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WILDFIRE MANAGEMENT SERVICES

Bushfire Attack Level Assessment and Development Report

for the subdivision of
112-126 Old Warrandyte Road, Donvale VIC 3111

Report prepared for

Mr Steve Matthews

May 2015

Report prepared by Terramatrix on behalf of Steve Matthews

Terramatrix project code: BAL-2015-03 Matthews-Donvale

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Version Control

Version	Date	Comments	Responsibility/ Distribution
1.0	05.05.14	Initial 'Method 1' BAL assessment and development report	JE/HA
2.0	15.05.15	Revised BAL assessment and report incorporating current site conditions and detailed 'Method 2' bushfire modelling	HA

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1 Introduction

This report details an assessment of the Bushfire Attack Level (BAL) construction standards likely to be applicable to dwellings in the subdivision at 112-126 Old Warrandyte Road, Donvale VIC 3111. It takes into consideration the current condition of the site, the future development and location of dwellings (based on designated building envelopes) and anticipated future vegetation management removal.

It should be noted that a BAL assessment is required for construction of the dwellings based on site conditions at the time of construction. This report incorporates proposed future vegetation management removal and determines likely applicable BALs in response to those conditions. The vegetation management standards, vegetation classifications and resultant BALs as determined in this report, should be checked to ensure they are applicable at the time of construction.

The whole site is in a designated Bushfire Prone Area (BPA). BPAs are those areas subject to or likely to be subject to bushfires, as determined by the Minister for Planning.

The Building Act 2003 and associated Building Regulations 2006, through application of the Building Code of Australia (BCA), require bushfire protection standards for certain classes of buildings in designated BPAs. The BCA requires that for certain defined classes of buildings:

'A building that is constructed in a designated bushfire prone area must, to the degree necessary, be designed and constructed to reduce the risk of ignition from a bushfire, appropriate to the—

(a) potential for ignition caused by burning embers, radiant heat or flame generated by a bushfire; and

(b) intensity of the bushfire attack on the building' (ABCB, 2013).

In Victoria applicable buildings must be constructed to a minimum BAL-12.5, or higher as determined by a site assessment or planning scheme requirement.

This report uses the Detailed Method (Method 2) from *AS 3959-2009 Construction of buildings in bushfire prone areas* (Standards Australia, 2009) to determine the BAL construction standards to be applied to the future dwellings.

2 Analysis

The author undertook a site assessment on 12 May 2015. The following steps have been used to determine the applicable BALs using the Detailed Method.

2.1 Forest Fire Danger Index (FFDI)

A FFDI of 100 has been applied.

2.2 Classified vegetation

Vegetation within 100m of all building envelopes was assessed. Vegetation more than 100 metres from the site is excluded from the assessment. Three types of classified vegetation apply.

'Woodland' occupies the central gully draining approximately west to east through the middle of the subdivision into the Mullum Mullum Creek (refer Figure 3). The area of Woodland approximates the Offset Zones (OZs) mapped by Ecology Australia and shown on Map 1 as OZ4, OZ5, OZ6 and OZ7. These areas have a variable foliage cover that in places exceeds the 30% threshold for a Forest classification, however, the fuel hazard of this central gully is more commensurate with Woodland, and thus this classification has been applied for the purposes of determining likely future setbacks and BALs for lots adjacent to this gully. Ongoing woody weed control is also occurring in this gully, which will further reduce elevated fuels and bring the understory vegetation further inline with a Woodland classification

The remnant riparian vegetation that occurs along the Mullum Mullum Creek, comprising OZ8, OZ9 and OZ12 (refer Map 1) has been conservatively classified as 'Forest'. This classified vegetation is not homogenous from a bushfire hazard perspective and fuel loads within it are highly variable (refer Figure 2 and Figure 7). Some areas are more heavily vegetated with a denser midstorey resulting in a higher elevated fuel hazard whilst other areas are more open and lacking a midstorey component i.e. they comprise not much more than a mature tree canopy cover over unslashed grass. The Forest classification is therefore considered precautionary although it is noted that ecological management and regeneration over time of the OZs may increase the fuel hazard.

Unslashed grass areas (with overstorey foliage cover less than 10%) are classified as Grassland under the AS3959-2009 methodology. Depending on their proximity to he dwellings, (unmanaged) Grassland areas may affect BALs for dwellings in addition to the Woodland and Forest patches.

It is important to note that this report assumes other areas within the site will be in a low threat or non-vegetated state at the time of construction i.e. they will meet one or more of the criteria for exclusion as specified in Table 1 below.

Table 1 - Exclusion criteria (low threat vegetation and non-vegetated areas) as per Section 2.2.3.2 of AS 3959-2009 (Standards Australia, 2009).

Exclusions under *AS 3959-2009*
(a) Vegetation of any type that is more than 100 m from the site.
(b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
(c) Multiple areas of vegetation less than 0.25 ha in area and not within 20m of the site, or each other.
(d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
(e) Non-vegetated areas, including waterways, roads, footpaths, buildings and rocky outcrops.
(f) Low threat vegetation including grassland managed in a minimal fuel condition (i.e. there is insufficient fuel available to significantly increase the severity of the bushfire attack, such as short cropped grass to a nominal height of 100mm), maintained lawns, golf courses, maintained public reserves and parklands, vineyards, orchards, cultivated gardens, commercial nurseries, nature strips and windbreaks.

Excluded areas include the cultivated gardens and areas of existing residential development within the 100m site assessment zone, proposed and existing roads and road reserves, all land within proposed lot boundaries and open grassland areas on public open space between the lots and patches of classified vegetation/proposed offset management zones.

OZ1, OZ2 and OZ3 are currently small patches of trees (with scattered shrubs) with a grassy understorey (refer Figure 6). They have been excluded in accordance with criteria C above.

Figure 1 - Looking northeast across Lots 1 and 2 at land on Mullum Mullum Creek flats just north of OZ12.

Figure 2 - Looking east at land below lots 3 and 4.

Figure 3 - Looking south at Woodland in the central gully.

Figure 4 - Looking west at OZ5.

Figure 5 - Looking east-southeast across middle group of lots above OZ9.

Figure 6 - Looking east-southeast at OZs 1, 2 and 3.

Figure 7 - Looking north at Forest on creek flats below lot 32 and 39.

2.3 Effective slope

The effective slope refers to the slope under the classified vegetation and is not necessarily the same as the slope between the classified vegetation and the building. Three effective effective slope classes have been applied in this assessment:

- *'All upslopes and flat land'* - Forest areas on the Mullum Mullum Creek flats
- *'Downslope >5° to 10°'* - Woodland on the southern side of the central gully
- *'Downslope >10° to 15°'* - Woodland on the northern side of the central gully

2.4 Bushfire behaviour modelling and BALs

Potential fire behaviour, resultant radiant heat impacts and BAL setback distances, have been calculated using the detailed method of AS 3959-2009. The resultant modelled setback distances are based on a 25% reduction rate of spread (ROS) (and resultant intensity) as credible fire behaviour will be less than the steady state ROS presumed in the AS 3959-2009 model, due to multiple factors including:

- Most, if not all of the lots adjacent to the proposed reserves are likely to experience fire impacts from the flank of a fire, which will result in significantly reduced fire intensity and hence radiant heat impacts than the head fire presumed in the AS3959-2009 model;
- Tindals Road provides a fuel break for the most likely fire scenario, which is a bushfire approaching along the creek driven by a north-northwesterly wind, and is likely to moderate the rate of spread;
- The Forest vegetation along the Mullum Creek has an average width of approximately 30m-50m which will constrain the ROS and results in reduced radiant heat impacts;
- A bushfire in the central gully will not result in a steady state rate of spread up either the northern side or the southern side of the gully as these are very short slopes;
- Any bushfire from local ignitions will not have time to 'fully develop'; and
- The majority of the hazard is to the east of the development, a direction not typically associated with extreme fire weather.

The interplay of these factors combined with the variability of the fuel hazard and the terrain may result in complex fire behaviour. Bushfire modelling outcomes also have a high degree of uncertainty due to the need to simplify or make assumptions about inherently complex systems including vegetation, topography and weather. It is therefore imperative that all fire behaviour modelling be seen only as an indicative rather than authoritative description of potential fire behaviour on a site. Cruz and Alexander (2013) found that only 3% of modelled outcomes represented observed outcomes for rates of spread in surface and crown fires, and suggested an error interval of $\pm$ 35% is a reasonable standard for assessing model performance.

Notwithstanding these qualifications, it is considered that the 25% reduction in rate of spread (and intensity) is justified in the method 2 approach, by the site characteristics and likely bushfire scenarios listed above.

The 25% reduction factor has been applied across the site (with the exception of Lot 1, as explained below) as the most conservative of three main impact scenarios, namely; a reduced rate of spread stemming from an accelerating fire; a reduction in radiant heat flux from a reduction in the head fire width from 100m to 50m; and a reduction in intensity as a result of exposure from the flank of a fire. The first two scenarios will result in a greater reduction than the 25% estimated from the third scenario.

The 25% figure represents an estimate of the reduction in intensity that occurs in proportion to the distance along the flank of a fire from the head (front) of the fire, based on Catchpole et. al. (1992). The length to breadth ratio was first calculated following the approach of Tolhurst (2007) by assuming 0km/hr wind speed (and other weather inputs being constant) driving fire growth at 90° to the head of the fire and a resultant FFDI of 35, to determine lateral rate of spread. The resultant theoretical elliptical shape and flank fire intensities as a proportion of head fire intensity, for a fire with a L:B ratio of 3, is shown in Figure 8.

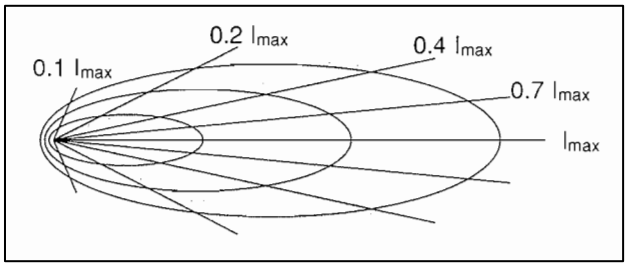

Figure 8 - Fireline intensities for a simple elliptically shaped fire showing the proportional reduction in intensity the further the distance back along the perimeter from the fire front (at Imax) (Catchpole et. al., 1992).

The resultant reduced setback distances for BAL-12.5 and BAL-19, based on the 25% reduction in intensity and rate of spread, are provided in Table 2 and shown in Map 1 as coloured transparent buffers. Map 1 shows that most, if not all, of the dwellings in the subdivision can be constructed to a BAL-12.5 standard if vegetation within the setback areas is managed to meet the criteria of excludable vegetation, as per Table 1.

It should be noted that many if not all of the dwellings will be setback further from the classified (unmanaged) vegetation then the building envelope edge that the modelled BAL distances have been measured from, and therefore the default AS 3959-2009 distances may in fact be achieved for many or even all lots.

The one possible exception is likely to be Lot 1, which is exposed to the Forest vegetation north of Old Warrandyte Rd. This lot may be subject to a direct head fire approach, with a potential 100m wide flame front at a steady state rate of spread. Accordingly, the detailed method 2 distances in Table 2 are not applicable and at least the northern elevation of the dwelling on this lot should be built to the BAL standard commensurate with the applicable default AS 3959-2009 distance i.e. BAL-12.5 if 48m or more of separation from the Forest to the north can be achieved, BAL-19 if 35m to less than <48m is the setback distance.

Table 2 - Possible BAL setback options (modelled and default AS 3959-2009 distances).

Vegetation	Slope Class	BAL setbacks (m)			
		Modelled		AS 3959 -2009 defaults	
		BAL-12.5	BAL-19	BAL-12.5	BAL-19
Forest	Flat/Upslope	41	30	48	35
	>5°-10°	59	44	69	53
Woodland	>5°-10°	42	30	50	37
	>10°-15°	51	38	60	45
Grassland	Flat/Upslope	n/a	n/a	19	13
	>0°-5°	n/a	n/a	22	15
	>5°-10°	n/a	n/a	25	17
	>10°-15°	n/a	n/a	28	20
	>15°-20°	n/a	n/a	32	23

Map 1 - Modelled BAL-12.5 setbacks and implications for OZs

3 Implications for future vegetation management and BALs

As has been discussed with Manningham City Council, it is recommended that those parts of OZs 4, 5, 6 and 7 that are within the coloured BAL-12.5 setbacks in Map 1, be managed in a low threat state commensurate with the exclusion criteria in Table 1. It is the authors understanding that this has been agreed to. If the grass within the red dotted lines (i.e. the land within 28m of the building envelopes) is also managed in a low threat state, the dwellings on Lots 5, 14, 15, 21, 22, 23, 24, 25, 26, 27 and 28 should be able to be built to a BAL-12.5 standard.

The BALs for dwellings on Lots 1, 2, 3 and 4 will be influenced by the vegetation management in the adjacent OZ12 (and OZ8). At the time of the site assessment (12-05-2015) this offset zone comprised long grass with an overhead tree canopy of around 10% and therefore could be classified as Grassland. If this grass is managed in a low threat state for at least 22m from the building envelopes (or dwelling) (shown as a yellow dotted line in Map 1), AND Forest vegetation is not within the yellow 41m setback shown, then a BAL-12.5 may be achievable for these lots (refer Section 2.4 above for discussion about Lot 1 northern elevations).

Lots 42, 43, 49, and 50 are potentially exposed only to Grassland as they are a sufficient distance from the Forest along the creek and OZs 1, 2 and 3 have been excluded under criteria C in Table 2. The required extent of grassland management in relation to these lots for a BAL-12.5 standard is 28m.

Lots 53-56 are sufficiently setback from the Forest on the creek flats for a BAL-12.5 standard (41m as shown by the yellow buffer in Map 1). For a BAL-12.5 the grass must also be managed for at least 28m from the dwellings (shown as a red dotted line around the building envelopes).

4 Conclusion

The bushfire analysis and method 2 modelling in this report shows that all lots should be able to achieve a BAL-12.5 construction standard if dwellings can be setback the commensurate modelled distances as per Table 2 in this report. This takes into consideration the current condition of the site, the future development and location of dwellings (based on the designated building envelopes) and anticipated future vegetation management removal.

This will however require the removal or management in a 'low threat state', of some areas of vegetation in OZs 4, 5, 6 and 7. Grassland must also be managed between 22-28m from the dwellings during the construction period/at the time of occupancy.

Future revegetation or enhancement of OZ12 may also have implications for BALs on lots 2, 3 and 4.

Appendix 1. Bushfire Attack Levels (BALs) explained.

Table 3 - Bushfire Attack Levels (BALs) explained (derived from *AS 3959-2009*, Standards, Australia, 2009).

Bushfire Attack Level (BAL)	Risk Level	Construction elements are expected to be exposed to…	Comment
BAL-Low	VERY LOW: There is insufficient risk to warrant any specific construction requirements but there is still some risk.	No specification.	At 4kW/m² pain to humans after 10 to 20 seconds exposure. Critical conditions at 10kW/m² and pain to humans after 3 seconds. Considered to be life threatening within 1 minute exposure in protective equipment.
BAL-12.5	LOW: There is risk of ember attack.	A radiant heat flux not greater than 12.5 kW/m²	At 12.5kW/m² standard float glass could fail and some timbers can ignite with prolonged exposure and piloted ignition.
BAL-19	MODERATE: There is a risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to radiant heat.	A radiant heat flux not greater than 19 kW/m²	At 19kW/m² screened float glass could fail.
BAL-29	HIGH: There is an increased risk of ember attack and burning debris ignited by windborne embers and a likelihood of exposure to an increased level of radiant heat.	A radiant heat flux not greater than 29 kW/m²	At 29kW/m² ignition of most timbers without piloted ignition after 3 minutes exposure. Toughened glass could fail.
BAL-40	VERY HIGH: There is a much increased risk of ember attack and burning debris ignited by windborne embers, a likelihood of exposure to a high level of radiant heat and some likelihood of direct exposure to flames from the fire front.	A radiant heat flux not greater than 40 kW/m²	At 42kW/m² ignition of cotton fabric after 5 seconds exposure (without piloted ignition).
BAL- FZ (i.e. Flame Zone)	EXTREME: There is an extremely high risk of ember attack and a likelihood of exposure to an extreme level of radiant heat and direct exposure to flames from the fire front.	A radiant heat flux greater than 40 kW/m²	At 45kW/m² ignition of timber in 20 seconds (without piloted ignition).

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