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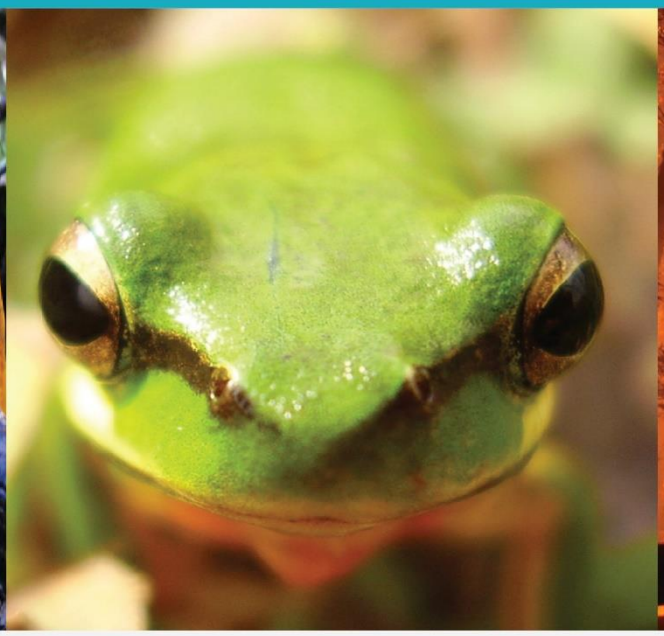

BUSHFIRE PROTECTION ASSESSMENT

Planning Proposal

Lot 2 DP 1159910

66 The Saddle Road

Brunswick Heads

22 December 2021

(REF: 21CRC03)

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Planning Proposal

Lot 2 DP 1159910, 66 The Saddle Road, Brunswick Heads

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Date:	22/12/21
File:	21CRC03

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Disclaimer:

This report has been prepared to provide advice to the client on matters pertaining to the particular and specific development proposal as advised by the client and / or their authorised representatives. This report can be used by the client only for its intended purpose and for that purpose only. Should any other use of the advice be made by any person, including the client, then this firm advises that the advice should not be relied upon. The report and its attachments should be read as a whole and no individual part of the report or its attachments should be relied upon as meaning it reflects any advice by this firm. The report does not suggest or guarantee that a bush or grass fire will not occur and or impact the development. This report advises on policies and specifications published by the NSW Rural Fire Service e.g. Planning for Bush Fire Protection 2019.

The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

EXECUTIVE SUMMARY

This bushfire protection assessment has been undertaken for the proposed rezoning of Lot 2 DP 1159910, 66 The Saddle Road, Brunswick Heads.

This site is currently zoned RU2 Rural Landscape under Byron Local Environmental Plan 2014 and Deferred Matter, being Rural zonings under Byron Local Environmental Plan 1988.

Being a rezoning application, the final proposed use of the site is undetermined at this point. This assessment has considered a range of possible uses, including business park and light industrial.

Potential fire runs have been identified and assessed for mitigation measures.

Access is existing and suitable for the expected range of uses.

The assessment has concluded that the site can be provided with a suitable range of bushfire protection measures to suit a number of different uses.

This report assesses and identifies the potential protection measures which may be required. This report is for strategic planning purposes and is not suitable for submission for consent approval for specific land uses which must be assessed independently after detailed design layouts have been prepared post rezoning.

GLOSSARY OF TERMS

AHIMS	Aboriginal Heritage Information System
APZ	asset protection zone
AS1596	*Australian Standard – The storage and handling of LP Gas*
AS2419	*Australian Standard – Fire hydrant installations*
AS3745	*Australian Standard – Planning for emergencies in facilities*
AS3959	*Australian Standard – Construction of buildings in bushfire-prone areas 2018*
BAL	*bushfire attack level*
BCA	*Building Code of Australia*
BSA	bushfire safety authority
DA	development application
DLUP	Development Land Use Plan
EEC	Endangered ecological community
EP&A Act	*Environmental Planning & Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
FFDI	forest fire danger index
IPA	inner protection area
LEP	Local Environmental Plan
LGA	local government area
m	metres
NCC	*National Construction Code*
OPA	outer protection area
PBP 2019	*Planning for Bush Fire Protection 2019*
RF Act	*Rural Fires Act 1997*
RFS	NSW Rural Fire Service
SFR	short fire run
SFPP	special fire protection purpose
TBE	*Travers bushfire & ecology*

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ATTACHMENTS

1. INTRODUCTION

Travers bushfire & ecology has been engaged to undertake a bushfire protection assessment for the proposed rezoning located at Lot 2 DP 1159910, 66 The Saddle Road, Brunswick Heads.

The proposal is located on land identified as bushfire prone on the *Byron Shire Council* bushfire prone land map (refer Figure 1-1). Directions issued by the Minister under the *Environmental Planning and Assessment Act 1979* requires Council to consider the threat of bushfire on a landholding and adjacent lands.

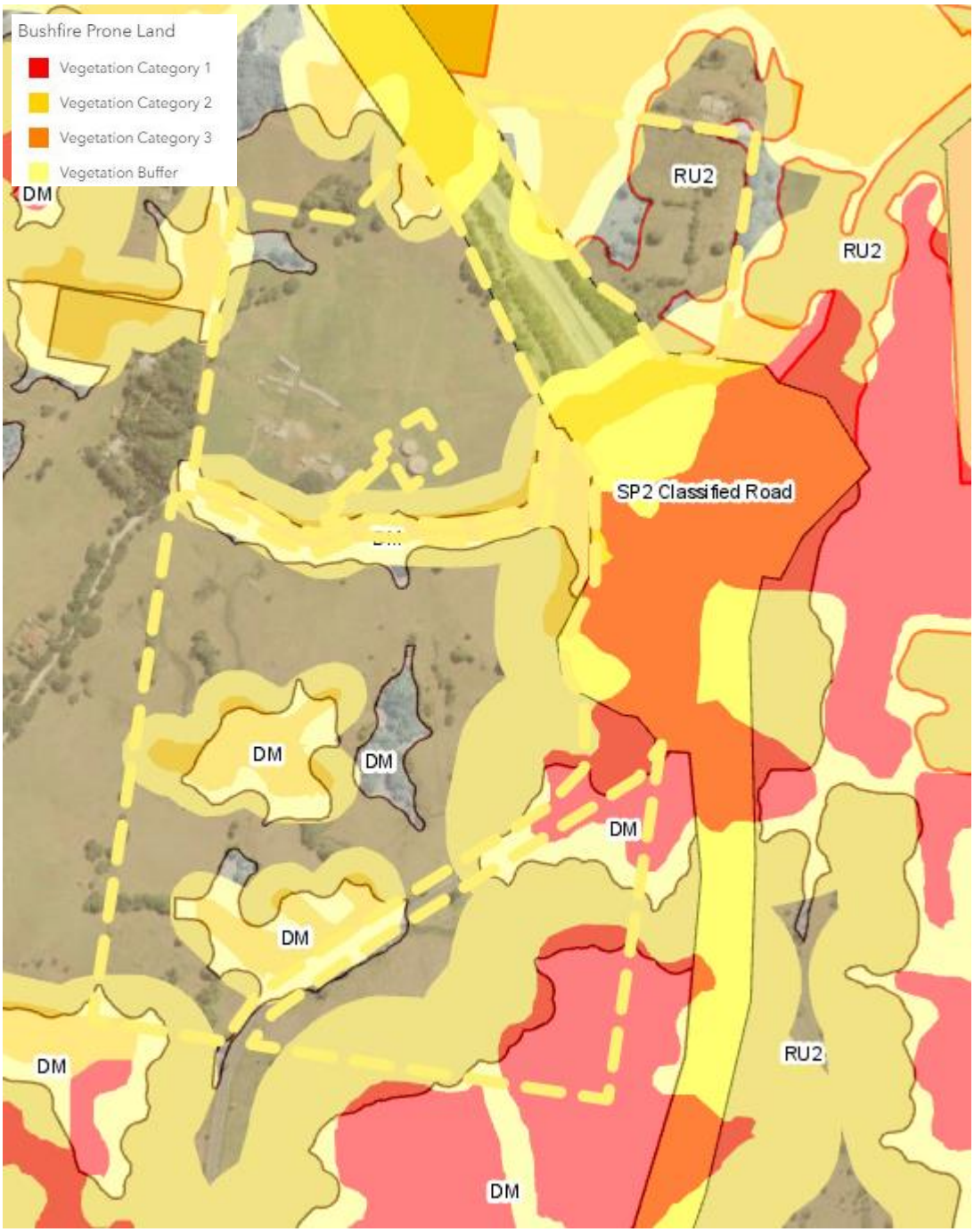


Figure 1-1 – Bushfire Prone Land Map

(Source: Planning Portal, 2021)

1.1 Aims of the assessment

Planning proposals are required to address the threat of bushfire to potential development. The objectives of this report are to;

a) to protect life, property and the environment from bush fire hazards, by discouraging the establishment of incompatible land uses in bush fire prone areas, and
b) to encourage sound management of bush fire prone areas.

The potential for future rezoning of the property, from a bushfire context, needs to ensure that future land uses are in a suitable location to minimise the risk and impact of bush fire attack. In addition, services and infrastructure to facilitate effective suppression of a bush fire also need to be provided.

The broad principles which should be applied to strategic level development are as follows:

a) not all land is suitable for development in the context of bush fire risk
b) any new development on bush fire prone land must comply with PBP
c) infrastructure associated with emergency evacuation and firefighting operations must be provided
d) Appropriate ongoing land management practices must be facilitated.

Strategic planning should provide for the exclusion of inappropriate development in bush fire prone areas as follows:

a) when the bush fire risk makes it inappropriate for new development to occur
b) for development that is likely to be difficult to evacuate during a bush fire
c) for development that will adversely affect other bush fire protection strategies or place existing development at increased risk
d) for development that is within an area of high bush fire risk where density of existing development may cause evacuation issues for both existing and new occupants.
e) where environmental constraints to the site cannot be overcome.

1.2 Proposed rezoning

The site has an area of approximately 25 Ha (central area under assessment, Figure 1-3) and is currently zoned under the Byron Local Environmental Plan 2014 as RU2 Rural Landscape and Deferred Matter. The areas of Deferred matter being predominately areas of remnant vegetation and have a Rural zoning under Byron Local Environmental Plan 1988.

The exact nature of the proposed future use of the site has not been determined at the time of preparing this report. The strategic planning carried out by the council calls for 6.5ha of the site to be zoned for Business Park and Light Industrial use.

As such, this assessment considers multiple land uses, including Special Fire Protection Purpose.

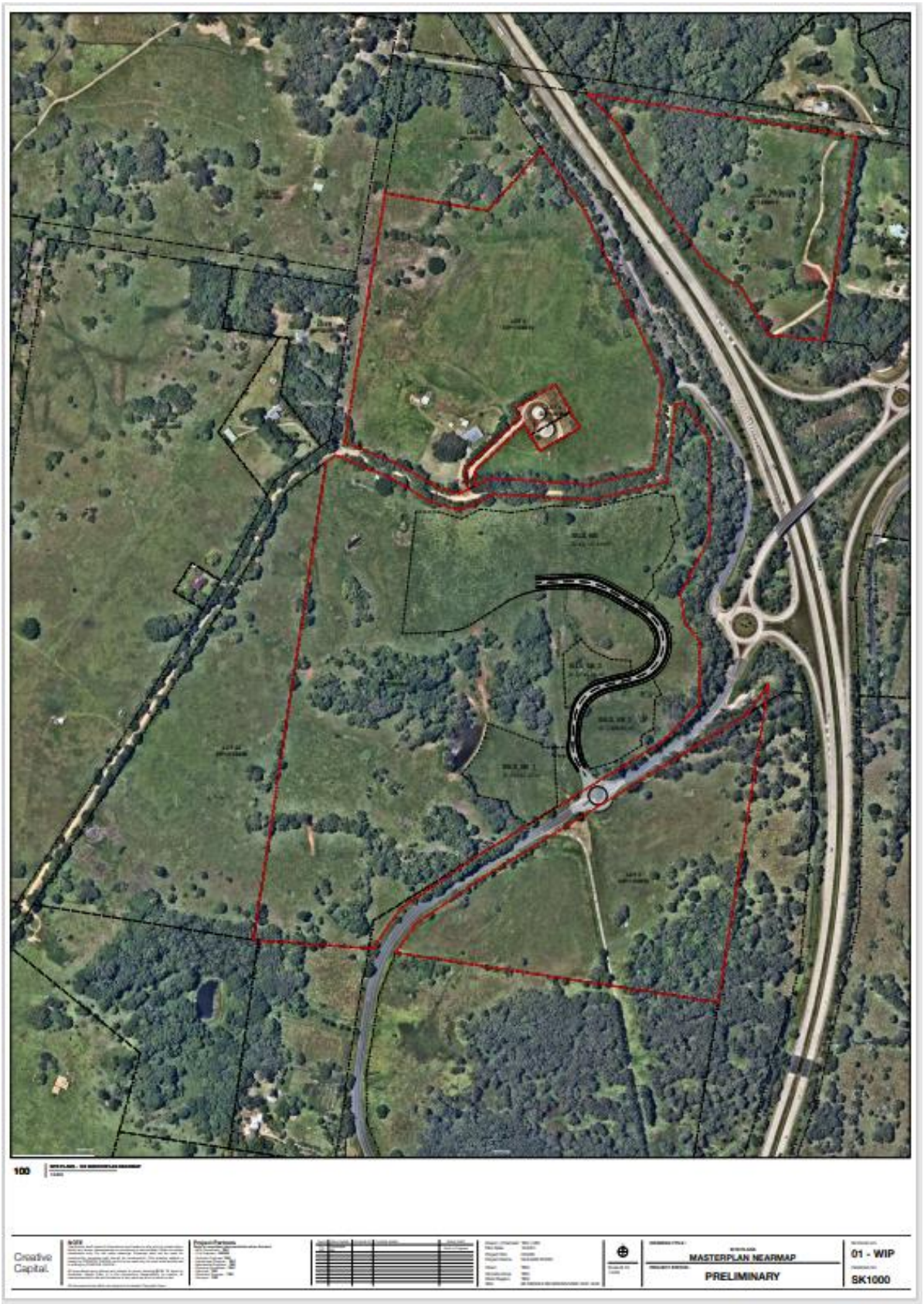


Figure 1-2 – Proposed Zoning Precincts
(Source: Creative Capital. Drawing. number. – SK1000 Rev. 01_WIP, dated 12/8/21)

1.3 Information collation

To achieve the aims of this report, a review of the information relevant to the property was undertaken prior to the initiation of field surveys. Information sources reviewed include the following:

- Byron Local Environmental Plan 2014
- *Nearmap* aerial photography
- Topographical maps *DLPI of NSW* 1:25,000
- *Australian Standard 3959 – 2018 Construction of buildings in bushfire-prone areas*
- The NSW Rural Fire Service document*; Planning for Bush Fire Protection 2019 (PBP)*
- *Community Resilience Practice Notes 2/12 Planning Instruments and Policies.*

An inspection of the proposed development site and surrounds was undertaken by Tony Hawkins on 9 November 2021 to assess the topography, slopes, aspect, drainage, vegetation and adjoining land use. The identification of existing bushfire measures and a visual appraisal of bushfire hazard and risk were also undertaken.

1.4 Site description

The site is located at Lot 2 DP 1159910, 66 The Saddle Road Brunswick Heads. The site is bisected by several roadways, including the M1 Pacific Motorway, Gulgan Road and The Saddle Road. The site under consideration for assessment is located generally central within the bisected areas and bounded by The Saddle Road to the North and East and Gulgan road to the south.

The site is surrounded predominately by Rural and Rural Residential land uses.

It is understood that the site was previously used for agricultural purposes and the majority of the site is cleared and has a mixed native/non-native grassland vegetation cover. Three main areas of bushland exist within the site. These areas vary in composition between rainforest, wet sclerophyll forest and non-native and/or weed vegetation.

Vegetation exists surrounding the site, varying between grassland, rainforest, wet sclerophyll forest and non-native and/or weed vegetation.

The site slopes from the north, falling to the south, with a steeper area running approximately east west south of the central east west line.

Figure 1-3 – Aerial appraisal
(Source Melcone Mosaic)

1.5 Legislation and planning instruments

1.5.1 Environmental Planning and Assessment Act (1979) and bush fire prone land

The *EP&A Act* governs environmental and land use planning and assessment within New South Wales. It provides for the establishment of environmental planning instruments,

development controls and the operation of construction controls through the *Building Code of Australia (BCA).* The identification of bushfire prone land is required under Section 10.3 of the *EP&A Act*.

PBP stipulates that if a proposed amendment to land use zoning or land use affects a designated bushfire prone area then under Section 9.1(2) of the *EP&A Act* Ministerial Direction No 4.14 must be applied. This requires Council to consult with the Commissioner of the RFS and to take into account any comments by the Commissioner and to have regard to the planning principles of *PBP*.

1.5.3 Planning for Bush Fire Protection 2019 (PBP)

Bushfire protection planning requires the consideration of the RFS planning document entitled *PBP. PBP* provides planning principles for rezoning to residential land as well as guidance on effective bushfire protection measures.

For strategic development proposals in bush fire prone areas *PBP* requires, as a minimum, assessment of the components in Table 1-1 below. These issues are addressed in Section 3 of this report, where appropriate and within the constraints of an unknown final land use.

Table 1-1 Requirements for a Bush Fire Strategic Study

Issue	Detail	Assessment Considerations	Comment
Bush fire landscape assessment	A bush fire landscape assessment considers the likelihood of a bush fire, its potential severity and intensity and the potential impact on life and property in the context of the broader surrounding landscape.	The bush fire hazard in the surrounding area, including: • Vegetation • Topography • Weather The potential fire behaviour that might be generated based on the above; Any history of bush fire in the area; Potential fire runs into the site and the intensity of such fire runs; and The difficulty in accessing and suppressing a fire, the continuity of bush fire hazards or the fragmentation of landscape fuels and the complexity of the associated terrain.	Considered in this assessment
Land use assessment	The land use assessment will identify the most appropriate locations within the masterplan area or site layout for the proposed land uses.	The risk profile of different areas of the development layout based on the above landscape study; The proposed land use zones and permitted uses; The most appropriate siting of different land uses based on risk profiles within the site (i.e. not locating development on ridge tops, SFPP development to be located in lower risk areas of the site); and	Considered in this assessment, however, final assessment will be dependent on land use and location of assets.

Issue	Detail	Assessment Considerations	Comment
		The impact of the siting of these uses on APZ provision.	
Access and egress	A study of the existing and proposed road networks both within and external to the masterplan area or site layout.	The capacity for the proposed road network to deal with evacuating residents and responding emergency services, based on the existing and proposed community profile; The location of key access routes and direction of travel; and The potential for development to be isolated in the event of a bush fire.	Considered in this assessment, however, final assessment will be dependent on land use and location of assets
Emergency services	An assessment of the future impact of new development on emergency services.	Consideration of the increase in demand for emergency services responding to a bush fire emergency including the need for new stations/ brigades; and Impact on the ability of emergency services to carry out fire suppression in a bush fire emergency.	Considered in this assessment, however, final assessment will be dependent on land use and location of assets
Infrastructure	An assessment of the issues associated with infrastructure and utilities.	The ability of the reticulated water system to deal with a major bush fire event in terms of pressures, flows, and spacing of hydrants; and Life safety issues associated with fire and proximity to high voltage power lines, natural gas supply lines etc.	Considered in this assessment, however, final assessment will be dependent on land use and location of assets
Adjoining land	The impact of new development on adjoining landowners and their ability to undertake bush fire management.	Consideration of the implications of a change in land use on adjoining land including increased pressure on BPMs through the implementation of Bush Fire Management Plans.	Considered in this assessment, however, final assessment will be dependent on land use and location of assets

1.6 Environmental and cultural constraints

1.6.1 Environmental constraints

No vegetation removal is proposed in this assessment other than the construction of an access road as shown in Figure 1-2. The access road is proposed to pass through previously cleared land with minimal impact and no threatened species identified.
Endangered ecological communities have been identified on the site and important ecological assets are located outside the proposed employment land precincts.

Future development, including the access road, which will inevitably impact larger areas of the site should be subject to detailed environmental studies, including potential intrusion into remnant bushland vegetation areas.

1.6.2 Cultural constraints

An Aboriginal Cultural Heritage Assessment Report (ACHAR) has been prepared for the site and locality. The ACHAR was undertaken with the assistance of Aboriginal community members, including Mr Leon Kelly and Mr Brian Kelly from Arakwal, and Warren Phillips and Maurice Gannon from Tweed Byron LALC. Important cultural aspects are located outside the proposed employment land precincts.

2. BUSHFIRE THREAT ASSESSMENT

To assess the bushfire threat and to determine the required width of an APZ for a development, an assessment of the potential hazardous vegetation and the effective slope within the vegetation is required. These elements include the potential hazardous landscape that may affect the site and the effective slope within that hazardous vegetation.

2.1 Fire History

A search of the SEED webmap (NPWS Fire history) shows no recorded fire history for the site.

A number of recorded fires have occurred in the surrounding District over a long time period (c1970 – present). In relative terms, none of these fires have been of notable size or presented obvious suppression difficulties. The recorded fire locations are shown in Figure 2- 1.

The fire history does not suggest or nor should it be implied that a major fire will or could not impact the site or in the surrounding area and pose an elevated threat to development. It is considered reasonable to assume however that the risk of a major bushfire is relatively low due to the vegetation type and climactic conditions.

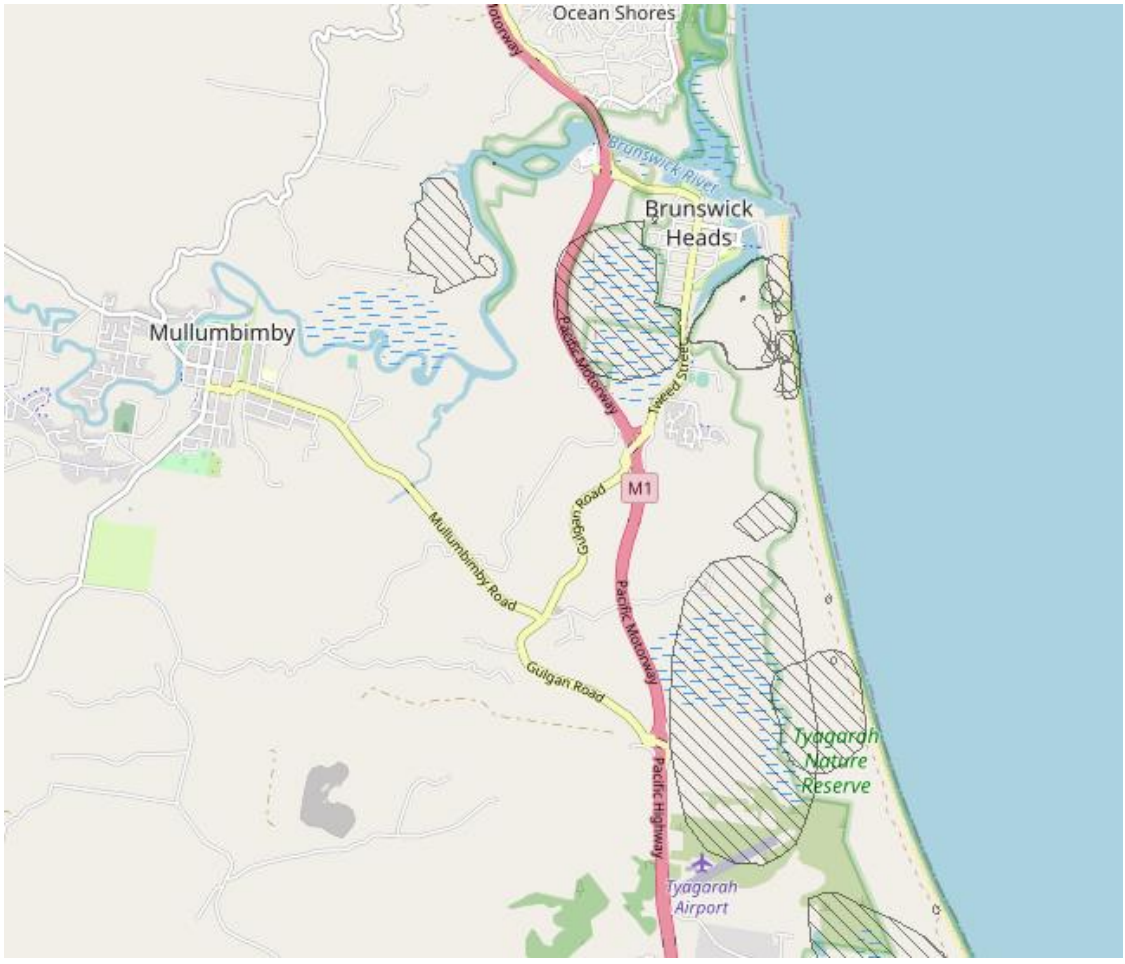


Figure 2- 1: Fire history for district surrounding site

(Source: NPWS Fire History - Seed Webmap)

2.2 Hazardous fuels

PBP guidelines require the identification of the predominant vegetation formation in accordance with David Keith (2004) if using the simplified acceptable solutions in PBP 2019, or alternatively the vegetation class if adopting the comprehensive vegetation fuel loads (as allowable when undertaking an assessment under Method 2 of AS3959). The hazardous vegetation is calculated for a distance of at least 140m from a proposed building envelope.

The vegetation posing a bushfire threat to the proposed development includes:

Table 2-1 - Vegetation

Fire Run	*Vegetation formation*	*Vegetation classification*	*Comprehensive fuel loads (t/ha)*	*Comment*
Fire Run 1	Grassland/Rainforest	Grassland	4.5	Narrow strip of mapped rainforest occurring as roadside vegetation. Slope present threat to the west away from site
Fire Run 2	Swamp Sclerophyll Forest/Rainforest	Swamp Sclerophyll Forest	22.6/34.1	Mapped Rainforest vegetation on site and forest adjoin off site. Main threat posed to north eastern corner of site
Fire Run 3	Sclerophyll grassy woodland	Sclerophyll grassy woodland	22.6/34.1	Small area of roadside vegetation offsite. Calculated as swamp sclerophyll forest following site inspection as a conservative measure
Fire Run 4	Swamp Sclerophyll Forest/Rainforest	Swamp Sclerophyll Forest	22.6/34.1	Mixture of rainforest and forest, calculations based on forest as the higher threat. Located within site
Fire Run 5	Rainforest	Rainforest	10/12	Located within site

Fire Run	Vegetation formation	Vegetation classification	Comprehensive fuel loads (t/ha)	Comment
Fire Run 6	Rainforest	Rainforest	10/12	Rainforest located on site and adjacent roadside reserve.
Fire Run 7	Rainforest	Rainforest	10/12	Mixture of rainforest and forest, calculations based on rainforest as the higher threat. Located mostly offsite on adjacent land
Fire Run 8	Grassland	Grassland	4.5	Located offsite on adjacent land
Fire Run 9	Grassland	Grassland	4.5	Located offsite on northern portion of overall Lot

The following assessment has adopted the comprehensive fuel loads (column four) identified above.

2.3 Effective slope

The effective slope has been assessed for up to 100m from the development site. Effective slope refers to that slope which provides the most effect upon likely fire behaviour. A mean average slope may not in all cases provide sufficient information such that an appropriate assessment can be determined.

The effective slope within the hazardous areas is provided in detail within Section 2.3 however can be summarised as follows;

- 1-4 degrees downslope within the RE1 zoned habitat corridor to the west and north
- 0-1 degrees downslope within the forested wetland to the south & south-east
- Level within the wetland detention basin to the south and retained dam to the west

The effective slope within the hazardous vegetation is described in detail within Table 2-2 below.

2.4 Bushfire attack assessment

The following assessment has determined the APZ and BAL levels via the following approaches;

- Appendix B Method 2 (alternative solution) of *AS3959 2018 Construction of buildings in bushfire prone areas*

A fire danger index (FDI) of 80 has been used to calculate bushfire behaviour on the site based on its location within the Far North Coast region. Grassland areas of the site should be calculated at a Grass Fire Danger Index (GFDI) of 110 for the Far North Coast. As a conservative measure, a GFDI of 130 has been adopted for this assessment. Table 2-2 provides a summary of the bushfire attack assessment based on the methodologies identified above. The Flamesol calculations utilised to derive these APZs widths are shown in Appendix 3.

Only the main fire run threats and consequent required APZ widths have been calculated in table 2-2.

Threats from the flanks and heel of these fire runs have not been calculated. It should be assumed that the threat presented by the flanks and heel of the fire runs will be of lesser intensity and therefore require APZS of reduced width as compared to the APZ for the Head of the fire.

The fire run head APZ widths have been provided to demonstrate that APZs are achievable within the site and are shown in the Schedule 1 map.

Table 2-2 - Bushfire Attack Assessment Summary

Fire run	*Predominant* Vegetation Class*	*Effective Slope*	*Minimum APZ Required SFPP*	*Minimum APZ Required Non SFPP (BAL 29)*
1	Grassland/Rainforest	<5°	N/A (Not main threat to site)	N/A (Not main threat to site)
2	Swamp Sclerophyll Forest/Rainforest	14°	108.5m	38.9m
3	Sclerophyll grassy woodland	17.53°	86.2m	42.9m
4	Swamp Sclerophyll Forest/Rainforest	8.91°	60.8m	19.5m
5	Rainforest	11.69°	53.3m	16.6m
6	Rainforest	1.48°	53.9m	17m
7	Rainforest	15.73°	62.2m	20.2
8	Grassland	5.84°	26.6m	6.8m
9	Grassland	2.15°	33.5m	9.19m

***Note 1:** In cases where there are a mix of vegetation types, it is the higher hazard that is said to predominate (as per *PBP 2019*)

3. SPECIFIC PROTECTION ISSUES

3.1 Asset protection zones (APZs)

Table 3.1 outlines the proposal's compliance with the performance criteria for APZs.

Table 3-1 – Performance criteria for asset protection zones (PBP 2019 guidelines pg. 43)

Performance criteria	*Acceptable solutions*	*Acceptable solution*	*Performance solution*	*Comment*
Potential building footprints will not be exposed to radiant heat levels exceeding 29kW/m^2 (10kW/m^2 for SFPP)) on each proposed lot	APZs are provided in accordance with Tables A1.12.2 and A1.12.4 based on the FFDI	☐	☑	APZs can be achieved within the site area with a minimum of clearing and disturbance.
APZs are managed and maintained to prevent the spread of a fire towards the building	APZs are managed in accordance with the requirements of Appendix 4	☑	☐	Can be made a condition of consent.
The APZ is provided in perpetuity	APZs are wholly within the boundaries of the development site	☑	☐	Complies.
APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised	The APZ is located on lands with a slope of less than 18^o	☑	☐	Complies. All potential APZ slopes are less than 18 degrees.
Landscaping is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind-driven embers to cause ignitions	Landscaping is in accordance with Appendix 4	☑	☐	Can be made a condition of consent

3.2 Building protection

Building construction standards for proposed future buildings located within 100m of bushfire prone land are to be applied in accordance with *AS3959 C construction of buildings in bushfire*

prone areas (2018) or *NASH Standard - Steel Framed Construction in Bushfire Areas* and Section 7.5 of *Planning for Bush Fire Protection 2019* and will be determined by the final layout and designated use..

3.3 Hazard management

APZs are required to be managed as an inner protection area (IPA) in accordance with RFS guidelines *Standards for Asset Protection Zones* (RFS, 2005), with landscaping design to comply with Appendix 4 of *PBP*. Appendix 2 of this report provides additional maintenance advice for vegetation within the APZ.

3.4 Access for firefighting operations

Future layout design should be compliant with the guidelines and acceptable solutions of PBP.

Dependent on use, a secondary emergency access/egress point may be required. The main access is proposed to be from a point on Gulgan Road. A secondary emergency access is available at the north of the site via The Saddle Road.

The Saddle Road is an unsealed public road and two wheel drive accessible. The Saddle road is steep in sections travelling east to west, possibly nearing the acceptable maximum criteria. As an emergency egress however, traffic would be travelling downhill and the grade is not relevant.

It is recommended that if The Saddle road is required as an emergency secondary access/egress, that it should be accurately surveyed for compliance with the acceptable solutions of PBP at the time of Development Application preparation.

Typical acceptable solutions are shown in Table 3-2 below.

Table 3-2 – Performance criteria for access within Residential Subdivisions (PBP 2019) Guidelines pg. 44)

Performance criteria		*Acceptable solution*	*Acceptable solution*	*Performance solution*	*Comment*
ACCESS (GENERAL REQUIREMENTS)	Firefighting vehicles are provided with safe, all weather access to structures.	Property access roads are two-wheel drive, all-weather roads	☑	☐	Can comply
		Perimeter roads are provided for residential subdivisions of three or more allotments.	☑	☐	Can comply.
		Subdivisions of three or more allotments have more than one access in and out of the development.	☑	☐	Can comply if required.
		Traffic management devices are constructed to not prohibit access by emergency services vehicles.	☑	☐	Can be a condition of consent.

Performance criteria	Acceptable solution	Acceptable solution	Performance solution	Comment
	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.	☑	☐	Complies. All roads will be sealed.
	All roads are through roads	☑	☐	Can comply
	Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200m in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end.	☑	☐	Can comply
	Where kerb and guttering are provided on perimeter roads, roll top kerbing should be used to the hazard side of the road.	☑	☐	Can comply
	Where access / egress can only be achieved through forest, woodland or heath vegetation, secondary access shall be provided to an alternate point on the existing public road system.	☑	☐	Can comply.
	One way only public access roads are no less than 3.5 metres wide and have designated parking bays with hydrants located outside of these areas to ensure accessibility to reticulated water for fire suppression.	☑	☐	Can comply

Performance criteria		Acceptable solution	Acceptable solution	Performance solution	Comment
	The capacity of access roads is adequate for firefighting vehicles.	The capacity of perimeter and non-perimeter road surfaces and any bridges / causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges / causeways are to clearly indicate load rating.	☑	☐	Can comply
	There is appropriate access to water supply.	Hydrants are located outside of parking reserves and road carriageways to ensure accessibility to reticulated water for fire suppression.	☑	☐	Can be a condition of consent.
		Hydrants are provided in accordance with *AS 2419.1:2005.*	☑	☐	Can be a condition of consent.
		There is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available.	☑	☐	Can be a condition of consent.
PERIMETER ROADS	Access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating as well as providing a safe operational environment for emergency service personnel during firefighting and emergency management	Are two-way sealed roads.	☑	☐	Can comply
		Minimum 8m carriageway width kerb to kerb.	☑	☐	Can comply
		Parking is provided outside of the carriageway width.	☑	☐	Can comply
		Hydrants are located clear of parking areas.	☑	☐	Can comply
		There are through roads, and these are linked to the internal road system at an interval of no greater than 500m.	☑	☐	Can comply
		Curves of roads have a minimum inner radius of 6m.	☑	☐	Complies.

Performance criteria		Acceptable solution	Acceptable solution	Performance solution	Comment
	on the interface.	The maximum grade road is 15° and average grade is 10°.	☑	☐	Can comply
		The road crossfall does not exceed 3°.	☑	☐	Can comply
		A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.	☑	☐	Can comply
NON-PERIMETER ROADS	Access roads are designed to allow safe access and egress for medium rigid firefighting vehicles while residents are evacuating.	Minimum 5.5m carriageway width kerb to kerb.	☑	☐	Can comply
		Parking is provided outside of the carriageway width.	☑	☐	Can comply
		Hydrants are located clear of parking areas.	☑	☐	Can comply
		Roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m.	☑	☐	Can comply
		Curves of roads have a minimum inner radius of 6m.	☑	☐	Can comply
		The road crossfall does not exceed 3°.	☑	☐	Can comply.
		A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.	☑	☐	Can comply
PROPERTY ACCESS	Firefighting vehicles can access the dwelling and exit the property safely.	There are no specific access requirements in an urban area where an unobstructed path (no greater than 70m) is provided between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road	☑	☐	Can comply.

Performance criteria	Acceptable solution	Acceptable solution	Performance solution	Comment
	speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles.			

3.5 Water supplies

The intent of measures is to provide adequate services of water for the protection of buildings during and after the passage of bushfire. Table 3-3 outlines the proposal's compliance with the acceptable solutions for reticulated water supply.

Table 3-3 – Performance criteria for reticulated water supplies (PBP guidelines pg. 47)

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Adequate water supplies is provided for firefighting purposes.	Reticulated water is to be provided to the development, where available.	☑	☐	Can comply
	A static water supply is provided for non-reticulated developments or where reticulated water supply cannot be guaranteed	☑	☐	Can comply
	Static water supplies shall comply with Table 5.3d.	☑	☐	Can comply
Water supplies are located at regular intervals.	Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard *AS 2419.1:2005.*	☑	☐	Can comply.
The water supply is accessible and reliable for firefighting operations.	Hydrants are not located within any road carriageway.	☑	☐	Can comply.
	Reticulated water supply to urban subdivisions uses a ring main system for areas for areas with perimeter roads.	☑	☐	Can comply.
Flows and pressure are appropriate.	Fire hydrant flows and pressures comply with the relevant clauses of *AS 2419.1:2005.*	☑	☐	Can comply
The integrity of the water supply is maintained.	All above-ground water service pipes are metal, including and up to any taps.	☑	☐	Can comply.

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
	Above ground water storage tank shall be of concrete or metal	☑	☐	Can comply.

3.6 Gas

The intent of measures is to locate gas so as not to contribute to the risk of fire to a building. Table 3-4 outlines the required acceptable solutions for gas supply.

Table 3-4 – Performance criteria for gas supplies (PBP Guidelines pg. 47)

Performance criteria	Acceptable solutions	Acceptable solution	Performance solution	Comment
Location of gas services will not lead to the ignition of surrounding bushland or the fabric of buildings.	Reticulated or bottled gas bottles are to be installed and maintained in accordance with *AS/NZS 1596 (2014)*, the requirements of relevant authorities and metal piping is to be used.	☑	☐	Can comply.
	All fixed gas cylinders are to be kept clear of flammable materials to a distance of 10m and shielded on the hazard side.	☑	☐	Can comply
	Connections to and from gas cylinders are metal.	☑	☐	Can comply
	Polymer sheathed flexible gas supply lines are not used.	☑	☐	Can comply.
	Above ground gas service pipes are metal, including and up to any outlets.	☑	☐	Can comply

3.7 Electricity

The intent of measures is to locate electricity so as not to contribute to the risk of fire to a building.

Table 3-5 outlines the required acceptable solutions for the subdivision's electricity supply.

Table 3-5 – performance criteria for electricity services (pbp guidelines pg. 47)

Performance criteria	*Acceptable Solutions*	*Acceptable solution*	*Performance solution*	*Comment*
Location of electricity services limit the possibility of ignition of surrounding bushland or the fabric of buildings.	Where practicable, electrical transmission lines are underground.	☑	☐	Can comply
	Where overhead electrical transmission lines are proposed: lines are installed with short pole spacing (30m), unless crossing gullies, gorges or riparian areas; and no part of a tree is closer to a power line than the distance set out in ISSC3 Guideline for Managing Vegetation Near Power Lines.	☑	☐	Can comply

3.8 Emergency Management and Evacuation

Depending on planned use, an emergency management and evacuation plan may be required. Where this is required, the plan should be consistent with the NSW RFS publication; *A Guide to developing a Bush fire emergency and evacuation Plan* and the Australian Standard AS3745:2010 p*lanning for emergencies in facilities*.

]

4. CONCLUSION & RECOMMENDATIONS

4.1 Conclusion

Our assessment found that bushfire can potentially affect the site from a number of areas of remnant vegetation. The overall fire risk from this vegetation and after considering fire history, climate and available mitigation options is comparatively low.

The site can accommodate asset protection zones within its boundaries with a minimum of environmental disturbance, while still providing viable options for a number of development types.

This report has assumed broad worst case scenarios for each type of development in order to demonstrate that APZs can be achieved and located within the site. Future development should be assessed on the basis of detailed layout plans and uses, with specific assessment of bushfire threats to those developments. It is anticipated that the indicated APZ widths in this report may be reduced significantly following detailed site specific assessment.

The assessment has concluded that future development on site can comply with the planning principles of *PBP*.

This report assesses and identifies the potential protection measures which may be required. This report is not suitable for submission for consent approval for specific land uses which must be assessed independently after the preparation of more detailed design layouts and information.

5. REFERENCES

Australian Building Codes Board (2010) – *Building Code of Australia*, Class 1 and Class 10 Buildings Housing Provisions Volume 2.

Chan, K.W. (2001) – *The suitability of the use of various treated timbers for building constructions in bushfire prone areas*. Warrington Fire Research.

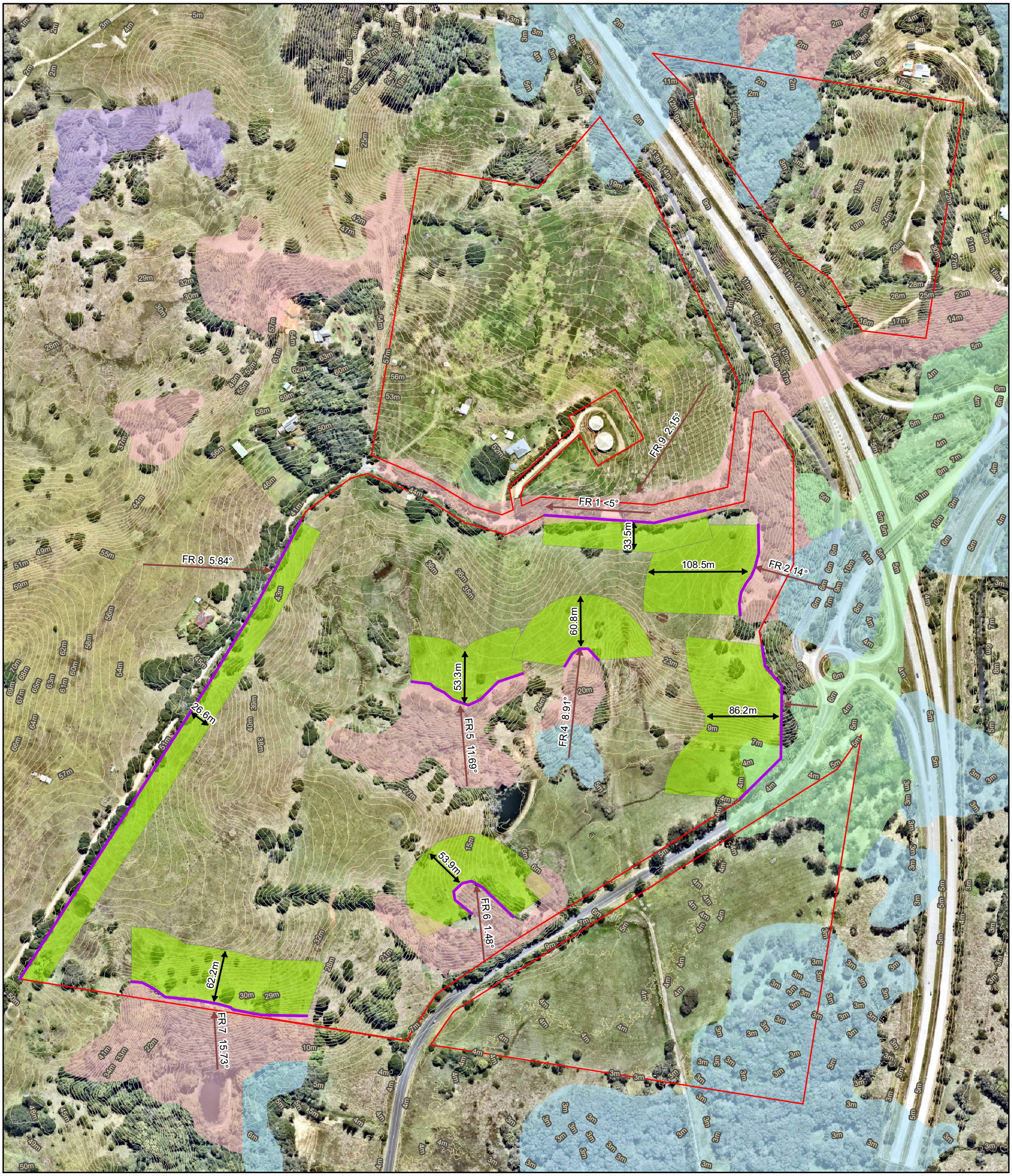
Councils of Standards Australia AS3959 (2009) – *Australian Standard Construction of buildings in bush fire-prone areas.*

Keith, David (2004) – *Ocean Shores to Desert Dunes – The Native Vegetation of New South Wales and the ACT*. The Department of Environment and Climate Change.

Rural Fire Service (2019) - *Planning for bushfire protection – a guide for councils, planners, fire authorities and developers*. NSW Rural Fire Service.

Tan, B., Midgley, S., Douglas, G. and Short (2004) - *A methodology for assessing bushfire attack.* RFS Development Control Service.

SCHEDULE 1. PLAN OF BUSHFIRE ASSESSMENT



Legend

- Lot Boundary (source - LPI)
- Contour 1m (source - LiDAR)
- Fire Run
- Edge Of Vegetation
- Asset Protection Zone (APZ)

Vegetation Community

- Rainforest
- Sclerophyll grassy woodland
- Swamp sclerophyll forest
- Wet sclerophyll forest

Aerial source: Nearmap

TRAVERS BUSHFIRE & ECOLOGY
A TBE ENVIRONMENTAL COMPANY

PROJECT & MXD REFERENCE
66 The Saddle Road, Brunswick Heads
21CR03_BF001

DATE & ISSUE NUMBER
22/12/2021
Issue 1
KM

SCALE & COORDINATE SYSTEM
1:4,000
GDA 1994 MGA Zone 56

0 100 200 m

TITLE

Schedule 1 - Fire Protection Measures

Disclaimer: The mapping is indicative of available space and location of features which may prove critical in assessing the viability of the proposed works. Mapping has been produced on a map base with an inherent level of inaccuracy, the location of all mapped features are to be confirmed by a registered surveyor.

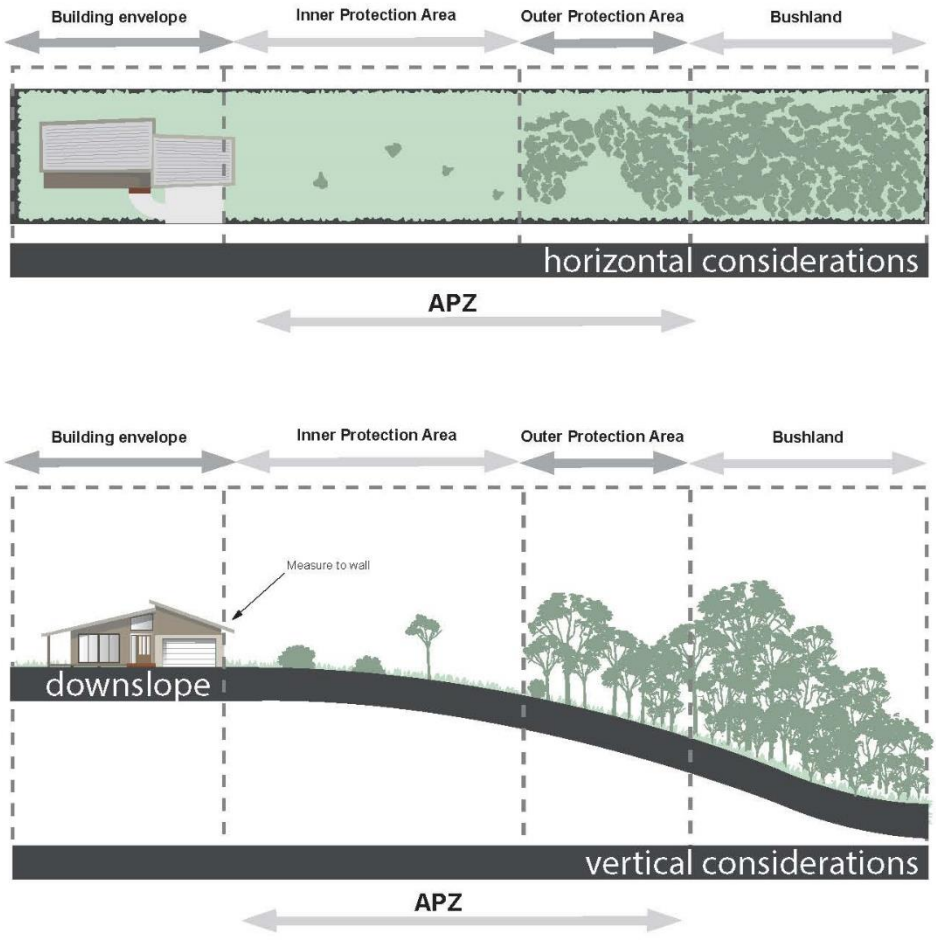
Document Path: N:\GIS STORAGE\N Drive\21CR03_66SaddleRd_ByronBay\MXDs\21CR03_BF001.mxd

APPENDIX 1. MANAGEMENT OF ASSET PROTECTION ZONES

The RFS provides basic advice in respect of managing APZs through documents such as, *Standards for Asset Protection Zones* (RFS, 2005), with landscaping to comply with Appendix 4 of *PBP*.

In forest vegetation an APZ may consist of two subordinate areas, an inner protection area (IPA) and an outer protection area (OPA). The IPA is the area immediately surrounding the building and the OPA (up to 30% of the total APZ width) is between the IPA and the hazard.

A typical APZ is graphically represented below.



APZs and progressive reduction in fuel loads
(Source: PBP, 2019)

> **Note:** Vegetation management as shown is for illustrative purposes only. Specific advice is to be sought regarding vegetation removal and retention from a qualified and experienced expert to ensure APZs comply with the RFS performance criteria.

The following table adapted from *PBP 2019* provides maintenance advice for vegetation within the IPA and OPA. The APZ is to be maintained in perpetuity and maintenance should be undertaken regularly, particularly in advance of the bushfire season.

	Inner Protection Area	Outer Protection Area
Trees	➢ Tree canopy cover should be **less than 15%** at maturity; ➢ Trees at maturity should not touch or overhang the building; ➢ Lower limbs should be removed up to a height of **2m above the ground**; ➢ Tree canopies should be separated by **2 to 5m**; and ➢ Preference should be given to retaining smooth barked and evergreen trees.	➢ Tree canopy cover should be **less than 30%;** and ➢ Canopies should be separated by **2 to 5m**.
Shrubs	➢ Large discontinuities or gaps in the vegetation should be provided to slow down or break the progress of fire towards buildings; ➢ Shrubs should not be located under trees; ➢ Shrubs should form **less than 10%** ground cover; and ➢ Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.	➢ Shrubs should not form a continuous canopy; and ➢ Shrubs should **form less than 20%** of ground cover.
Grass and Leaf Litter	➢ Grass should be kept mown to a height of **less than 100mm**; and ➢ Leaves and other debris should be removed	➢ Grass should be kept mown to a height of **less than 100mm**; and ➢ Leaf and other debris should be removed.

	All Management Zones
Weeds	➢ All weeds should be removed in accordance with best practice guidelines, and measures taken to prevent their further spread
Landscaping	➢ Suitable impervious areas being provided immediately surrounding the building such as courtyards, paths and driveways; ➢ Restrict planting in the immediate vicinity of the building which may over time and if not properly maintained come into contact with the building; ➢ When considering landscape species consideration needs to be given to estimated size of the plant at maturity; ➢ Avoid species with rough fibrous bark, or which retain/shed bark in long strips or retain dead material in their canopies; ➢ Use smooth bark species of trees species which generally do not carry a fire up the bark into the crown; ➢ Avoid planting of deciduous species that may increase fuel at surface / ground level (i.e. leaf litter); ➢ Avoid climbing species to walls and pergolas; ➢ Locate combustible materials such as woodchips / mulch, flammable fuel stores away from the building; ➢ Locate combustible structures such as garden sheds, pergolas and materials such timber garden furniture way from the building; and ➢ Use of low flammability vegetation species.

APPENDIX 2. FLAMESOL CALCULATIONS

Calculated December 17, 2021, 2:04 pm (MDc v.4.9)

Fire Run 2 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	100	Rate of spread	7.22 km/h
Vegetation classification	Forest	Flame length	51.05 m
Understorey fuel load	22.6 t/ha	Flame angle	59 °, 63 °, 68 °, 72 °, 74 ° & 85 °
Total fuel load	34.1 t/ha	Elevation of receiver	15.09 m, 14.38 m, 12.92 m, 10.72 m, 9.27 m & 0 m
Vegetation height	n/a	Fire intensity	127,284 kW/m
Effective slope	14.2 °	Transmissivity	0.803, 0.781, 0.758, 0.741, 0.733 & 0.6850000000000001
Site slope	8 °	Viewfactor	0.4456, 0.3317, 0.2241, 0.1507, 0.1219 & 0.0326
Flame width	100 m	Minimum distance to < 40 kW/m²	48.3 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	59.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	76.3 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	96.3 m
		Minimum distance to < 10 kW/m²	108.5 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

Calculated December 17, 2021, 2:06 pm (MDc v.4.9)

Fire run 2 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	5.77 km/h
Vegetation classification	Forest	Flame length	41.65 m
Understorey fuel load	22.6 t/ha	Flame angle	52 °, 60 °, 67 °, 71 °, 73 ° & 84 °
Total fuel load	34.1 t/ha	Elevation of receiver	12.14 m, 12.57 m, 11.83 m, 10.15 m, 9.039999999999999 m & 0 m
Vegetation height	n/a	Fire intensity	101,827 kW/m
Effective slope	14.2 °	Transmissivity	0.838, 0.8080000000000001, 0.777, 0.753, 0.743 & 0.6840000000000001
Site slope	8 °	Viewfactor	0.6263, 0.4714, 0.3214, 0.2178, 0.1766 & 0.0479
Flame width	100 m	Minimum distance to < 40 kW/m²	30.4 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	38.9 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	52.2 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	67.90000000000001 m
		Minimum distance to < 10 kW/m²	77.3 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

Calculated December 17, 2021, 1:58 pm (MDc v.4.9)

Fire run 3 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	7.27 km/h
Vegetation classification	Forest	Flame length	51.36 m
Understorey fuel load	22.6 t/ha	Flame angle	46 °, 50 °, 55 °, 60 °, 63 ° & 77 °
Total fuel load	34.1 t/ha	Elevation of receiver	15.35 m, 16.01 m, 16.56 m, 16.8 m, 16.84 m & 13.45 m
Vegetation height	n/a	Fire intensity	128,130 kW/m
Effective slope	17.53 °	Transmissivity	0.821, 0.801, 0.779, 0.76, 0.751 & 0.696
Site slope	4 °	Viewfactor	0.4348, 0.3228, 0.2178, 0.147, 0.1189 & 0.032
Flame width	54 m	Minimum distance to < 40 kW/m²	44.6 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	52.3 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	63.9 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	77.59999999999999 m
		Minimum distance to < 10 kW/m²	86.2 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

Calculated December 17, 2021, 2:08 pm (MDc v.4.9)

fire run 3 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	7.27 km/h
Vegetation classification	Forest	Flame length	51.36 m
Understorey fuel load	22.6 t/ha	Flame angle	40 °, 45 °, 50 °, 56 °, 58 ° & 73 °
Total fuel load	34.1 t/ha	Elevation of receiver	13.98 m, 15.16 m, 15.97 m, 16.78 m, 16.77 m & 14.96 m
Vegetation height	n/a	Fire intensity	128,130 kW/m
Effective slope	17.53 °	Transmissivity	0.841, 0.8169999999999999, 0.791, 0.767, 0.757 & 0.703
Site slope	4 °	Viewfactor	0.6223, 0.4661, 0.3158, 0.2138, 0.1734 & 0.0467
Flame width	54 m	Minimum distance to < 40 kW/m²	36.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	42.9 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	52.9 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	64.5 m
		Minimum distance to < 10 kW/m²	71.59999999999999 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

Calculated December 17, 2021, 2:12 pm (MDc v.4.9)

Fire Run 4 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	4.01 km/h
Vegetation classification	Forest	Flame length	30.17 m
Understorey fuel load	22.6 t/ha	Flame angle	52.43 °, 56.43 °, 61.43 °, 65.43000000000001 °, 68.43000000000001 ° & 79.43000000000001 °
Total fuel load	34.1 t/ha	Elevation of receiver	10.21 m, 10.47 m, 10.61 m, 10.45 m, 10.38 m & 7.64 m
Vegetation height	n/a	Fire intensity	70,687 kW/m
Effective slope	8.91 °	Transmissivity	0.839, 0.821, 0.8, 0.78, 0.771 & 0.723
Site slope	3.43 °	Viewfactor	0.4247, 0.3154, 0.2124, 0.143, 0.1158 & 0.0308
Flame width	47 m	Minimum distance to < 40 kW/m²	29.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	35 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	43.9 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	54.4 m
		Minimum distance to < 10 kW/m²	60.8 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

Calculated December 17, 2021, 2:13 pm (MDc v.4.9)

Fire run 4 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	47	Rate of spread	2.35 km/h
Vegetation classification	Forest	Flame length	19.41 m
Understorey fuel load	22.6 t/ha	Flame angle	50.43 °, 58.43 °, 63.43 °, 68.43000000000001 °, 70.43000000000001 ° & 80.43000000000001 °
Total fuel load	34.1 t/ha	Elevation of receiver	6.57 m, 7.1 m, 7.11 m, 7 m, 6.85 m & 4.84 m
Vegetation height	n/a	Fire intensity	41,529 kW/m
Effective slope	8.91 °	Transmissivity	0.867, 0.848, 0.825, 0.804, 0.794 & 0.738
Site slope	3.43 °	Viewfactor	0.6037, 0.4479, 0.3014, 0.2035, 0.1655 & 0.0444
Flame width	47 m	Minimum distance to < 40 kW/m²	15.1 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	19.5 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	26.1 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	33.7 m
		Minimum distance to < 10 kW/m²	38.2 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

Calculated December 17, 2021, 2:21 pm (MDc v.4.9)

Fire Run 5 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.15 km/h
Vegetation classification	Rainforest	Flame length	15.41 m
Understorey fuel load	10 t/ha	Flame angle	67.43000000000001 °, 73.43000000000001 °, 77.43000000000001 °, 80.43000000000001 °, 81.43000000000001 ° & 86.43000000000001 °
Total fuel load	12 t/ha	Elevation of receiver	6.05 m, 5.96 m, 5.51 m, 4.85 m, 4.42 m & 0.54 m
Vegetation height	n/a	Fire intensity	13,334 kW/m
Effective slope	11.69 °	Transmissivity	0.854, 0.834, 0.8090000000000001, 0.786, 0.775 & 0.722
Site slope	3.43 °	Viewfactor	0.419, 0.3106, 0.2096, 0.1419, 0.1151 & 0.0309
Flame width	100 m	Minimum distance to < 40 kW/m²	17.7 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	23.7 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	33.6 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	45.8 m
		Minimum distance to < 10 kW/m²	53.3 m

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

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

Calculated December 17, 2021, 2:22 pm (MDc v.4.9)

Fire Run 5 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.15 km/h
Vegetation classification	Rainforest	Flame length	15.41 m
Understorey fuel load	10 t/ha	Flame angle	54.43 °, 65.43000000000001 °, 73.43000000000001 °, 77.43000000000001 °, 79.43000000000001 ° & 85.43000000000001 °
Total fuel load	12 t/ha	Elevation of receiver	5.52 m, 6.01 m, 5.93 m, 5.47 m, 5.15 m & 1.91 m
Vegetation height	n/a	Fire intensity	13,334 kW/m
Effective slope	11.69 °	Transmissivity	0.871, 0.851, 0.825, 0.799, 0.786 & 0.725
Site slope	3.43 °	Viewfactor	0.603, 0.4471, 0.3023, 0.2052, 0.1671 & 0.0452
Flame width	100 m	Minimum distance to < 40 kW/m²	12.3 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	16.6 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	24.3 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	34.2 m
		Minimum distance to < 10 kW/m²	40.4 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

Calculated December 17, 2021, 2:39 pm (MDc v.4.9)

Fire Run 6 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.18 km/h
Vegetation classification	Rainforest	Flame length	15.61 m
Understorey fuel load	10 t/ha	Flame angle	65.48 °, 71.48 °, 75.48 °, 78.48 °, 79.48 ° & 84.48 °
Total fuel load	12 t/ha	Elevation of receiver	6.63 m, 6.77 m, 6.67 m, 6.45 m, 6.28 m & 4.66 m
Vegetation height	n/a	Fire intensity	13,519 kW/m
Effective slope	11.89 °	Transmissivity	0.853, 0.834, 0.8080000000000001, 0.785, 0.774 & 0.722
Site slope	1.48 °	Viewfactor	0.4176, 0.3106, 0.2094, 0.1421, 0.1154 & 0.0309
Flame width	100 m	Minimum distance to < 40 kW/m²	18.2 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	24.2 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	34.2 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	46.4 m
		Minimum distance to < 10 kW/m²	53.9 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

Calculated December 17, 2021, 2:39 pm (MDc v.4.9)

Fire run 6 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.18 km/h
Vegetation classification	Rainforest	Flame length	15.61 m
Understorey fuel load	10 t/ha	Flame angle	53.48 °, 63.48 °, 71.48 °, 75.48 °, 77.48 ° & 83.48 °
Total fuel load	12 t/ha	Elevation of receiver	5.94 m, 6.54 m, 6.76 m, 6.65 m, 6.56 m & 5.24 m
Vegetation height	n/a	Fire intensity	13,519 kW/m
Effective slope	11.89 °	Transmissivity	0.87, 0.851, 0.824, 0.798, 0.785 & 0.724
Site slope	1.48 °	Viewfactor	0.601, 0.4478, 0.3024, 0.2051, 0.1672 & 0.0452
Flame width	100 m	Minimum distance to < 40 kW/m²	12.7 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	17 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	24.8 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	34.8 m
		Minimum distance to < 10 kW/m²	41 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

Calculated December 17, 2021, 2:57 pm (MDc v.4.9)

Fire Run 7 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.84 km/h
Vegetation classification	Rainforest	Flame length	19.91 m
Understorey fuel load	10 t/ha	Flame angle	71.97 °, 77.97 °, 82.97 °, 85.97 °, 86.97 ° & 92.97 °
Total fuel load	12 t/ha	Elevation of receiver	5.28 m, 4.19 m, 2.1 m, 0 m, 0 m & 0 m
Vegetation height	n/a	Fire intensity	17,621 kW/m
Effective slope	15.73 °	Transmissivity	0.843, 0.821, 0.795, 0.774, 0.763 & 0.712
Site slope	10.97 °	Viewfactor	0.4232, 0.3156, 0.2131, 0.1445, 0.1169 & 0.0313
Flame width	100 m	Minimum distance to < 40 kW/m²	21.6 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	28.6 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	40.1 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	53.8 m
		Minimum distance to < 10 kW/m²	62.2 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

Calculated December 17, 2021, 2:58 pm (MDc v.4.9)

Fire Run 7 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Fire Danger Index	80	Rate of spread	2.84 km/h
Vegetation classification	Rainforest	Flame length	19.91 m
Understorey fuel load	10 t/ha	Flame angle	59.97 °, 70.97 °, 78.97 °, 82.97 °, 84.97 ° & 91.97 °
Total fuel load	12 t/ha	Elevation of receiver	5.71 m, 5.49 m, 4.09 m, 1.99 m, 0.65 m & 0 m
Vegetation height	n/a	Fire intensity	17,621 kW/m
Effective slope	15.73 °	Transmissivity	0.863, 0.84, 0.8110000000000001, 0.785, 0.772 & 0.716
Site slope	10.97 °	Viewfactor	0.6047, 0.4525, 0.3074, 0.2092, 0.17 & 0.0458
Flame width	100 m	Minimum distance to < 40 kW/m²	14.9 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	20.2 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	29.3 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	40.7 m
		Minimum distance to < 10 kW/m²	47.8 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

Calculated December 17, 2021, 3:54 pm (MDc v.4.9)

Fire Run 8 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	130	Rate of spread	11.29 km/h
Vegetation classification	Grassland	Flame length	6.1 m
Understorey fuel load	4.5 t/ha	Flame angle	70.14 °, 76.14 °, 82.14 °, 85.14 °, 87.14 ° & 90.14 °
Total fuel load	4.5 t/ha	Elevation of receiver	2.33 m, 2.23 m, 1.93 m, 1.45 m, 1.12 m & 0 m
Vegetation height	n/a	Fire intensity	26,260 kW/m
Effective slope	-5.84 °	Transmissivity	0.884, 0.872, 0.855, 0.834, 0.822 & 0.754
Site slope	4.14 °	Viewfactor	0.4021, 0.296, 0.1979, 0.1338, 0.1088 & 0.0296
Flame width	100 m	Minimum distance to < 40 kW/m²	7.3 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	10 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	15 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	22 m
		Minimum distance to < 10 kW/m²	26.6 m

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

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

Calculated December 17, 2021, 3:55 pm (MDc v.4.9)

Fire Run 8 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	130	Rate of spread	11.29 km/h
Vegetation classification	Grassland	Flame length	6.1 m
Understorey fuel load	4.5 t/ha	Flame angle	56.14 °, 68.14 °, 77.14 °, 82.14 °, 84.14 ° & 89.14 °
Total fuel load	4.5 t/ha	Elevation of receiver	2.17 m, 2.33 m, 2.22 m, 1.91 m, 1.67 m & 0 m
Vegetation height	n/a	Fire intensity	26,260 kW/m
Effective slope	-5.84 °	Transmissivity	0.89, 0.88, 0.864, 0.846, 0.835 & 0.76
Site slope	4.14 °	Viewfactor	0.5903, 0.4306, 0.2875, 0.1939, 0.1571 & 0.0431
Flame width	100 m	Minimum distance to < 40 kW/m²	4.9 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	6.8 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	10.3 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	15.3 m
		Minimum distance to < 10 kW/m²	18.9 m

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

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

Calculated December 21, 2021, 11:21 am (MDc v.4.9)

Fire Run 9 SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	130	Rate of spread	19.6 km/h
Vegetation classification	Grassland	Flame length	8.039999999999999 m
Understorey fuel load	4.5 t/ha	Flame angle	66 °, 72 °, 78 °, 81 °, 82 ° & 85 °
Total fuel load	4.5 t/ha	Elevation of receiver	3.67 m, 3.82 m, 3.93 m, 3.97 m, 3.98 m & 4 m
Vegetation height	n/a	Fire intensity	45,576 kW/m
Effective slope	2.15 °	Transmissivity	0.876, 0.863, 0.842, 0.819, 0.8070000000000001 & 0.745
Site slope	0 °	Viewfactor	0.4056, 0.2984, 0.2012, 0.1363, 0.1106 & 0.03
Flame width	100 m	Minimum distance to < 40 kW/m²	9.800000000000001 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	13.3 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	19.6 m
Flame temperature	1,200 K	Minimum distance to < 12.5 kW/m²	28 m
		Minimum distance to < 10 kW/m²	33.5 m

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

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

Calculated December 21, 2021, 11:22 am (MDc v.4.9)

Fire Run 9 Non SFPP

Minimum Distance Calculator - AS3959-2018 (Method 2)			
Inputs		Outputs	
Grassland Fire Danger Index	130	Rate of spread	19.6 km/h
Vegetation classification	Grassland	Flame length	8.039999999999999 m
Understorey fuel load	4.5 t/ha	Flame angle	54 °, 64 °, 73 °, 78 °, 80 ° & 85 °
Total fuel load	4.5 t/ha	Elevation of receiver	3.25 m, 3.61 m, 3.84 m, 3.93 m, 3.96 m & 4 m
Vegetation height	n/a	Fire intensity	45,576 kW/m
Effective slope	2.15 °	Transmissivity	0.885, 0.873, 0.854, 0.833, 0.82 & 0.748
Site slope	0 °	Viewfactor	0.5914, 0.4319, 0.2917, 0.197, 0.1597 & 0.0438
Flame width	100 m	Minimum distance to < 40 kW/m²	6.7 m
Windspeed	n/a	Minimum distance to < 29 kW/m²	9.199999999999999 m
Heat of combustion	18,600 kJ/kg	Minimum distance to < 19 kW/m²	13.6 m
Flame temperature	1,090 K	Minimum distance to < 12.5 kW/m²	20 m
		Minimum distance to < 10 kW/m²	24.3 m

Rate of Spread - Noble et al. 1980

Flame length - Purton, 1982

Elevation of receiver - Douglas & Tan, 2005

Flame angle - Douglas & Tan, 2005

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