



# Bushfire Constraints Assessment

**Lot 5/DP825745, 2 Macarthur Drive, Holsworthy, NSW**

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The document status, as outlined below, chronologically outlines the report versions and their purpose. The initial Bushfire Threat Assessment of the subject site has been prepared by RPS, and a subsequent review and sign off undertaken by Ted Smith from Peak Land Management (Level 3 Accredited BPAD).

**Document Status**

Version	Purpose of Document	Orig	Review	Review Date
V1	Draft for Interval Review	SG	AO/RD	Dec 2016
V2	Draft for Interval Review	TS	AO/RD	May 12, 2017
V3	Final Review	TS	AO/RD	May 18, 2017
V4	Final Review	TS	AO/RD	May 26, 2017

Approval for Issue

Name	Signature	Date
Ted Smith		26 <sup>th</sup> May 2017

BPD-PD Certification



Ted Smith  
BPD-PD-17671 Accredited Bushfire Practitioner

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# List of Abbreviations

Abbreviation	Meaning
APZ	Asset Protection Zone
AS2419-2005	Australian Standard – Fire Hydrant Installations
AS3959-2009	Australian Standard – Construction of Buildings in Bush Fire Prone Areas
BCA	Building Code of Australia
BRMC	Bushfire Risk Management Committee
BFRMP	Bush Fire Risk Management Plan
BPA	Bush Fire Prone Area (Also Bushfire Prone Land)
BPL	Bush Fire Prone Land
BPL Map	Bush Fire Prone Land Map
BPMs	Bush Fire Protection Measures
BTA	Bushfire Threat Assessment
<i>EP&amp;A Act</i>	<i>NSW Environmental Planning and Assessment Act 1979</i>
FDI	Fire Danger Index
FMP	Fuel Management Plan
ha	hectare
IPA	Inner Protection Area
LEP	Local Environment Plan
LGA	Local Government Area
OPA	Outer Protection Area
MFZ	Managed Fuel Zone
PBP	Planning for Bushfire Protection 2006
RF Act	Rural Fires Act 1997
RF Regulation	Rural Fires Regulation
RPS	RPS Australia East Pty Ltd

## 1.0 Introduction

RPS has been engaged by Architectus, to undertake a Preliminary Bushfire Constraint Assessment on the potential bushfire hazard on and surrounding Lot 5/ DP825745, 2 Macarthur Drive, Holsworthy NSW (**Figure 1**).

The assessment aims to consider and assess the bushfire hazard and associated potential threats the site may be exposed to, and to outline the minimum mitigative measures which may be required to suitably ameliorate the potential bushfire hazard that may affect the future development of the site.

This document aims to provide additional information for consideration for future development design that will assist in achieving the required bushfire protection measures, whilst aiming to attain the desired development outcome for the site.

### 1.1 Site Particulars

The site is located at 2 Macarthur Drive, Holsworthy within the City of Liverpool Local Government Area (LGA).

The site is described as Lot 5/ DP825745 and has an area of 1.86 ha. This area consists of a large cleared section of land with bare soil, along with maintained grassed areas with sparse trees and shrubs.

Boundaries of the site include Heathcote Road to the north and east, railway tracks and army barracks to the south, and residential housing to the west. According to the City of Liverpool Local Environmental Plan 2008 the site is located within a Bushfire Vegetation Buffer (see **Figure 2**), indicating the site is within Bushfire Prone Land.

The site is located on land zoned as B2 – Local Centre, with surrounding land zoned as SP2 – Infrastructure, and R4 – High Density Residential (refer to **Figure 3**). Army barracks are located to the south of the site.

<b>Address:</b>	2 Macarthur Drive, Holsworthy , NSW
<b>Lot on Plan:</b>	Lot 5/ DP825745
<b>Site Area:</b>	1.86 ha
<b>Easements:</b>	-
<b>Existing Land Uses :</b>	B2 – Local Centre Cleared Land
<b>Surrounding Land Uses:</b>	SP2 – Infrastructure, and R4 – High Density Residential



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**Legend**

- Site Location
- Cadastre



TITLE : <b>FIGURE 1 - SITE LOCATION</b>	LOCATION : <b>HOLSWORTHY, NSW</b>	DATUM:GDA 1994	DATE : <b>15/05/2017</b>	VERSION (PLAN BY): AA3 (amy.obrien)
		PROJECTION: GDA 1994 MGA Zone 56	PURPOSE: <b>BTA</b>	PATH: J:\OBS\134k\134701 Holsworthy\10 - Drafting\Arcgis Map Documents\BTA\ArcGIS mapping documents\134701 Figure 1 Site Location AA3 20161213.mxd



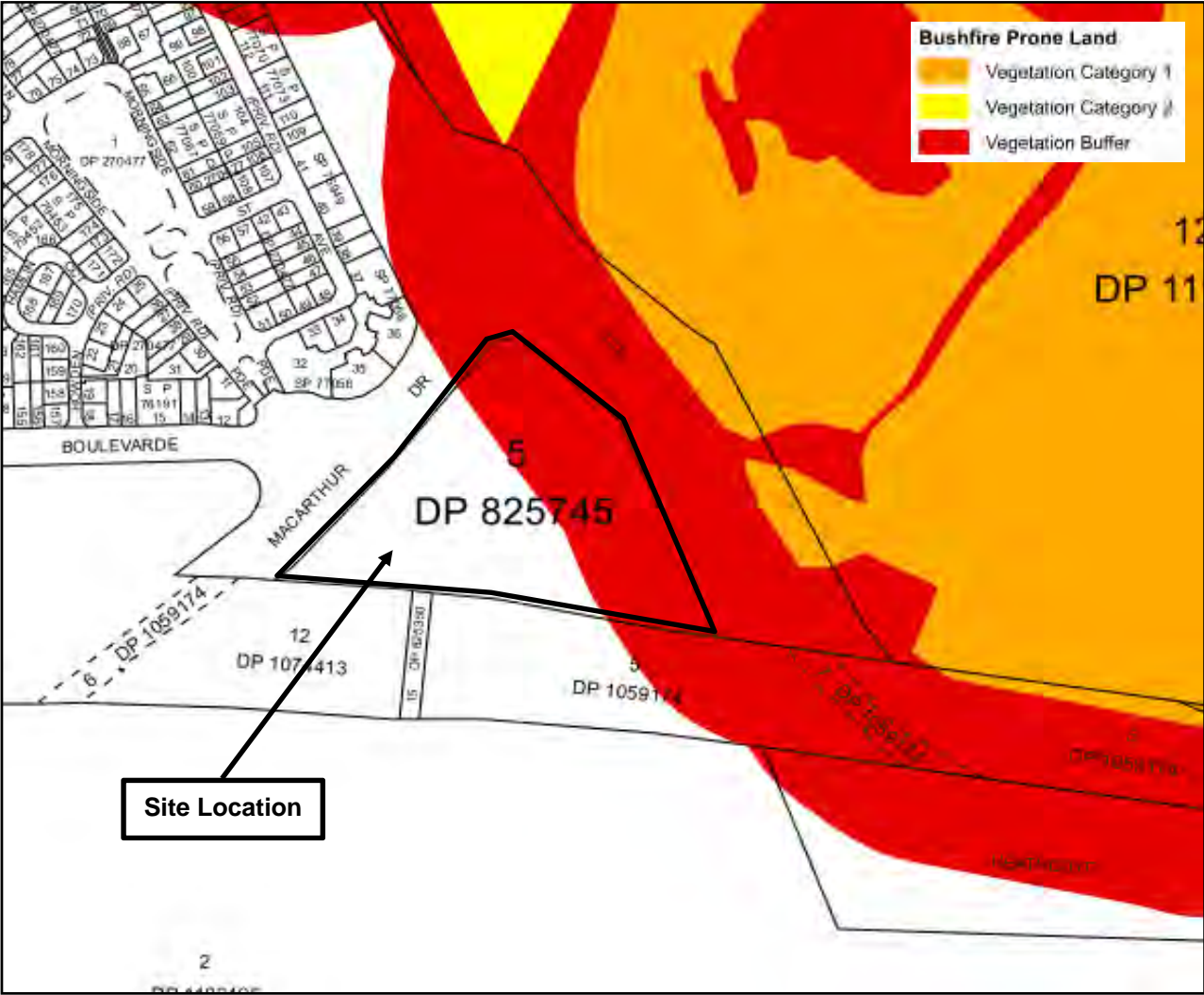


Figure 2 Bushfire Prone Land Map of the Site (Liverpool City Council Bushfire Prone Land Map)



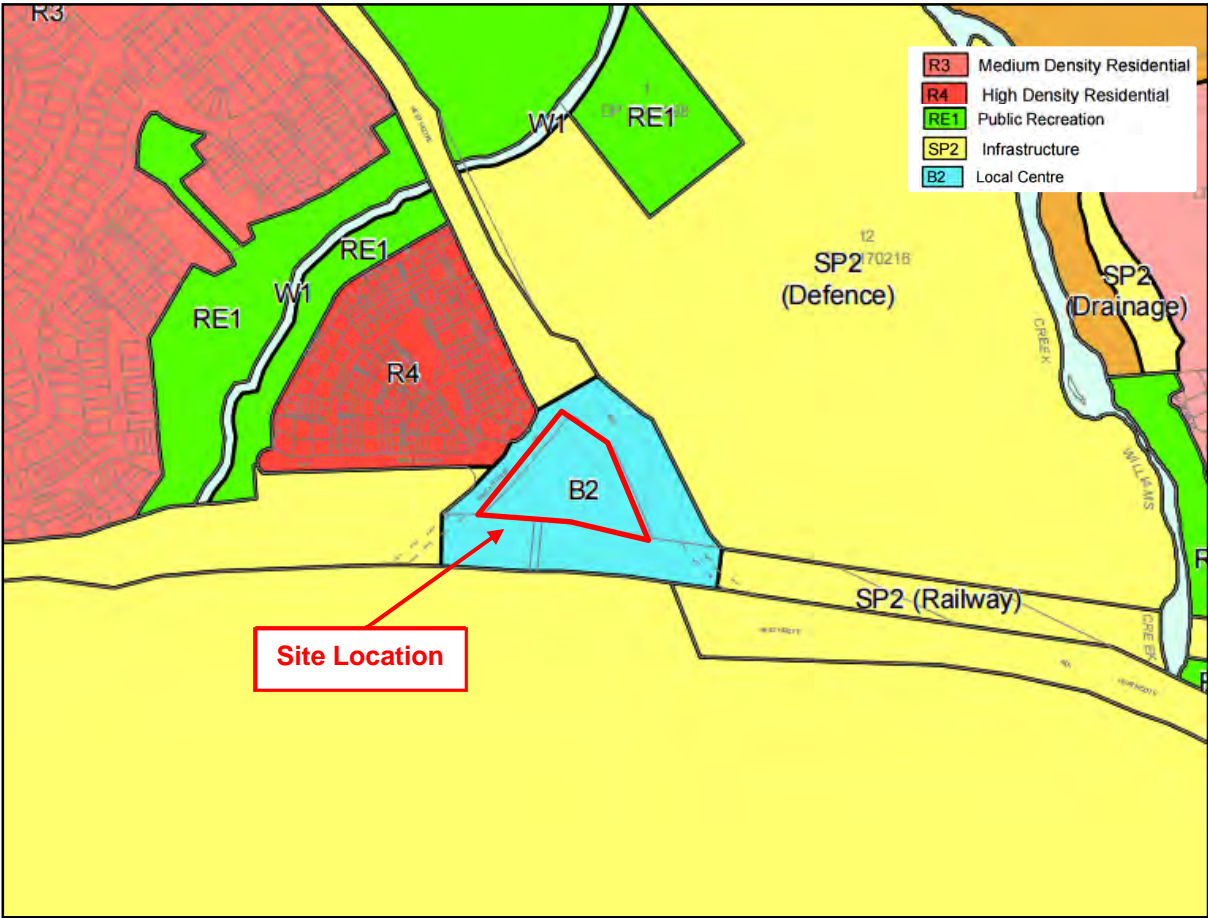


Figure 3 Land Zoning (Liverpool Local Environmental Plan 2008 Sheet LZN-015)

**1.2 Description of Potential Additional Land Uses**

It is understood the proposed development includes the construction of multiple storey residential buildings consisting of approximately 400 apartments, a community space, childcare facilities, retail buildings and car parking.

It is noted that childcare facilities are classified as Special Fire Protection Purpose’s (SFPP) and development of accommodation and childcare facilities are not permitted within Asset Protection Zones (APZ’s) or Managed Fuel Zones (MFZ’s). Furthermore, childcare facilities have been modelled (**Appendix 1**) and are likely to require a minimum 88 metre buffer from the nearest bushfire hazard, or 43 m from the eastern boundary.

**1.3 Aims of Assessment**

The overall outcome of this assessment is to demonstrate that the development does not increase the risk caused by bushfires to people, property or public safety.

- To determine the classification of the vegetation on and surrounding the development (out to a distance of 140 metres beyond the property boundary), in accordance with the vegetation classification system contained in AS3959-2009;
- Undertake an assessment of this vegetation to determine if it is deemed to be a bushfire hazard;
- Undertake an assessment to determine the slope of the land on and surrounding the development;
- Undertake a bushfire assessment of the site that considers the following matters:

- 
- » The extent to which any future development will require a setback (Asset Protection Zone/defendable space);
  - » The siting and adequacy of water supplies for fire fighting purposes;
  - » The capacity of internal roads to handle increased volumes of traffic in the event of a bushfire emergency;
  - » Whether or not internal roads in the vicinity have two-way access;
  - » The adequacy of emergency access/egress to the site;
  - » The adequacy of bushfire maintenance plans and fire emergency procedures for the proposed development; and
  - » The construction standards to be used for any future buildings within the proposed development.

The objective of bushfire hazard management for any development, including places of employment is as follows:

- Development avoids natural hazard areas or mitigates the risk of the natural hazard;
- Development supports, and does not unduly burden, disaster management response, or recovery capacity and capabilities;
- 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;
- Development avoids the risk 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; and
- Development maintains or enhances natural processes and the protective function of landforms and vegetation that can mitigate risks associated with the natural hazard.



## 2.0 Bushfire Hazard Assessment

### 2.1 Vegetation Assessment

In accordance with the RFS Planning for Bushfire Protection 2006 (PBP 2006), an assessment of the vegetation over a distance of 140 m in all directions from the site was undertaken.

The site is surrounded predominantly by residential and industrial curtilage to the west and south, Heathcote Road to the east, Macarthur Drive to the west, and a railway line to the south.

The primary bushfire hazard is located on land to the east. This land is zoned as defence land (SP2) managed by the Commonwealth Government adjoining the Georges River. The vegetation has been identified as Dry Sclerophyll Forest (**Figure 4 & Plate 4**). It is around 20 m in height, with a shrub understorey, and has numerous trails throughout it.

Where vegetation has <10% tree canopy cover and unmanaged understorey it has been assessed as Grassland. This occurs to the east of the site near mapped Forest in one area that has been predominantly cleared of trees.

Where separate discrete parcels of Forest occur which are >20 m lateral separation from any other Forest remnant, and are <1 Ha or <50 m wide fire run towards the subject site, they have been assessed as equivalent to Rainforest as per PBP 2006. This occurs to the south-east of the subject site.

A small strip of unmanaged and managed Grassland occurs around the site to the east, and south, being around 20 m wide. It has been taken here conservatively as unmanaged Grassland, however with the approval of the relevant landowners could easily be managed (slashed a few times each year) and assessed as no hazard if this occurred (**Plate 1-3 & 5**).

It should be noted that PBP 2006 does not take into account Grasslands as a hazard, however AS 3959 does.

The vegetation over the subject site is cleared and managed land (**Plate 3**).



**Plate 1 Grassland hazard south of the site**



**Plate 2 Grassland hazard east of the site along Heathcote Road**





**Plate 3 Heathcote Road looking west towards the site**



**Plate 4 Forest Hazard east of the site**





Plate 5 Vegetation along railway south of the site

## 2.2 Effective Slope Assessment

For the purpose of this bushfire assessment, the land on and surrounding the site has been assessed through aerial photograph and a site inspection. The effective slope influencing fire behaviour approaching the site has been conducted by measuring the worst-case scenario slope where the vegetation occurs over a 100 m distance.

The site itself is located on relatively flat terrain at approximately 13 m above sea level. Land underlying vegetation surrounding the site consists of slopes varying between 0.5 and 6.05 degrees downslope, steepest downslope east of the site as it falls away from Heathcote Road (**Figure 4**).



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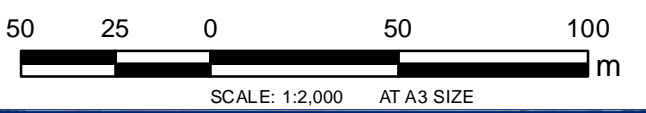


**Legend**

- RL
- 1 m Contours
- Transect
- Site Location
- 100 m Slope Buffer
- 140 m Vegetation Buffer
- Cadastre

**Class**

- Water
- Cleared/ Managed Land
- Forest
- Grassland
- Woodland < 1 ha equiv Rainforest



<b>TITLE :</b> FIGURE 4 - VEGETATION AND SLOPE ASSESSMENT	<b>LOCATION :</b> HOLSWORTHY, NSW	<b>DATUM:</b> GDA 1994	<b>DATE :</b> 15/05/2017	<b>VERSION (PLAN BY):</b> AA3 (amy.obrien)
		<b>PROJECTION:</b> GDA 1994 MGA Zone 56	<b>PURPOSE:</b> BTA	<b>PATH:</b> J:\JOBS\134k\134701 Holsworthy\10 - Drafting\Arcgis Map Documents\BTA\ArcGIS mapping documents\Figure 2 Slope and Vegetation Assessment AA3 20161206.mxd



### 3.0 Bushfire Attack Level Assessment

#### 3.1 Radiant Heat Exposure

Based on the unique site characteristics identified by the Bushfire Threat Assessment, the intensity of a potential bushfire event presented as the radiant heat exposure was calculated at several locations throughout the development site.

The NBC Bushfire Attack Assessor was used to calculate the radiant heat exposure based on the methodology detailed under Method 2 by AS 3959-2009 Construction of buildings in bushfire prone areas. Nine transects were selected based on the slope and vegetation that would have greatest influence on fire behaviour. Although several fire runs do not expose the site to the entire width of the fire front, the calculations assume the site is exposed to a 100m flame width with the fire run approaching perpendicular to the site.

**Appendix 1** provides the results of the modelling for each transect in order to achieve BAL-29 setback

Transect	Direction of Hazard	Vegetation Classification	Slope	Overall Fuel Load t/ha	BAL-29 Separation Distance (m)
1	NE	Forest	1.72° downslope	25	32
2	E	Grassland	5.04° upslope	6	9
3	E	Forest	6.05° downslope	25	39
4	S	Grassland	0.57° upslope	6	9
5	S	Grassland	1.15° upslope	6	9
6	W	Grassland	0.57° downslope	6	10

#### 3.2 Residential Purposes

Buildings of Class 1-4 of the Building Code of Australia including residential dwellings and residential units must meet the BCA which calls up AS3959-2009 which details a set of ‘Deemed-to-Satisfy’ building provisions. The general aims and objectives of PBP 2006 also apply in relation to other matters such as Asset Protection Zones, access, water and services, emergency planning and landscaping/ vegetation management.

Under PBP 2006 the nominated Asset Protection Zone as set out in the Table above and **Figure 5** needs to be provided, and future dwellings/unit blocks constructed to the relevant BAL (29 or lower) as determined by AS 3959, and a detailed bushfire report to be completed later.

#### 3.3 Special Fire Protection Purposes

Special Fire Protection Purposes (SFPP) means the occupants of the proposed development may be more vulnerable to bush fire attack and therefore may require greater protection from such threats as well as assisted evacuation.

Section 4.2.3 of the NSW Rural Fire Service PBP 2006 provides protection measures for SFPP developments; such as child care centres. In comparison to a standard residential development where radiant heat levels of no greater than 29 kW/m<sup>2</sup> are acceptable, radiant heat levels of no greater than 10kW/m<sup>2</sup> must not be experienced by emergency services workers aiding occupants



evacuating a child care centre. To achieve radiant heat levels of less than 10 kW/m<sup>2</sup>, APZs of 88m have been modelled (**Figure 5**), or 43m from the eastern boundary of the subject site.

### 3.4 Other Development

Buildings of Class 5 to 8 and 10 of the Building Code of Australia including offices, warehouses and other commercial or industrial facilities are considered as Other Development by PBP 2006. The BCA does not provide any bushfire specific performance requirements and as such AS3959-2009 does not apply as a set of 'Deemed-to-Satisfy' building provisions. The general aims and objectives of PBP 2006 apply in relation to other matters such as access, water and services, emergency planning and landscaping/ vegetation management. The follow objectives are therefore applied to these types of development:

- To provide safe access to/from the public road system for firefighters providing property protection during a bushfire and for occupant egress during evacuation;
- To provide adequate services of water for the protection of buildings during and after the passage of bushfire and to locate gas (connections and bottles) and electricity so as not to contribute to the risk of fire to a building; and
- To provide suitable emergency and evacuation (and relocation) arrangements for occupants of the development and consideration of storage of hazardous materials away from the hazard wherever possible.

### 3.5 Access

In the unlikely event of a serious bushfire, it will be essential to ensure that adequate ingress / egress and the provision of defendable space are afforded in the subdivision layout. The following recommends design specifications for perimeter roads (also see **Appendix 2**):

- Be two-wheel drive all weather roads;
- Perimeter roads are two-way with a minimum 8m wide kerb to kerb;
- Public roads between 6.5 metres and 8 metres wide are No Parking on one side with services (hydrants) located on this side;
- Public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays;
- Be through roads, but if unavoidable then dead ends should be not more than 200 metres in length, incorporate a minimum 12 metres turning circle (either in cul-de-sac or T-head formation) and should be clearly sign posted as dead ends;
- The capacity of road surfaces is sufficient to carry fully loaded fire fighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes for all other areas);
- Non perimeter roads comply with table – Road widths for Category 1 Tanker;
- Curves of roads (other than perimeter roads) are a minimum inner radius of 6 metres and minimal in number, to allow for rapid access and egress;
- Maximum grade for sealed roads do not exceed 12.5°;
- Have a minimum vertical clearance to a height of four metres at all times; and
- Parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays.



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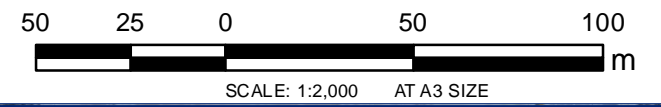


**Legend**

- RL
- 1 m Contours
- Transect
- Site Location
- 100 m Slope Buffer
- 140 m Vegetation Buffer
- Special Fire Protection Development Setback (43 m from boundary)
- Cadastre

**Class**

- Water
- Cleared/ Managed Land
- Forest
- Grassland
- Woodland < 1 ha equiv Rainforest



<b>TITLE :</b> FIGURE 5 - SPECIAL FIRE PROTECTION DEVELOPMENT SETBACK	<b>LOCATION :</b> HOLSWORTHY, NSW	<b>DATUM:</b> GDA 1994	<b>DATE :</b> 18/05/2017	<b>VERSION (PLAN BY):</b> AA3 (amy.obrien)
		<b>PROJECTION:</b> GDA 1994 MGA Zone 56	<b>PURPOSE:</b> BTA	<b>PATH:</b> J:\JOBS\134k\134701 Holsworthy\10 - Drafting\Arcgis Map Documents\BTA\ArcGIS mapping documents\Figure 5 Special Fire Protection setback AA3 20170515.mxd



## 4.0 Conclusion and Recommendations

It is clear from this investigation and assessment the site constitutes Bushfire Prone Land. The severity of a potential bushfire attack from the existing bushfire hazard within and surrounding the site was calculated using Method 2 under AS3959-2009. Although non-habitable buildings (offices, commercial and industrial structures) are not required to be constructed to satisfy AS3959-2009, it is generally accepted good practice that any building frequently occupied by persons should be located to avoid exposure to radiant heat levels greater than  $29 \text{ kW/m}^2$ .

The results of the radiant heat modelling concluded that a reasonable separation distance of 39m would satisfy the Aims and Objectives PBP 2006 for these commercial buildings, although they can be located closer if required.

In summary, the following key recommendations have been generated for consideration during the design process for any future development of the site:

- A combination of Asset Protection Zones (APZ) separating all occupied residential and commercial buildings from the surrounding bushfire threat to the west, south east, and east to ensure that no residential buildings, and where feasible no frequently occupied commercial buildings are exposed to radiant heat levels greater than  $29 \text{ kW/m}^2$ . In this case this equates to 39 m from the hazard to the east, or approximately 0m from the eastern boundary and therefore can be achieved with no bushfire Asset Protection Zone /siting constraints;
- Any SFPP developments (child care centres) shall be located so as to ensure they are  $<10 \text{ W/m}^2$  radiant heat exposure. In this case this equates to 88 m from the hazard to the east, or approximately 43 m from the eastern boundary;
- Residential dwellings/units within the site should have due regard to the specific considerations given in the BCA, which makes specific reference to the Australian Standard (AS3959 – 2009) construction of buildings in bushfire prone areas;
- Internal roads are to be constructed in accordance with PBP 2006, preferably 8m wide, however 6m wide would be acceptable subject to no parking along the kerbside;
- Consideration should be given to landscaping and fuel loads on site to decrease potential fire hazards on site;
- Any proposed development are to be linked to the existing mains pressure water supply and that suitable hydrants be clearly marked and provided for the purposes of bushfire protection. Fire hydrant spacing, sizing and pressure should comply with AS2419.1, 2005;
- An Emergency Management Plan shall be prepared identifying onsite refuge areas/shelters in place and emergency refuge areas; in accordance with the NSW Rural Fire Service 'Neighbourhood Safer Places' guidelines 2012/2013; and
- Should any future development occur on the site, we recommend a comprehensive Bushfire Threat Assessment (BTA) is undertaken to more accurately determine the bushfire hazard and recommend a series of bushfire mitigation measures that in combination will suitably manage the risk to life and property from the threat of bushfire attack, and address legislation requirements.

## Appendix I

### Radiant Heat Modelling Report



#### NBC Bushfire Attack Assessment Report V2.1

AS3959 (2009) Appendix B - Detailed Method 2

**Print Date:** 12/05/2017

**Assessment Date:** 12/05/2017

**Site Street Address:** 2 Macarthur Dr, Holsworthy  
**Assessor:** Ted Smith, PEAK LAND MANAGEMENT BPAD Certified Practitioner  
**Local Government Area:** Liverpool **Alpine Area:** No

#### Equations Used

Transmissivity: Fuss and Hammins, 2002  
 Flame Length: RFS PBP, 2001  
 Rate of Fire Spread: Noble et al., 1980  
 Radiant Heat: Drysdale, 1985; Sullivan et al., 2003; Tan et al., 2005  
 Peak Elevation of Receiver: Tan et al., 2005  
 Peak Flame Angle: Tan et al., 2005

**Run Description:** East

#### Vegetation Information

<b>Vegetation Type:</b> Grassland	<b>Vegetation Group:</b> Grassland
<b>Vegetation Slope:</b> 5 Degrees	<b>Vegetation Slope Type:</b> Upslope
<b>Surface Fuel Load(t/ha):</b> 4.5	<b>Overall Fuel Load(t/ha):</b> 4.5

#### Site Information

<b>Site Slope:</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m):</b> Default	<b>APZ/Separation(m):</b> 9

#### Fire Inputs

<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
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#### Calculation Parameters

<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 130

#### Program Outputs

<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 2.94
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 27828
<b>Radiant Heat(kW/m2):</b> 23.12	<b>Flame Angle (degrees):</b> 69
<b>Flame Length(m):</b> 6.29	<b>Maximum View Factor:</b> 0.349
<b>Rate Of Spread (km/h):</b> 11.97	<b>Inner Protection Area(m):</b> 9
<b>Transmissivity:</b> 0.872	<b>Outer Protection Area(m):</b> 0



<b>Run Description:</b> East	
<b>Vegetation Information</b>	
<b>Vegetation Type:</b> Forest	<b>Vegetation Group:</b> Forest and Woodland
<b>Vegetation Slope:</b> 6 Degrees	<b>Vegetation Slope Type:</b> Downslope
<b>Surface Fuel Load(t/ha):</b> 25	<b>Overall Fuel Load(t/ha):</b> 35
<b>Site Information</b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 39
<b>Fire Inputs</b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
<b>Calculation Parameters</b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 100
<b>Program Outputs</b>	
<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 14.59
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 82072
<b>Radiant Heat(kW/m2):</b> 24.44	<b>Flame Angle (degrees):</b> 60
<b>Flame Length(m):</b> 33.7	<b>Maximum View Factor:</b> 0.4
<b>Rate Of Spread (km/h):</b> 4.54	<b>Inner Protection Area(m):</b> 26
<b>Transmissivity:</b> 0.804	<b>Outer Protection Area(m):</b> 13

<b>Run Description:</b> East	
<b>Vegetation Information</b>	
<b>Vegetation Type:</b> Forest	<b>Vegetation Group:</b> Forest and Woodland
<b>Vegetation Slope:</b> 6 Degrees	<b>Vegetation Slope Type:</b> Downslope
<b>Surface Fuel Load(t/ha):</b> 25	<b>Overall Fuel Load(t/ha):</b> 35
<b>Site Information</b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 88
<b>Fire Inputs</b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1200
<b>Calculation Parameters</b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 100
<b>Program Outputs</b>	
<b>Category of Attack:</b> LOW	<b>Peak Elevation of Receiver(m):</b> 16.03
<b>Level of Construction:</b> BAL 12.5	<b>Fire Intensity(kW/m):</b> 82072
<b>Radiant Heat(kW/m2):</b> 9.89	<b>Flame Angle (degrees):</b> 72
<b>Flame Length(m):</b> 33.7	<b>Maximum View Factor:</b> 0.119
<b>Rate Of Spread (km/h):</b> 4.54	<b>Inner Protection Area(m):</b> 65
<b>Transmissivity:</b> 0.745	<b>Outer Protection Area(m):</b> 23

<b>Run Description:</b> North-East	
<b>Vegetation Information</b>	
<b>Vegetation Type:</b> Forest	<b>Vegetation Group:</b> Forest and Woodland
<b>Vegetation Slope:</b> 1.72 Degrees	<b>Vegetation Slope Type:</b> Downslope
<b>Surface Fuel Load(t/ha):</b> 25	<b>Overall Fuel Load(t/ha):</b> 25
<b>Site Information</b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 32
<b>Fire Inputs</b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
<b>Calculation Parameters</b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 100
<b>Program Outputs</b>	
<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 11.22
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 43633
<b>Radiant Heat(kW/m2):</b> 22.87	<b>Flame Angle (degrees):</b> 64
<b>Flame Length(m):</b> 24.96	<b>Maximum View Factor:</b> 0.37
<b>Rate Of Spread (km/h):</b> 3.38	<b>Inner Protection Area(m):</b> 32
<b>Transmissivity:</b> 0.813	<b>Outer Protection Area(m):</b> 0

<b>Run Description:</b> South	
<b>Vegetation Information</b>	
<b>Vegetation Type:</b> Grassland	<b>Vegetation Group:</b> Grassland
<b>Vegetation Slope:</b> 1 Degrees	<b>Vegetation Slope Type:</b> Downslope
<b>Surface Fuel Load(t/ha):</b> 4.5	<b>Overall Fuel Load(t/ha):</b> 4.5
<b>Site Information</b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 9
<b>Fire Inputs</b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
<b>Calculation Parameters</b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 130
<b>Program Outputs</b>	
<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 3.48
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 42099
<b>Radiant Heat(kW/m2):</b> 28.52	<b>Flame Angle (degrees):</b> 64
<b>Flame Length(m):</b> 7.73	<b>Maximum View Factor:</b> 0.429
<b>Rate Of Spread (km/h):</b> 18.11	<b>Inner Protection Area(m):</b> 9
<b>Transmissivity:</b> 0.874	<b>Outer Protection Area(m):</b> 0



<b>Run Description:</b> South	
<b><u>Vegetation Information</u></b>	
<b>Vegetation Type:</b> Grassland	<b>Vegetation Group:</b> Grassland
<b>Vegetation Slope:</b> 1 Degrees	<b>Vegetation Slope Type:</b> Upslope
<b>Surface Fuel Load(t/ha):</b> 4.5	<b>Overall Fuel Load(t/ha):</b> 4.5
<b><u>Site Information</u></b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 9
<b><u>Fire Inputs</u></b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
<b><u>Calculation Parameters</u></b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 130
<b><u>Program Outputs</u></b>	
<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 3.3
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 36673
<b>Radiant Heat(kW/m2):</b> 26.59	<b>Flame Angle (degrees):</b> 66
<b>Flame Length(m):</b> 7.22	<b>Maximum View Factor:</b> 0.4
<b>Rate Of Spread (km/h):</b> 15.77	<b>Inner Protection Area(m):</b> 9
<b>Transmissivity:</b> 0.873	<b>Outer Protection Area(m):</b> 0

<b>Run Description:</b> West	
<b><u>Vegetation Information</u></b>	
<b>Vegetation Type:</b> Grassland	<b>Vegetation Group:</b> Grassland
<b>Vegetation Slope:</b> 1 Degrees	<b>Vegetation Slope Type:</b> Downslope
<b>Surface Fuel Load(t/ha):</b> 4.5	<b>Overall Fuel Load(t/ha):</b> 4.5
<b><u>Site Information</u></b>	
<b>Site Slope</b> 0 Degrees	<b>Site Slope Type:</b> Downslope
<b>Elevation of Receiver(m)</b> Default	<b>APZ/Separation(m):</b> 10
<b><u>Fire Inputs</u></b>	
<b>Veg./Flame Width(m):</b> 100	<b>Flame Temp(K)</b> 1090
<b><u>Calculation Parameters</u></b>	
<b>Flame Emissivity:</b> 95	<b>Relative Humidity(%):</b> 25
<b>Heat of Combustion(kJ/kg)</b> 18600	<b>Ambient Temp(K):</b> 308
<b>Moisture Factor:</b> 5	<b>FDI:</b> 130
<b><u>Program Outputs</u></b>	
<b>Category of Attack:</b> HIGH	<b>Peak Elevation of Receiver(m):</b> 3.56
<b>Level of Construction:</b> BAL 29	<b>Fire Intensity(kW/m):</b> 42099
<b>Radiant Heat(kW/m2):</b> 25.51	<b>Flame Angle (degrees):</b> 67
<b>Flame Length(m):</b> 7.73	<b>Maximum View Factor:</b> 0.386
<b>Rate Of Spread (km/h):</b> 18.11	<b>Inner Protection Area(m):</b> 10
<b>Transmissivity:</b> 0.87	<b>Outer Protection Area(m):</b> 0

## Appendix 2

### PBP 2006 Chapter 4 Access – Public roads



## Access (1) – Public Roads

**Intent of measures: to provide safe operational access to structures and water supply for emergency services, while residents are seeking to evacuate from an area.**

### Background

Public roads include the perimeter road and the internal road system of any urban subdivision as well as public roads in rural-residential subdivisions.

A **perimeter road** is the preferred option to separate bushland from urban areas. Fire trails will only be considered acceptable in exceptional circumstances. This is based on the difficulties and costs associated with maintaining fire trails on private land. A perimeter fire trail cannot be imposed on the adjoining land and should not cross a number of residential allotments.

The perimeter road forms part of the APZ and is required to provide a separation between the building and the boundary of the bush fire hazard.

The purpose of the public road system is to:

- provide firefighters with easier access to structures, allowing more efficient use of firefighting resources;
- provide a safe retreat for firefighters; and
- provide a clear control line from which to conduct hazard reduction or back burning operations.

Roads should provide sufficient width to allow firefighting vehicle crews to work with firefighting equipment about the vehicle.

Where staged development occurs or development operates under an approved Masterplan, the RFS will consider temporary perimeter roading subject to availability of reticulated water supply.

Table 4.1 provides the minimum widths for public roads that are not perimeter roads for the safe access of fire fighting vehicles in urban areas.

Curve radius (inside edge) (metres)	Swept Path (metres width)	Single lane (metres width)	Two way (metres width)
<40	3.5	4.5	8.0
40-69	3.0	3.9	7.5
70-100	2.7	3.6	6.9
>100	2.5	3.5	6.5

Source: AS 2890.2 – 2002.

Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle)

Figure 4.4 provides the dimensions for the curvature of roads (inner and outer turning circles) to be used for access roads (both public and private) and fire trails.

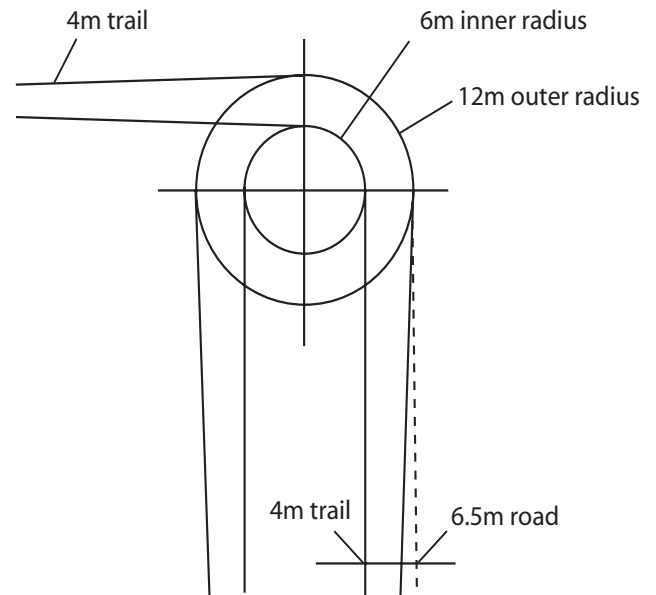


Figure 4.4 Dimensions for inner and outer turning circle radius for (public and private access) roads and fire trails.



Examples of public road access arrangements that do not facilitate bush fire fighting.

Performance Criteria	Acceptable solutions
The intent may be achieved where:	
<ul style="list-style-type: none"> <li>firefighters are provided with safe all weather access to structures (thus allowing more efficient use of firefighting resources)</li> </ul>	<ul style="list-style-type: none"> <li>public roads are two-wheel drive, all weather roads.</li> </ul>
<ul style="list-style-type: none"> <li>public road widths and design that allow safe access for firefighters while residents are evacuating an area.</li> </ul>	<ul style="list-style-type: none"> <li>urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle).</li> <li>the perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas.</li> <li>traffic management devices are constructed to facilitate access by emergency services vehicles.</li> <li>public roads have a cross fall not exceeding 3 degrees.</li> <li>all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard.</li> <li>curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress.</li> <li>the minimum distance between inner and outer curves is six metres.</li> <li>maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient.</li> <li>there is a minimum vertical clearance to a height of four metres above the road at all times.</li> </ul>
<ul style="list-style-type: none"> <li>the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles.</li> </ul>	<ul style="list-style-type: none"> <li>the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicate load rating.</li> </ul>
<ul style="list-style-type: none"> <li>roads that are clearly sign-posted (with easily distinguishable names) and buildings/properties that are clearly numbered.</li> </ul>	<ul style="list-style-type: none"> <li>public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression.</li> <li>public roads between 6.5 metres and 8 metres wide are No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression.</li> </ul>
<ul style="list-style-type: none"> <li>there is clear access to reticulated water supply</li> </ul>	<ul style="list-style-type: none"> <li>public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.</li> <li>one way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression.</li> </ul>
<ul style="list-style-type: none"> <li>parking does not obstruct the minimum paved width</li> </ul>	<ul style="list-style-type: none"> <li>parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays.</li> <li>public roads directly interfacing the bush fire hazard vegetation provide roll top kerbing to the hazard side of the road.</li> </ul>