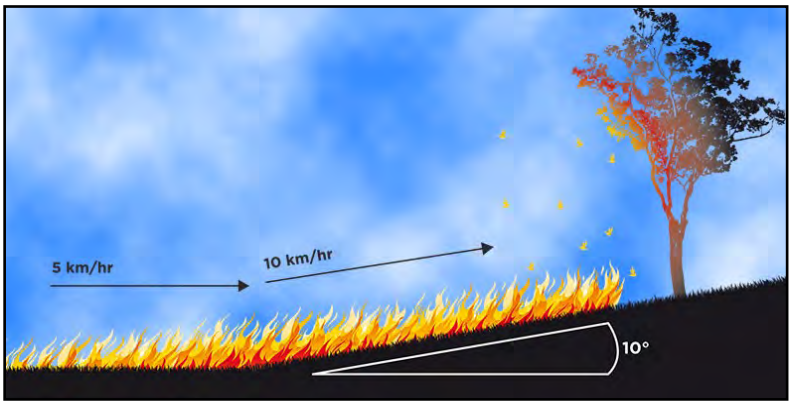

Figure 17. Effects of Topography on Bushfire (source: Country Fire Authority)

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 17).

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.

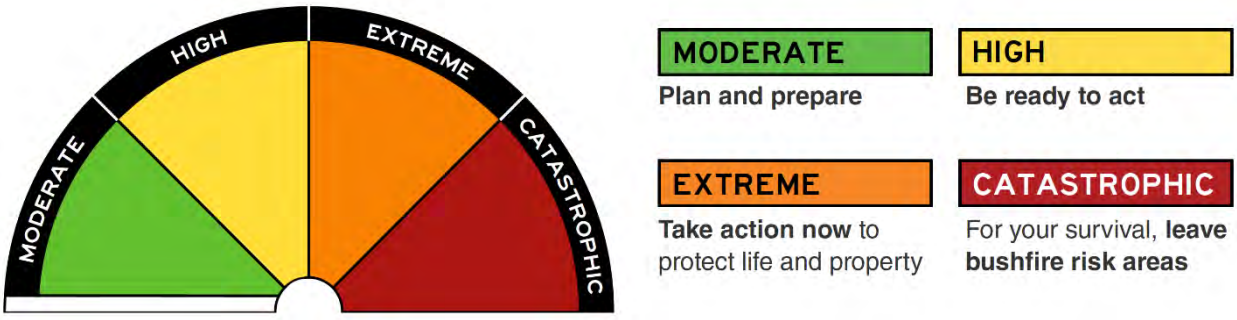

Figure 18. Australian Fire Danger Rating System (source: AFAC, 2025)

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 18, below). Ember attack is addressed within the AS 3959-2018 through Construction Standard requirements.

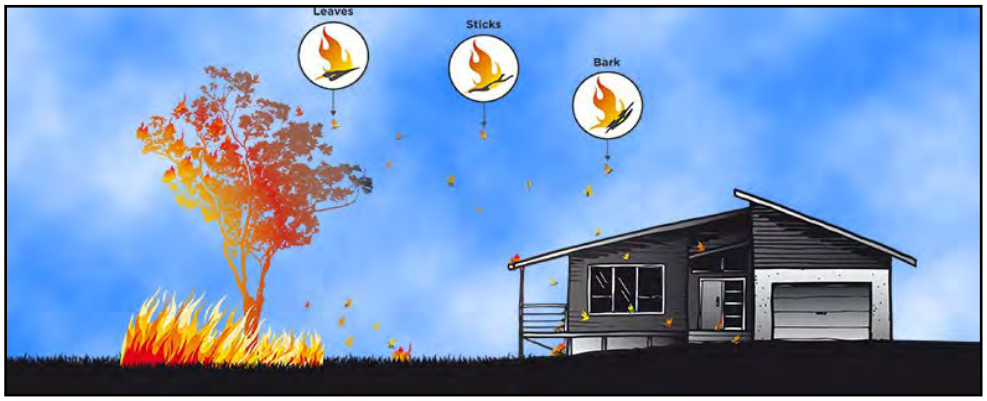

Figure 19. Ember Attack (source: Country Fire Authority)

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 19, 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 development will be achieved directly off Thornbill Drive to the west. Additionally, access and egress will be achieved via foot through the development area heading west, which will prevent entrapment during a bushfire event. S5 Environmental recommend the driveway be constructed to the 'private access roads or driveways' design requirements as outlined in *Table 8.2.5.3.C* '*Road design requirements for emergency vehicle access*', within of Section 8.2.5 Bushfire Overlay Code, to be confirmed by the Project Town Planner or Engineer. Thornbill Drive is 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). S5 Environmental stipulate that the renovation of the existing dwelling will achieve a maximum BAL score of 19. Following this, the proposed driveway will be located to achieve a maximum BAL score of 29. 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 vulnerable use buildings applies to any new Class 9 Building 9. Therefore, any future habitable Class 9 buildings within the development must adhere to the relevant BAL construction Standards based on their location. It is noted that BAL requirements cannot be applied retrospectively to the existing building. However, should substantial renovations be proposed, it is recommended that a Certifier should advise as to then the BAL requirements apply.

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 West Logan Fire Station is located approximately 16 km (by road) to the north-east of the subject site. The contact details for the West Logan Fire Station are:

- Address: 2 Orr Ct, Hillcrest QLD 4118
- Phone: (07) 3081 6800

6.3.5 Vegetation Management and Landscaping

Asset Protection Zone (APZ) and Low Fuel Load Areas

The QFD acknowledges the type, location and ongoing maintenance of landscaping as a necessary Bushfire Protection Measure. An Asset Protection Zone (APZ) has been proposed between the BAL 29 line and hazardous vegetation, to ensure vegetation within this area is managed at a low-fuel state. This will reduce potential bushfire risks to the habitable structure on site. This APZ will extend approximately 1,401 m² between the rehabilitated vegetation and habitable structure and must be maintained in perpetuity to guarantee ongoing protection from bushfires in the locality. The proposed driveway and carpark is located outside the APZ due to its non-flammable nature and being non-habitable structures.

Figure 21. Proposed Asset Protection Zone

Landscaping

S5 Environmental recommend that future owners 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.

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.

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.

7.0 CONCLUSION

This Bushfire Hazard Assessment concluded that the proposed development is within 100m of potentially hazardous vegetation to the south, south-west and south-east. The AS 3959-2018 Method 2 radiant heat flux exposure assessment determined that the habitable structure will be exposed to a maximum radiant heat exposure of 19 kW/m^2, equivalent to BAL 19.It is noted that BAL requirements cannot be applied retrospectively to the existing building. However, should substantial renovations be proposed, it is recommended that a Certifier advise as to then the BAL requirements apply. Should it be determined that they apply, 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 development, which recommends key mitigation measures to be implemented to ensure the risk to people, infrastructure and property is acceptable and minimised. Of note, a APZ is recommended between the hazardous vegetation proposed for rehabilitation and BAL 29 setback, to ensure a maximum BAL score of 29 is achieved by the habitable structure. Additionally, the area development area (shown in Figure 1) is recommended to be kept in a low-fuel state.

Overall, the proposed development complies with the relevant LCC bushfire related assessment benchmarks, refer to Appendix A.

8.0 REFERENCES

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APPENDIX A

LCC Bushfire Hazard Overlay Code Response

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
For accepted development (subject to requirements) and assessable development.			
Location, design and siting of development			
PO1 Development is designed to: a. minimise risk of bushfire hazard; b. provide safe premises; c. create efficient emergency access for fire-fighting and other emergency vehicles. Note - Planning scheme policy 6 - Management of bushfire hazard provides guidelines on how to achieve this outcome.	AO1 Development: a. does not increase the number of persons living in, or lots in, the Bushfire hazard area identified on Bushfire hazard overlay map OM-03.00; or b. is on a site that a bushfire hazard assessment prepared in accordance with the methodology in Planning scheme policy 6 – Management of bushfire hazard determines is of low bushfire hazard	Complies S5 Environmental have prepared a site-specific Bushfire Hazard Assessment and Management Plan which has also included surrounding areas (within 150 m) in accordance with the *Logan Planning Scheme 2015* Bushfire Hazard Overlay Code and SC6.2.6 Management of Bushfire Hazard. Post development, the development area and neighboring lot to the south will be of Low Potential Bushfire Intensity (< 4,000 kW/m^2), with areas of High Potential Bushfire Intensity situated to the east of the subject site and to the south of the assessment area. The proposed development will be located within areas of Low Potential Bushfire Intensity. The driveway is wide enough to provide access for firefighting and evacuating vehicles. Furthermore, evacuating vehicles will travel towards the west and away from potentially hazardous vegetation to the south and east.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO2 Development is sited and constructed to minimise the bushfire hazard and maximise the protection of life and property from bushfire. Editor's note - Planning scheme policy 6 - Management of bushfire hazard contains guidance on the preparation of bushfire management plans.	AO2 Development is located and constructed: a. where there is no bushfire management plan approved by an existing development approval: i. such that the bushfire attack level is less than or equal to BAL-29; ii. away from the most likely direction of a fire front; iii. so that elements of the development least susceptible to fire are sited closest to the bushfire hazard; iv. such that asset protection zones are sited on land with a slope less than 18 degrees; v. such that asset protection zones are entirely within the boundaries of the private property of the development site; or b. where an approved bushfire management plan directs development to be located. Note - BAL = Bushfire attack level is the radiant heat flux a building will experience during a bushfire and is a measure of heat energy impacting on a surface expressed as kW/m2. BAL is calculated from the following factors; vegetation type, fuel loads, distance to vegetation, Forest Fire danger Index (FDI), flame length, fire behaviour/intensity and slope. BAL is used to determine the required construction level of a building and the size of asset protection zones (inner and outer radiation zones). Further information on calculating the BAL can be obtained from AS3959-2009. Editor's note - Asset protection zones are not located on slopes greater than 18 degrees to ensure maintenance is practical, soil stability is not compromised and the potential for crown/canopy fires is reduced.	Complies S5 Environmental understand that, following the application of the recommendations outlined within this report, the maximum radiant heat flux the proposed development will be exposed to is 29 kW/m^2, equivalent to BAL 29, which is suitable for habitable structures.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO3 Reconfiguring a lot ensures that lots are designed to minimise bushfire hazard and provide safe sites for people, property and buildings.	AO3 Lots: a. are suitable for people, property and buildings by: i. having a bushfire attack level less than or equal to BAL-29; or ii. containing a development envelope area that has a bushfire attack level less than or equal to BAL-29; b. provide asset protection zones that: i. are located on land with a slope less than 18 degrees; ii. are located on the same lot.	Complies S5 Environmental understand that existing dwelling that is to undergo renovation will be exposed to a maximum radiant heat flux of 29 kW/m^2, equivalent to BAL 29, which is acceptable for a habitable structure.	
Vehicular access and fire maintenance trails			

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
PO4 Access for fire management and evacuation is provided by access that: a. separates premises from adjoining vegetation; b. is safely accessible by fire fighting vehicles; c. has regular vehicular access points for bushfire management, response and evacuation; d. has regular vehicle passing and turning areas for bushfire management, response and evacuation; e. allows access at all times for fire fighting vehicles; f. allows for maintenance, burning off and bushfire response; g. has vehicular links to an alternative through road; h. is readily maintained. Editor's note - Planning scheme policy 6 - Management of bushfire hazard provides details on alternative solutions for providing fire management access and evacuation	AO4 Access for fire management and evacuation is provided by vehicular access in the form of a perimeter road: a. with a minimum reserve width of 20 metres; b. located between the premises and adjoining vegetation; c. with a maximum gradient of 12.5 percent; d. constructed to otherwise comply with section 3.4 - Movement infrastructure standards of Planning scheme policy 5 - Infrastructure; e. that has a layout that does not include a cul-de-sac.	Performance Solution S5 Environmental recommend the driveway be constructed to the 'private access roads or driveways' design requirements as outlined in Table 8.2.5.3.C 'Road design requirements for emergency vehicle access', within of Section 8.2.5 Bushfire Overlay Code, to be confirmed by the Project Town Planner or Engineer. This would ensure the development sufficiently facilitates the movement of vehicles for firefighting and evacuation purposes. Access to the Church will be achieved by a pathway that connects to the driveway, which connects onto Thornbill Drive to the west. The driveway does not include a cul-de-sac and is entirely situated within areas of Low Potential Bushfire Intensity (equal to, or less than 4,000 kW/m^2).	
Water supply			
PO5 Development has access to adequate water supply for fire fighting purposes.	AO5 Development: a. is connected to a reticulated water supply scheme that has sufficient flow and pressure characteristics for fire fighting purposes at all times with a minimum pressure and flow of 10 litres per second at 200kPa; or	Complies S5 Environmental understand the subject site will be connected to a reticulated water supply which has sufficient flow and pressure characteristics to meet the Planning Scheme requirements.	

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
	b. has an on-site water storage in accordance with Table 8.2.3.3.2 - Water storage for fire fighting, dedicated or retained for fire fighting purposes that is made of fire resistant materials and is: i. a separate tank; or ii. a reserve section in the bottom part of the main water supply tank. Editor's note - The requirement in AO5 is: - in addition to the requirement for potable water supply/storage in AO2 in Table 9.4.3.3.1 - Infrastructure code: accepted development (subject to requirements) and assessable development.; - reflected in AO5 in Table 9.4.3.3.1 - Infrastructure code: accepted development (subject to requirements) and assessable development.		
For assessable development			
Community infrastructure			
PO6 Community infrastructure is not located in a bushfire hazard area or is able to function effectively during and immediately after a bushfire event.	AO6 Community infrastructure is: a. not located in a Bushfire hazard area identified on Bushfire hazard overlay map OM-03.00; or b. located to ensure that: i. the core services provided by the community infrastructure is able to function effectively during bushfire events; ii. access to the community infrastructure is not compromised by bushfire events; iii. the safe storage of valuable records, public records and items of cultural or historic significance is able to be maintained during a bushfire event.	Complies The existing dwelling which is to be renovated into a church will be located within a area of Low Potential Bushfire Intensity (< 4,000 kW/m^2), which is not hazardous.	

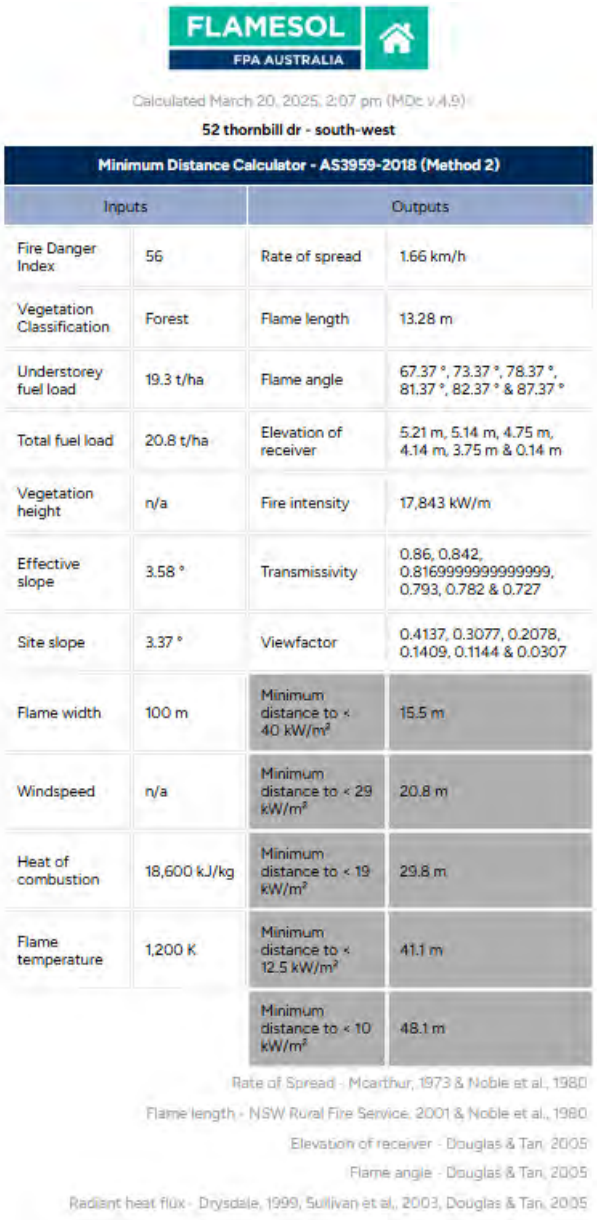
PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	COMMENTS ✓ Complies X Non-Compliance PS Performance Solution NA Not Applicable	COUNCIL USE ONLY
Hazardous materials			
PO7 Public safety and the environment are not adversely affected by the adverse impacts of bushfire on hazardous materials including fuels, explosives and flammable chemicals manufactured or stored in bulk on premises.	AO7 Hazardous materials: a. storage is in compliance with AS1940 - The storage and handling of flammable and combustible liquids; b. manufacturing does not occur in a Bushfire hazard area on Bushfire hazard overlay map OM-03.00.	Complies The proposed development is for a community facility (church), driveway and pathway and S5 Environmental understand will not involve the storage and handling of flammable and combustible liquids.	

APPENDIX B

Flamesol Inputs and Outputs

Summary of Input Parameters for Hazardous Vegetation to the South-west

Parameter	Input	Note
FFDI	56	Source: QFD BRC MapViewer.
Surface Fuel Load	19.3 t/ha	Surface and Near Surface Fuel Load – QFD VHC 9.1 Surface Fuel Loads. This is in line with BCC's Technical Bushfire Guide for the calculation of understorey or surface fuel loads.
Overall Fuel Load	20.8 t/ha	Total Fuel Load – QFD VHC 16.1 Total Fuel Loads.
Effective Slope	3.58 ^{o}	Hazardous vegetation is sited upslope of the proposed development. A minimum Effective Slope of 1 ^{o} was utilised.
Site Slope	3.37 ^{o}	Hazardous vegetation is sited upslope of the proposed development. A minimum Site Slope of 1 ^{o} was utilised.
Flame Temperature	1,200 K	Standard input in accordance with the BRC.
Flame Width	100 m	Standard input, in accordance with AS 3959-2018.



FLAMESOL
FPA AUSTRALIA

Calculated March 20, 2025, 2:07 pm (MDc v.4.9)

52 thornbill dr - south-west

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	56	Rate of spread	1.66 km/h
Vegetation Classification	Forest	Flame length	13.28 m
Understorey fuel load	19.3 t/ha	Flame angle	67.37 °, 73.37 °, 78.37 °, 81.37 °, 82.37 ° & 87.37 °
Total fuel load	20.8 t/ha	Elevation of receiver	5.21 m, 5.14 m, 4.75 m, 4.14 m, 3.75 m & 0.14 m
Vegetation height	n/a	Fire intensity	17,843 kW/m
Effective slope	3.58 °	Transmissivity	0.86, 0.842, 0.8169999999999999, 0.793, 0.782 & 0.727
Site slope	3.37 °	Viewfactor	0.4137, 0.3077, 0.2078, 0.1409, 0.1144 & 0.0307
Flame width	100 m	Minimum distance to < 40 kW/m²	15.5 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	20.8 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	29.8 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	41.1 m
		Minimum distance to < 10 kW/m²	48.1 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

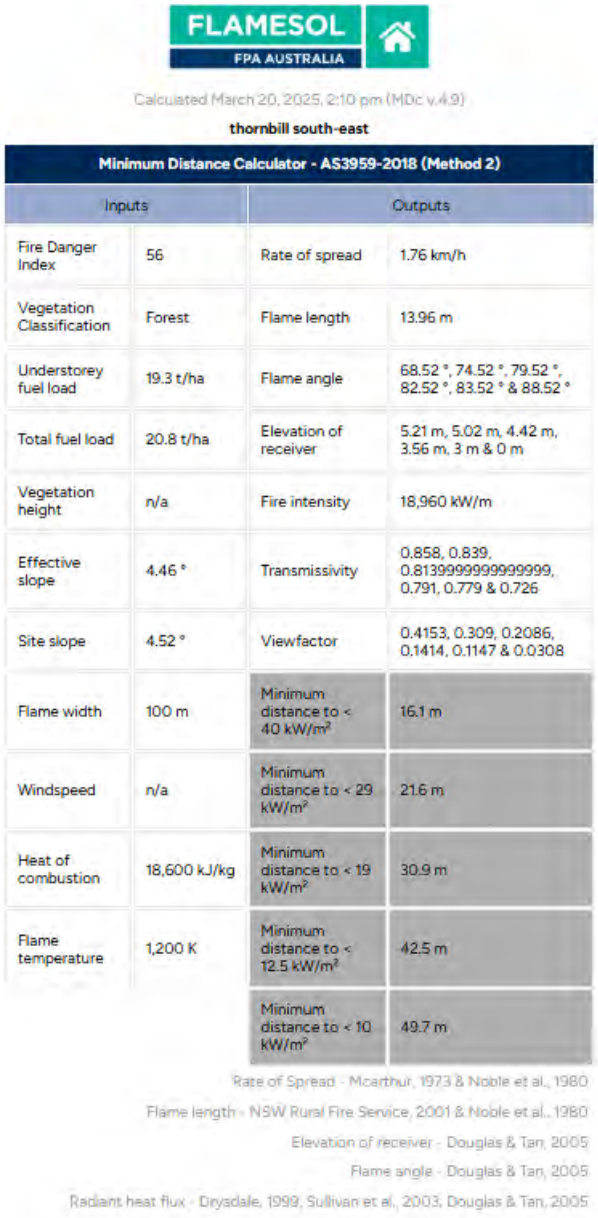
Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

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

Summary of Input Parameters for Hazardous Vegetation to the South-east

Parameter	Input	Note
FFDI	56	Source: QFD BRC MapViewer.
Surface Fuel Load	19.3 t/ha	Surface and Near Surface Fuel Load – QFD VHC 9.2 Surface Fuel Loads. This is in line with BCC's Technical Bushfire Guide for the calculation of understorey or surface fuel loads.
Overall Fuel Load	20.8 t/ha	Total Fuel Load – QFD VHC 9.2 Total Fuel Loads.
Effective Slope	4.46 ^{o}	The previous bushfire hazard assessment completed by Queensland Bushfire Planning (October 2021) for the proposed development used a Nikon Forestry Pro Range Finder and Inclinometer and determined the hazardous vegetation was downslope of the proposed development area.
Site Slope	4.52 ^{o}	Hazardous vegetation is sited directly up to the proposed residential development. A minimum Site Slope of 1 ^{o} was utilised.
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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FPA AUSTRALIA

Calculated March 20, 2025, 2:10 pm (MDc v.4.9)

thornbill south-east

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	56	Rate of spread	1.76 km/h
Vegetation Classification	Forest	Flame length	13.96 m
Understorey fuel load	19.3 t/ha	Flame angle	68.52 °, 74.52 °, 79.52 °, 82.52 °, 83.52 ° & 88.52 °
Total fuel load	20.8 t/ha	Elevation of receiver	5.21 m, 5.02 m, 4.42 m, 3.56 m, 3 m & 0 m
Vegetation height	n/a	Fire intensity	18,960 kW/m
Effective slope	4.46 °	Transmissivity	0.858, 0.839, 0.8139999999999999, 0.791, 0.779 & 0.726
Site slope	4.52 °	Viewfactor	0.4153, 0.309, 0.2086, 0.1414, 0.1147 & 0.0308
Flame width	100 m	Minimum distance to < 40 kW/m²	16.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	21.6 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	30.9 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	42.5 m
		Minimum distance to < 10 kW/m²	49.7 m

Rate of Spread - Mcarthur, 1973 & Noble et al., 1980

Flame length - NSW Rural Fire Service, 2001 & Noble et al., 1980

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

Radiant heat flux - Drysdale, 1999, Sullivan et al., 2003, Douglas & Tan, 2005

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

APPENDIX C

Slope Lines and Calculations

BUSHFIRE SLOPE CALCULATOR										
Vegetation to the South-west										
Effective Slope					**Site Slope**					
Direction	Upslope				Direction	Upslope				
Top Elevation	104	m			Top Elevation	102	m			
Bottom Elevation	102	m	Slope %	6.25%	Bottom Elevation	99	m	Slope %	5.88%	
Distance	32	m	**Slope (°)**	**3.58**	Distance	51	m	**Slope (°)**	**3.37**	
Vegetation to the South-east										
Effective Slope					**Site Slope**					
Direction	Downslope				Direction	Downslope				
Top Elevation	95	m			Top Elevation	98	m			
Bottom Elevation	87	m	Slope %	7.77%	Bottom Elevation	95	m	Slope %	7.89%	
Distance	103	m	**Slope (°)**	**4.45**	Distance	38	m	**Slope (°)**	**4.52**