Bushfire Assessment Report

27 Lang Drive, Bolwarra Heights

Prepared for

SNL Building Constructions

Final V2 / August 2023

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Matt Doherty - Director

22 August 2023

BPD Certification:

Stuart Greville
Accredited Bushfire Practitioner
BPAD – 26202 (Exp: Nov 2023)

This report has been prepared in accordance with Appendix 2 of Planning for Bushfire Protection 2019 and certifies the development conforms to the specifications and requirements of Section 100B of the Rural Fires Act 1997 and S4.14 of the Environmental Planning and Assessment Act 1979.

Disclaimer

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Finally, the implementation of the measures and recommendations forwarded within this report would contribute to the amelioration of the potential impact of any bushfire upon the development site, but they do not and cannot guarantee that the area will not be affected by bushfire at some time.

EXECUTIVE SUMMARY

MJD Environmental has been engaged by SNL Building Constructions to prepare a Bushfire Assessment Report to accompany a Development Application to Maitland City Council for a proposed 1 into 14 Lot residential subdivision at 27 Lang Drive, Bolwarra Heights NSW.

This assessment has considered and assessed the bushfire hazard and associated potential threats relevant to the Proposal, and to outline the minimum mitigative measures which would be required in accordance with *Planning for Bush Fire Protection 2019* (PBP), as adopted through the *Environmental Planning & Assessment Amendment* (Planning for Bush Fire Protection) *Regulation 2020*.

In order to determine whether the proposed development is bushfire-prone, and if so, which setbacks and other relevant Bush Fire Protection Measures (BPM) will be appropriate, this assessment adhered to the methodology and procedures outlined in PBP (2019) via assessment of acceptable solutions as outlined in Chapter 5 of PBP (2019) and APZ modelled via AS3959 Method 2.

This assessment has been made based on the bushfire hazards in and around the Site at the time of site inspection and report production.

The assessment found that hazard vegetation types occur within 140m of the Site. The risks occur from a mosaic of Grassland and Short Heath vegetation surrounding the site predominately located to the south, west and north-east of the site. The current primary risk occurs from the Hunter Macleay Dry Sclerophyll Forest hazard to the south and has been assessed as having the greatest effect on bushfire behaviour. The slope under the primary hazard vegetation to the south is upslope. Additionally, a 2nd order water course runs through the centre to the lot from east to west, vegetation within the riparian zone has been assessed as Coastal Floodplain Wetlands. While the water course is currently managed land, it has the possibility to be revegetated to return to a rainforest riparian zone that meets appropriate APZ and IPA standards and regulations. In the case of revegetation and management this would become the primary hazard in the form of a rainforest (riparian) hazard vegetation. The vegetation and slope classification has been assessed in this manner. The slope under this primary hazard vegetation varies from upslope/ flat to -7.2° Downslope.

The site has been split into two portions: the North-Western Portion includes land to the northwest of the watercourse; and the South-eastern Portion refers to the land situated north of the watercourse to the southeast.

In summary, the following key recommendations have been generated to enable the proposal to comply with PBP (2019).

Asset Protection Zones

- A 14m APZ is required from the Hunter Macleay Dry Sclerophyll Forest hazard to the south of the Site.
- APZ management across the site and outside of the riparian corridor is to achieve the IPA performance criteria outlined in Appendix 4 of PBP (2019).
- Assessment of BAL based on AS3959 Method 2, has shown that any future development on the site will be able to comply with this standard.

Access

- A non-perimeter internal through road will be constructed from Hilldale Drive to Lang Drive. All lots have direct frontage to the new road to be constructed. Notably the access is partly approved (but not constructed) as part of the 4-lot subdivision. The road to be constructed will be formed sealed public road and comply with the width, grade, curve radius and vertical clearance set out in Table 5.3b of PBP 2019 namely general and internal road requirements.

Services – Water supply, Gas and Electricity

- Reticulated water supply shall be extended and augmented within the site.
- Services are to be provided and connected to the site in accordance with PBP (2019) as summarised and assessed in Chapter 3, Section 3.3 of this report.

Landscaping and Fuel Management

- Careful consideration of future site landscaping and ongoing fuel management must occur to minimise the potential impact of bushfire on the site.
- All landscaping and fuel management must provide due consideration of PBP (2019) Appendix 4.

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GLOSSARY OF TERMS AND ABBREVIATIONS

Term/ Abbreviation	Meaning
API	Aerial Photograph Interpretation
APZ	Asset Protection Zone
AS2419-2005	Australian Standard – Fire Hydrant Installations
AS3959-2018	Australian Standard – Construction of Buildings in Bush Fire Prone Areas
BAR	Bushfire Assessment Report
BCA	Building Code of Australia
BC Act	Biodiversity Conservation Act 2016
BMP	Bush Fire Management Plan
BPA	Bush Fire Prone Area (Also Bushfire Prone Land)
BPL	Bush Fire Prone Land
BPLM	Bush Fire Prone Land Map
BPM	Bush Fire Protection Measures
BTA	Bushfire Threat Assessment
DoE	Commonwealth Department of the Environment
DPI Water	NSW Department of Primary Industries – Water
EPA Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FDI	Fire Danger Index
FMP	Fuel Management Plan
ha	hectare
IPA	Inner Protection Area
LGA	Local Government Area
LLS Act	Local Land Services Act 2013
NCC	National Construction Code
OPA	Outer Protection Area
OEH	NSW Office of Environment and Heritage
PBP or PBP (2019)	Planning for Bushfire Protection 2019
RF Act	Rural Fires Act 1997
RF Regulation	Rural Fires Regulation
RFS	NSW Rural Fire Service
TSC Act	NSW Threatened Species Conservation Act 1995 (as repealed)

1 Introduction

MJD Environmental has been engaged by SNL Building Constructions to prepare a Bushfire Assessment Report to accompany a Development Application to Maitland City Council for a proposed 1 into 14 Lot residential subdivision at 27 Lang Drive, Bolwarra Heights NSW. Hereafter referred to as the 'site'. Refer to **Figure 1.**

This assessment aims to consider and assess the bushfire hazard and associated potential threats relevant to the Proposal, and to outline the minimum mitigative measures which would be required in accordance with *Planning for Bush Fire Protection 2019* (PBP), as adopted through the *Environmental Planning & Assessment Amendment* (Planning for Bush Fire Protection) *Regulation 2020*.

In order to determine whether the proposed development is bushfire-prone, and if so, which setbacks and other relevant Bush Fire Protection Measures (BPM) will be appropriate, this assessment adheres to the methodology and procedures outlined in PBP (2019) via assessment of acceptable solutions as outlined in Chapter 5 of PBP (2019) with APZ and BAL determined via assessment of performance solutions as outlined in AS 3959 (2018). This assessment has been made based on the bushfire hazards in and around the Site at the time of site inspection (September 2022 and July 2023) and report production.

1.1 Description of Proposal

The proposed development involves a 1 into 14 lot residential subdivision on the site. A one into two subdivision has been lodged with Council and the site benefits from an existing four lot subdivision fronting Hilldale Drive that included the construction of a road of Hilldale Drive (Council Ref: DA 93-439). The site has a second order watercourse running from the north to the south-west and the proposal includes the construction of a culvert leading to a cul-de-sac to the east.

A copy of the proposed Site Plan, is enclosed as **Appendix A**.

1.2 Aims & Objectives

This BAR addresses the aims and objectives of PBP 2019, being:

- Afford buildings and their occupants protection from exposure to a bushfire;
- Provide for a defendable space to be located around buildings;
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings;
- Ensure that appropriate operational access and egress for emergency service personnel and occupants is available;
- Provide for ongoing management and maintenance of bushfire protection measures; and
- Ensure that utility services are adequate to meet the needs of firefighters.

Chapter 5.2 of PBP 2019 specifies the following objectives to be applied in relation to access, water supply and services, and emergency and evacuation planning for developments of this type, applicable to the proposal:

- minimise perimeters of the subdivision exposed to the bush fire hazard (hourglass shapes, which maximise perimeters and create bottlenecks should be avoided);
- minimise vegetated corridors that permit the passage of bush fire towards buildings; provide for the siting of future dwellings away from ridge-tops and steep slopes, within saddles and narrow ridge crests;
- ensure that APZs between a bush fire hazard and future dwellings are effectively designed to address the relevant bush fire attack mechanisms;
- ensure the ongoing maintenance of APZs;

- provide adequate access from all properties to the wider road network for residents and emergency services;
- provide access to hazard vegetation to facilitate bush fire mitigation works and fire suppression; and
- ensure the provision of an adequate supply of water and other services to facilitate effective firefighting.

1.3 Site Particulars

Locality	The Site is situated at 27 Lang Drive, Bolwarra Heights, NSW.
Land Title	Lot 1 DP 1156433
LGA	Maitland City Council
Area	8.89 Ha (approx.)
Zoning	R5 Large Lot Residential
Boundaries	The site is situated to the west of Lang Drive. The site is bound residential dwellings to the north-west and south-west. To the south, west and north-east consists of managed land with residential dwellings in the north-east, and south-east. Vegetation in these areas include scattered remnant canopy species and regrowth vegetation.
Current Land Use	The site is predominantly cleared managed land with a residential dwelling in the east. There is a small cluster of vegetation surrounding the residential dwelling that extends south creating a fragmented corridor to the forested area south of the site boundary. A 2nd order watercourse runs though the site north to south-west.
Topography	The site contains gentle undulating topography that overall slopes gently to the east, with the highest elevation occurring in the north-west corner at approximately 22m ASL. There are two intermittent streams located on site that includes one first order stream running from the western boundary to northern boundary and one first order stream located in the east of the site running north-south.
Climate / Fire History	The Site lies within a geographical area with a Forest Fire Danger Index (FDI) rating of 100. The site is classified as being affected by Category 2 hazard and Buffer on the Bushfire Prone Land Map (DPE 2022). Refer to Figure 2.
Environment & Cultural Significance	A search of the AHIMS register has been completed on the 31st August 2022 and confirmed that there are no recorded Aboriginal sites or places on or near the site.

27 LANG DRIVE, BOLWARRA HEIGHTS

FIGURE 1: SITE LOCATION

Legend

- Watercourse
- Site
- Lot

0 70 140 280

Meters

1:5,000

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27 LANG DRIVE, BOLWARRA HEIGHTS

FIGURE 2: BUSHFIRE PRONE LAND MAP

Legend

- Watercourse
- Site
- Lot

Bush Fire Prone Vegetation

- Category 1
- Category 3
- 100m BFPV Buffer

0 25 50 100

Meters

1:2,000

N W E S

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2 Bushfire Hazard Analysis

2.1 Vegetation Assessment

Methodology

The vegetation in and around the Site, has been assessed to 140m from the site boundary (building area), in accordance with PBP 2019. This assessment has been made via a combination of:

- aerial photo interpretation;
- on site visit (September 2022 and July 2023); and
- reference to regional community vegetation mapping.

These vegetation communities have been classified for bushfire purposes into structure and formation using the system adopted by Keith (2004) and using Figure A1.2 of PBP (2019) with due regard to Section A1.10 (low threat vegetation – exclusions) and A1.11.1 (remnant bushland – simplified approach) where present and Appendix 1 of PBP (2019).

Refer to Photos below for vegetation observed in and around the Site during site inspection.

Vegetation Classification

Vegetation classification has been presented in **Table 1** below and **Figure 5**.

Table 1 Vegetation Classification

Direction	Description	Vegetation Classification (Primary Hazard)
North-Western Portion		
North	▪ Managed land ▪ Established residential dwellings	Managed Land
North-East (T01)	▪ Grassland	Grassland
South (T11 & T12)	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a Vegetation Management Plan (VMP) as riparian vegetation hazard rather than current grassland hazard.	Rainforest
South (T14)	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a VMP as riparian vegetation hazard rather than current grassland hazard.	Rainforest
West (T10)	▪ Riparian Vegetation running through residential dwellings and managed land	Rainforest
South-East Portion		
North	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a VMP as riparian vegetation hazard rather than current grassland hazard.	Rainforest
North (T16)	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a VMP as riparian vegetation hazard rather than current grassland hazard	Rainforest
North (T15)	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a VMP as riparian vegetation hazard rather than current grassland hazard	Rainforest

West (T13)	▪ Watercourse containing grassland within riparian zone. To be assessed based on future potential for rehabilitation via a VMP as riparian vegetation hazard rather than current grassland hazard.	Rainforest
South (T09)	▪ Riparian vegetation along first order stream	Rainforest
South (T08)	▪ Pasture / Grassland ▪ Disturbance area regenerating to adjacent vegetation characterised by Eucalypt canopy	Forest
South (T07)	▪ Pasture / Grassland ▪ Remnant vegetation characterised by Eucalypt canopy coupled with mid and lower stratum	Forest
South (T06)	▪ Remnant vegetation characterised by Eucalypt canopy coupled with mid and lower stratum ▪ Grassland	Forest
South (T05)	▪ Pasture / Grassland	Grassland
South (T04)	▪ Remnant vegetation ▪ Vegetation is bordered by a residential dwelling, managed land and grassland. Site boundary is within 50m from hazard.	Rainforest
East (T02)	▪ Grazed pasture / Grassland	Grassland
East (T03)	▪ Grazed pasture with scattered trees	Grassland

Note: The area of riparian corridor associated with the 2nd order stream that runs between the north-western portion and south-eastern portion of the development has been described as rainforest riparian should the waterway be managed and revegetated via a VMP.

The South-eastern Portions southern boundary hazards (T08, T07 & T06) has been classified as forest vegetation to the site boundary to account for potential future growth if current management ceases.

Site Photos

Photo 1: Vegetation along the southern boundary of the site ranging from forest, short heath and rainforest riparian

Photo 2: Site looking South-West from the north boundary on eastern side of the watercourse

Photo 3: Southern boundary looking East at current primary forest hazard vegetation

Photo 4: Location of proposed watercourse crossing

2.2 Slope Assessment

Methodology

In accordance with PBP (2019), an assessment of the slope was conducted throughout the Site (where a hazard is present) and for a distance of 100m around the Site in the hazard direction. Both the average slope and maximum slopes were considered to determine the level of gradient which will most significantly influence fire behaviour on the Site. The slope was categorised within the slope classification under PBP Appendix A1.4.

Slope assessment was assisted by:

- Preparation of a digital elevation model based on LiDAR;
- Preparation of slope assessment based on 1m contours derived from the DEM;
- On-site slope classification; and
- Aerial overlay.

Effective Slope

The slope class under any bushfire hazard within 100m is presented in **Table 2** below and **Figure 3**.

Table 2 Slope Class

Direction	Vegetation Classification (Primary Hazard)	Slope Class
North-Western Portion		
North-East (T01)	Grassland	0-5° Downslope
South (T11)	Rainforest	Upslope
South (T14)	Rainforest	0-5° Downslope
West (T10)	Rainforest	Upslope
South-East Portion		
North (T12)	Rainforest	0-5° Downslope
North (T16)	Rainforest	5-10° Downslope
North (T15)	Rainforest	0-5° Downslope
West (T13)	Rainforest	0-5° Downslope
South (T09)	Rainforest	Upslope
South (T08)	Forest	Upslope
South (T07)	Forest	Upslope
South (T06)	Forest	Upslope
South (T05)	Grassland	Upslope
South (T04)	Rainforest	Upslope
East (T02)	Grassland	Upslope
East (T03)	Grassland	Upslope

27 LANG DRIVE, BOLWARRA HEIGHTS

FIGURE 3: SLOPE AND VEGETATION CLASSIFICATION

Legend

- Elevation (m)
- Transects
- Watercourse
- Contour (1m)
- Site
- Slope Classification Buffer (100m)
- Vegetation Classification Buffer (140m)
- Cadastral Boundaries

Vegetation (Keith 2004)

- Forest
- Short Heath
- Rainforest (Riparian)
- Rainforest (Low Hazard)
- Freshwater Wetland
- Grassland

N W E S

0 40 80 160

Meters

1:2,500

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3 Bushfire Protection Measures

PBP 2019 sets out a suite of BPMs and criteria that require consideration and assessment for applicable proposals on bushfire prone land in order to provide an adequate level of protection to new developments.

The following measures have been considered and discussed throughout this chapter with due regard to PBP (2019):

- Asset Protection Zones (APZ)
- Bushfire Attack Level (BAL)
- Access
- Services – Water supply, Gas and Electricity
- Landscaping and Fuel Management
- Emergency Management

As this development proposal entails a subdivision, the following objectives will be applied in relation to access, water supply and services, and emergency and evacuation planning:

- minimise perimeters of the subdivision exposed to the bush fire hazard (hourglass shapes, which maximise perimeters and create bottlenecks should be avoided);
- minimise vegetated corridors that permit the passage of bush fire towards buildings; provide for the siting of future dwellings away from ridge-tops and steep slopes, within saddles and narrow ridge crests;
- ensure that APZs between a bush fire hazard and future dwellings are effectively designed to address the relevant bush fire attack mechanisms;
- ensure the ongoing maintenance of APZs;
- provide adequate access from all properties to the wider road network for residents and emergency services;
- provide access to hazard vegetation to facilitate bush fire mitigation works and fire suppression; and
- ensure the provision of an adequate supply of water and other services to facilitate effective firefighting.

The proposed development is able to meet the performance criteria for acceptable solutions for subdivision development, giving due regards to the requirements of Chapter 5 of PBP 2019. A suitable package of BPMs has been developed and documented in this report that is commensurate with the assessed level of risk to the development.

3.1 Asset Protection Zone

An APZ is a buffer zone between the hazard and buildings that is progressively managed to minimise bushfire hazard (fuel loads and reduce potential radiant heat levels, flame, ember and smoke attack) PBP (2019), in order to mitigate risk to life and asset. Where a hazard vegetation classification has been determined, an APZ can consist of two areas being:

1) Inner Protection Area (IPA) – The IPA extends from the edge of the development/ buildings to the OPA. The IPA aims to provide defendable space and reduce potential for direct or spontaneous ignition by providing a heavily reduced or fuel free zone.
2) Outer Protection Area (OPA) – The OPA is located adjacent to the hazard. Within the OPA any trees and shrubs should be maintained in a manner such that the vegetation is not continuous in order to reduce flame length and fire intensity. A properly managed OPA can aid in ember attack by filtering embers and slowing the fires rate of spread.

An APZ can include the following:

- Lawns;
- discontinuous gardens;
- swimming pools;
- driveways;
- detached garages;
- open space / parkland;
- car parking; and
- cycleway and formed walkways.

3.1.1 Determining APZs

The Site lies within the Maitland City Council LGA and therefore is assessed under an FDI (Fire Danger Index) rating of 100. The Performance Criteria may be met by designing an Alternate Solution (Performance Solution); which in this instance involves the modelling of radiant heat using the methodology detailed in Appendix B of Australian Standard AS3959 Construction of buildings in bushfire prone areas (AS3959- 2018).

Modelling of the radiant heat exposure, the size and shape of a bushfire hazard influence on the behaviour of bushfire and associated risk to the built environment / development. With specific regard to bushfire hazard setbacks for residential subdivisions, the Performance Criteria for APZs is satisfied if radiant heat levels of 29kW/m^2 or less are experienced on each proposed lot.

The NBC Bushfire Attack Assessor V4.1 was used to model the bushfire radiant heat exposure which determined the applicable APZ setback to achieve a 29kw/m^2. The modelled APZ has been detailed in **Table 3** and **Figure 4**. Refer to **Appendix B** for a copy of the NBC Bushfire Attack Assessment Report V4.1 report.

Table 3 Required APZ (AS 3959 2018 Method 2)

Direction	Vegetation Classification (Primary Hazard)	Slope Class	Approved APZ
North-Western Portion			
North-East (T01)	Grassland	0-5° Downslope	11m
South (T11)	Rainforest	Upslope	10m
South (T14)	Rainforest	0-5° Downslope	12m
West (T10)	Rainforest	Upslope	9m
South-East Portion			
North (T12)	Rainforest	0-5° Downslope	10m
North (T16)	Rainforest	5-10° Downslope	14m
North (T15)	Rainforest	0-5° Downslope	11m

Direction	Vegetation Classification (Primary Hazard)	Slope Class	Approved APZ
West (T13)	Rainforest	0-5° Downslope	10m
South (T09)	Rainforest	Upslope	9m
South (T08)	Forest	Upslope	14m
South (T07)	Forest	Upslope	13m
South (T06)	Forest	Upslope	14m
South (T05)	Grassland	Upslope	9m
South (T04)	Rainforest	Upslope	9m
East (T02)	Grassland	Upslope	9m
East (T03)	Grassland	Upslope	9m

Site management is to continue for the life of the development and maintain site management levels to the IPA, standards outside the riparian area, per Appendix 4 of PBP (2019).

3.1.2 Determining BAL

The NBC Bushfire Attack Assessor V4.1 was used to model the bushfire radiant heat exposure which determined the applicable BAL. The modelled BAL contours have been detailed in **Table 4** and mapped in **Figure 5**.

Table 4 Required BAL (AS 3959 2018 Method 2)

Direction of Hazard	Vegetation Classification	Slope Class	APZ (PBP 2019)	Separation Distance (m)	BAL
North-Western Portion					
North-East (T01)	Grassland	0-5° Downslope	11m	<9 9-<12 12-<17 17-<25 25-<50	BAL- FZ BAL-40 BAL-29 BAL-19 **BAL-12.5**
South (T11)	Rainforest	Upslope	10m	<6 6-<9 9-<14 14-<20 20-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5

South (T14)	Rainforest	0-5° Downslope	12m	<8 8-<11 11-<17 17-<24 24-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
West (T10)	Rainforest	Upslope	9m	<5 5-<8 8-<13 13-<19 19-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South-East Portion					
North (T12)	Rainforest	0-5° Downslope	10m	<6 6-<9 9-<14 14-<21 21-<10	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
North (T16)	Rainforest	5-10° Downslope	14m	<10 10-<14 14-<20 20-<28 28-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
North (T15)	Rainforest	0-5° Downslope	11m	<7 7-<11 11-<16 16-<23 23-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
West (T13)	Rainforest	0-5° Downslope	10m	<7 7-<10 10-<15 15-<22 22-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South (T09)	Rainforest	Upslope	9m	<5 5-<8 8-<12 12-<18 18-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South (T08)	Forest	Upslope	14m	<10 10-<14 14-<20 20-<29 29-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South (T07)	Forest	Upslope	13m	<10 10-<13 13-<19 19-<27 27-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5

South (T06)	Forest	Upslope	14m	<10 10-<14 14-<20 20-<28 28-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South (T05)	Grassland	Upslope	9m	<8 8-<10 10-<15 15-<22 22-<50	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
South (T04)	Rainforest	Upslope	9m	<5 5-<8 8-<13 13-<19 19-<100	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
East (T02)	Grassland	Upslope	9m	<8 8-<10 10-<15 15-<22 22-<50	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5
East (T03)	Grassland	Upslope	9m	<8 8-<10 10-<15 15-<22 22-<50	BAL- FZ BAL-40 BAL-29 BAL-19 BAL-12.5

27 LANG DRIVE, BOLWARRA HEIGHTS

FIGURE 4: REQUIRED ASSET PROTECTION ZONES

Legend

- Site
- Proposed Layout
- Watercourse
- Cadastral Boundaries
- Required Asset Protection Zone (AS3959-2018 Method 2)

Vegetation (Keith 2004)

- Forest - Hunter Macleay DSF
- Forested Wetland - Coastal Floodplain Wetland
- Grassland

0 25 50 100

Meters

1:1,500

N W E S

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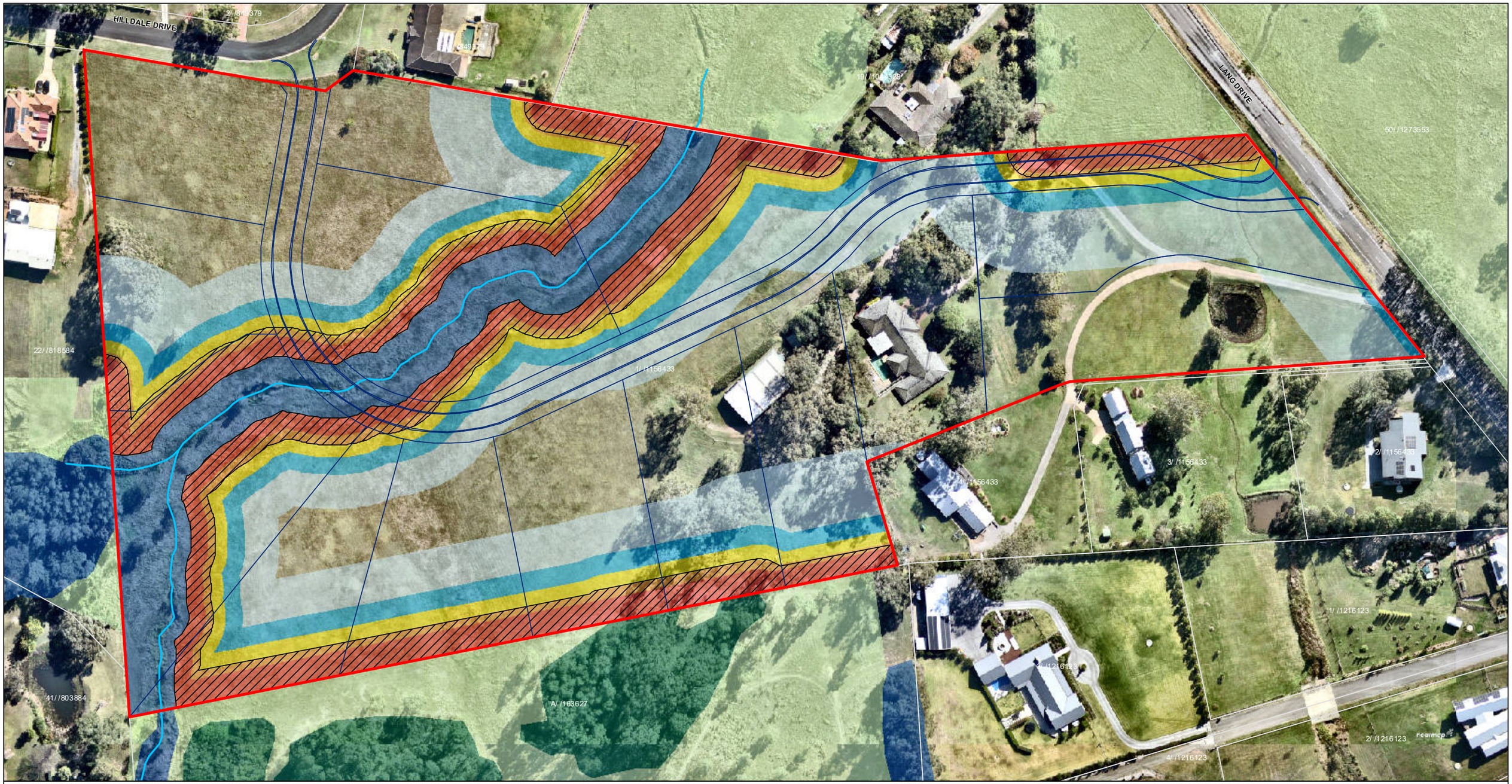

27 LANG DRIVE, BOLWARRA HEIGHTS

FIGURE 5: REQUIRED BUSHFIRE ATTACK LEVELS

Legend

- Site
- Proposed Layout
- Watercourse
- Cadastral Boundaries
- Required Asset Protection Zone (AS3959)

Vegetation (Keith 2004)

- Forest - Hunter Macleay DSF
- Forested Wetland - Coastal Floodplain Wetland
- Grassland

Required Bushfire Attack Levels

AS3959-2018 Method 2

- BAL-FZ
- BAL-40
- BAL-29
- BAL-19
- BAL-12.5

0 25 50 100

Meters

1:1,500

N W E S

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Aerial: NearMap (2023) | Data: MJD Environmental, GCA (2023), NSW Spatial Services (2021) | Datum/Projection: GDA 2020 MGA Zone 56 | Date: 17/08/2023 | Version 2 | Z:\22056 - 27 Lang Drive, Bolwarra Heights\22056_LangDr_BF_20230817.mxd | This plan should not be relied upon for critical design dimensions.

3.2 Access

In the event of a serious bushfire threat to the proposed development, it will be essential to ensure that adequate ingress / egress and the provision of defendable space are afforded in the development design with due regard to the requirements of Table 5.3b, and Appendix 3 of PBP (2019).

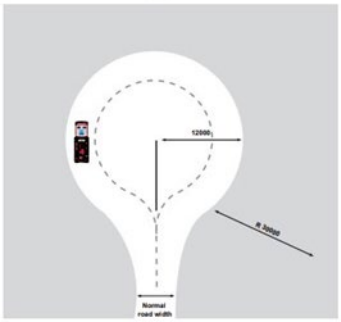
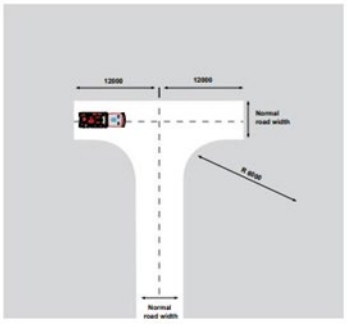
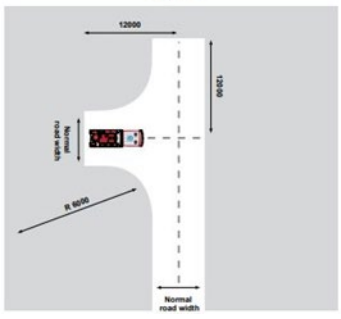
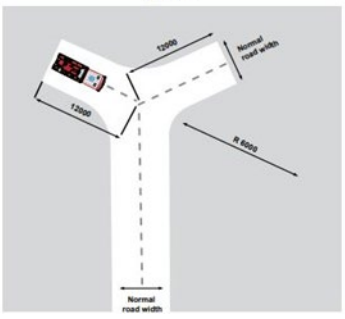
A non-perimeter internal through road will be constructed from Hilldale Drive to Lang Drive. All lots have direct frontage to the new road to be constructed. Notably the access is partly approved (but not constructed) as part of the 4-lot subdivision. The road to be constructed will be formed sealed public road and comply with the width, grade, curve radius and vertical clearance set out in Table 5.3b of PBP 2019 namely general and internal road requirements.

Refer to **Appendix A** for Site Plan showing access.

The following summarises the requirements of Table 5.3b, and Appendix 3 of PBP (2019) specifically general requirements, non-perimeter roads and property access. Deviations, beyond the performance solution for road length outlined above, from the below acceptable solutions for access may be considered (depending on the situation) through a performance-based assessment.

Table 5 : Acceptable solutions for access (PBP 2019)

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
General Requirements ▪ Firefighting vehicles are provided with safe, all-weather access to structures.	▪ property access roads are two-wheel drive, all weather roads; ▪ perimeter roads are provided for residential subdivisions of three or more allotments; ▪ subdivisions of three or more allotments have more than one access in and out of the development; ▪ traffic management devices are constructed to not prohibit access by emergency services vehicles; ▪ 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; ▪ all roads are through roads; ▪ dead end roads are not recommended, but if unavoidable, 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; ▪ where kerb and guttering is provided on perimeter roads, roll top kerbing should be used to the hazard side of the road; ▪ where access/egress can only be achieved through forest, woodland and heath vegetation, secondary access shall be provided to an alternate point on the existing public road system; and ▪ 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.
▪ 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.
▪ 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; ▪ hydrants are provided in accordance with the relevant clauses of AS 2419.1:2005; and ▪ there is suitable access for a Category 1 fire appliances to within 4m of the static water supply where no reticulated supply is available.

Performance Criteria	Acceptable Solutions
Non-perimeter access roads ▪ Access roads are designed to allow safe access and egress for firefighting vehicles while residents are evacuating.	▪ minimum 5.5m carriageway width kerb to kerb; ▪ minimum 5.5m carriageway width kerb to kerb; ▪ parking is provided outside of the carriageway width; hydrants are located clear of parking areas; ▪ roads are through roads, and these are linked to the internal road system at an interval of no greater than 500m; ▪ curves of roads have a minimum inner radius of 6m; ▪ the road crossfall does not exceed 3 degrees; and ▪ a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.
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 speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles. In circumstances where this cannot occur, the following requirements apply: ▪ minimum 4m carriageway width; ▪ in forest, woodland and heath situations, rural property access roads have passing bays every 200m that are 20m long by 2m wide, making a minimum trafficable width of 6m at the passing bay; ▪ a minimum vertical clearance of 4m to any overhanging obstructions, including tree branches; and ▪ provide a suitable turning area in accordance with Appendix 3. Curve radius (inside edge in metres) / Swept path (metres width): < 40 — 4.0 40 - 69 — 3.0 70 - 100 — 2.7 > 100 — 2.5 Type A  Type B  Type C  Type D 

Performance Criteria	Acceptable Solutions
	▪ curves have a minimum inner radius of 6m and are minimal in number to allow for rapid access and egress; ▪ the minimum distance between inner and outer curves is 6m; ▪ the crossfall is not more than 10 degrees; ▪ maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads; and ▪ a development comprising more than three dwellings has access by dedication of a road and not by right of way.

3.3 Services – Water, Electricity, Gas

The Site is to be developed in accordance with Table 5.3c of the PBP (2019), acceptable solutions for services listed in **Table 6**.

The proposal is able to satisfy these requirements given:

- The site can be connected to the 150 PVC watermain on Hildale Drive.
- The site is connected to the existing overhead electrical transmission lines.
- Any future gas connection shall be installed in accordance with the provisions of PBP (2019).

Table 6 Acceptable solutions for services (PBP 2019)

Performance Criteria	Acceptable Solutions
The intent may be achieved where:	
Water supplies ▪ an adequate water supply is provided for firefighting purposes.	▪ reticulated water is to be provided to the development, where available; and ▪ a static water supply is provided where no reticulated water is available.
▪ water supplies are located at regular intervals; and ▪ the water supply is accessible and reliable for firefighting operations.	▪ fire hydrant spacing, design and sizing comply with the relevant clauses of AS 2419.1:2005; ▪ hydrants are not located within any road carriageway; and ▪ reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads.
▪ flows and pressure are appropriate.	▪ fire hydrant flows and pressures comply with the relevant clauses of AS 2419.1:2005.
▪ the integrity of the water supply is maintained.	▪ all above-ground water service pipes external to the building are metal, including and up to any taps.
▪ a static water supply is provided for firefighting purposes in areas where reticulated water is not available.	▪ where no reticulated water supply is available, water for firefighting purposes is provided in accordance with Table 5.3d (refer to insert on left); ▪ a connection for firefighting purposes is located within the IPA or non-hazard side and away from the structure; ▪ 65mm Storz outlet with a ball valve is fitted to the outlet; ▪ ball valve and pipes are adequate for water flow and are metal; ▪ supply pipes from tank to ball valve have the same bore size to ensure flow volume; ▪ underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank;

Performance Criteria	Acceptable Solutions
	▪ a hardened ground surface for truck access is supplied within 4m; ▪ above-ground tanks are manufactured from concrete or metal; ▪ raised tanks have their stands constructed from non-combustible material or bush fire-resisting timber (see Appendix F of AS 3959); ▪ unobstructed access can be provided at all times; ▪ underground tanks are clearly marked; ▪ tanks on the hazard side of a building are provided with adequate shielding for the protection of firefighters; ▪ all exposed water pipes external to the building are metal, including any fittings; ▪ where pumps are provided, they are a minimum 5hp or 3kW petrol or diesel-powered pump, and are shielded against bush fire attack; any hose and reel for firefighting connected to the pump shall be 19mm internal diameter; and ▪ fire hose reels are constructed in accordance with AS/NZS 1221:1997, and installed in accordance with the relevant clauses of AS 2441:2005.
Electricity Services ▪ location of electricity services limits the possibility of ignition of surrounding bushland or the fabric of buildings	▪ where practicable, electrical transmission lines are underground. ▪ where overhead electrical transmission lines are proposed: o lines are installed with short pole spacing (30 metres), unless crossing gullies, gorges or riparian areas; and o no part of a tree is closer to a power line than the distance set out in accordance with the specifications in ISSC3 *Guideline for Managing Vegetation Near Power Lines*.
Gas services ▪ location and design of gas services will not lead to ignition of surrounding bushland or the fabric of buildings.	▪ reticulated or bottled gas is installed and maintained in accordance with AS/NZS 1596:2014 and the requirements of relevant authorities, and metal piping is used; ▪ all fixed gas cylinders are kept clear of all flammable materials to a distance of 10m and shielded on the hazard side; ▪ connections to and from gas cylinders are metal; ▪ polymer-sheathed flexible gas supply lines are not used; ▪ and above-ground gas service pipes are metal, including and up to any outlets.

3.4 Landscaping & Fuel Management

All future landscaping on the site should be designed and managed to minimise impact of bushfire based on the principles set out in PBP (2019) being:

- Prevent flame contact / direct ignition on the dwelling;
- Provide a defendable space for property protection;
- Reduce fire spread;
- Deflect and filter embers;
- Provide shelter from radiant heat; and
- Reduce wind speed.

In this manner, consideration should be given to species selection, planting location, flammability and size at maturity to ensure discontinuous canopy/ structure both vertically and horizontally to ensure the above principles are met.

Ongoing fuel management across the site as part of the maintenance regime should comply with the NSW RFS '*Asset protection zone standards'* and *Appendix 4 - Asset Protection Zone Requirements* of PBP (2019) which provides guidance on maintenance activities to assist in achieving the landscape principles.

Fencing and gates are to be constructed in accordance with PBP (2019) section 7.6 as follows:

Fences and gates in bush fire prone areas may play a significant role in the vulnerability of structures during bush fires. In this regard, all fences in bush fire prone areas should be made of either hardwood or non-combustible material.

However, in circumstances where the fence is within 6m of a building or in areas of BAL-29 or greater, they should be made of non-combustible material only.

3.5 Emergency Management

Any fire within the Site would be attended in the first instance by Bolwarra-Largs Rural Fire Brigade, with support available from the Fire and Rescue Maitland Fire Station and the Fire and Rescue Morpeth Fire Station.

To assist emergency response from the NSW RFS and/or NSW Fire and Rescue, site access is to comply with the provisions set out in PBP (2019) and all tanks (where/if provided) including connection points be readily accessible and clearly marked. If pumps are to be made available, they must be regularly maintained and in good working order.

4 Conclusion & Recommendations

MJD Environmental has been engaged by SNL Building Constructions to prepare a Bushfire Assessment Report to accompany a Development Application to Maitland City Council for the proposed development of a 1 into 14 Lot residential subdivision at 27 Lang Drive, Bolwarra Heights, NSW.

This assessment has considered and assessed the bushfire hazard and associated potential threats relevant to the Proposal, and to outline the minimum mitigative measures which would be required in accordance with *Planning for Bush Fire Protection 2019* (PBP), as adopted through the *Environmental Planning & Assessment Amendment* (Planning for Bush Fire Protection) *Regulation 2020*.

In order to determine whether the proposed development is bushfire-prone, and if so, which setbacks and other relevant Bush Fire Protection Measures (BPM) will be appropriate, this assessment adhered to the methodology and procedures outlined in PBP (2019) via assessment of acceptable solutions as outlined in Chapter 5 of PBP (2019) and APZ modelled via AS3959 Method 2.

This assessment has been made based on the bushfire hazards in and around the Site at the time of site inspection and report production.

The assessment found that hazard vegetation types occur within 140m of the Site. The risks occur from a mosaic of Grassland and Short Heath vegetation surrounding the site predominately located to the south, west and north-east of the site. The current primary risk occurs from the Hunter Macleay Dry Sclerophyll Forest hazard to the south and has been assessed as having the greatest effect on bushfire behaviour. The slope under the primary hazard vegetation to the south is upslope. Additionally, a 2nd order water course runs through the centre to the lot from east to west, vegetation within the riparian zone has been assessed as Coastal Floodplain Wetlands. While the water course is currently managed land, it has the possibility to be revegetated to return to a rainforest riparian zone that meets appropriate APZ and IPA standards and regulations. In the case of revegetation and management this would become the primary hazard in the form of a rainforest (riparian) hazard vegetation. The vegetation and slope classification has been assessed in this manner. The slope under this primary hazard vegetation varies from upslope/ flat to -7.2° Downslope.

The site has been split into two portions: the North-Western Portion includes land to the northwest of the watercourse; and the South-eastern Portion refers to the land situated north of the watercourse to the southeast.

Asset Protection Zones

- A 14m APZ is required from the Hunter Macleay Dry Sclerophyll Forest hazard to the south of the Site.
- APZ management across the site and outside of the riparian corridor is to achieve the IPA performance criteria outlined in Appendix 4 of PBP (2019).
- Assessment of BAL based on AS3959 Method 2, has shown that any future development on the site will be able to comply with this standard.

Access

- A non-perimeter internal through road will be constructed from Hilldale Drive to Lang Drive. All lots have direct frontage to the new road to be constructed. Notably the access is partly approved (but not constructed) as part of the 4-lot subdivision. The road to be constructed will be formed sealed public road and comply with the width, grade, curve radius and vertical clearance set out in Table 5.3b of PBP 2019 namely general and internal road requirements.

Services – Water supply, Gas and Electricity

- Reticulated water supply shall be extended and augmented within the site.
- Services are to be provided and connected to the site in accordance with PBP (2019) as summarised and assessed in Chapter 3, Section 3.3 of this report.

Landscaping and Fuel Management

- Careful consideration of future site landscaping and ongoing fuel management must occur to minimise the potential impact of bushfire on the site.
- All landscaping and fuel management must provide due consideration of PBP (2019) Appendix 4.

5 Bibliography

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NSW Rural Fire Service (2005). *Standards for Asset Protection Zones*. NSW Rural Fire Service.

Ramsay, GC and Dawkins, D (1993). *Building in Bushfire-prone Areas – Information and Advice.* CSIRO and Standards Australia.

Rural Fires and Environmental Assessment Legislation Amendment Act 2002.

Standards Australia (2018). *AS 3959 – 2018: Construction of Buildings in Bushfire-prone Areas.*

Appendix A Site Plan

PROPOSED RESIDENTIAL SUBDIVISION

27 LANG DRIVE, BOLWARRA HEIGHTS

DEVELOPMENT APPLICATION

CLIENT: LANG DRIVE INVESTMENTS

CONSENT AUTHORITY: MAITLAND CITY COUNCIL

DATE: JUNE 2023

DRAWING SCHEDULE PROJECT No. 22218

DWG No.	SHEET TITLE	REV
C00	COVER SHEET	3
C01	GENERAL ARRANGEMENT PLAN	3
C02	PLAN SHEET (SHEET 1 OF 2)	3
C03	PLAN SHEET (SHEET 2 OF 2)	3
C04	ROAD 01 LONGITUDINAL SECTION	3
C05	ROAD 01 CROSS SECTIONS (SHEET 1 OF 6)	3
C06	ROAD 01 CROSS SECTIONS (SHEET 2 OF 6)	3
C07	ROAD 01 CROSS SECTIONS (SHEET 3 OF 6)	3
C08	ROAD 01 CROSS SECTIONS (SHEET 4 OF 6)	3
C09	ROAD 01 CROSS SECTIONS (SHEET 5 OF 6)	3
C10	ROAD 01 CROSS SECTIONS (SHEET 6 OF 6)	3
C11	TYPICAL SECTIONS, DETAILS AND NOTES	3
C12	EARTHWORKS PLAN	3
C13	SOIL AND WATER MANAGEMENT PLAN	3
C14	SOIL AND WATER MANAGEMENT DETAILS	3

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PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
3	LAYOUT AMENDMENT	A.M	I.H	22.06.23
2	LAYOUT AMENDMENTS	A.M	I.H	23.03.23
1	ORIGINAL ISSUE	R.M	I.H	30.08.22

North

Scale
0 20 40 60 80m
1:1000 (A1) 1:2000 (A3)

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Designed	R.M
Cad Reference	22218C dC01 r3
Scale	1:1000
	A1 SHEET

Project Approval
IAN HILL (B.E)
Consulting Civil Engineer

Client

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PROPOSED SUBDIVISION
27 LANG DRIVE
BOLWARRA HEIGHTS

GENERAL ARRANGEMENT PLAN

Project No	
22218C	
Drawing No	Revision
C01	3

PLOT DATE: 23/06/2023 11:30:27 AM CAD FILE: Q:\22\22218 Hilldale Drive, Bolworra Heights\02_CAD\AutoCAD\Civil\22218C dC01 r3.dwg

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.

LEGEND

- (1) PIT NUMBER
- PROPOSED STORMWATER PIPE
- EXISTING STORMWATER PIPE
- EKI PIT
- SAG PIT
- IAD PIT
- DESIGN CONTOURS MAJOR
- DESIGN CONTOURS MINOR
- NATURAL CONTOURS MAJOR
- NATURAL CONTOURS MINOR

(A) EXISTING RIGHT OF CARRIAGEWAY 8 WIDE
(B) EXISTING EASEMENT FOR SEWER MAIN 4 WIDE
(E) EXISTING EASEMENT FOR ELECTRICITY & OTHER PURPOSES 7.1 WIDE & VARIABLE

HILLDALE DRIVE
EXISTING ROLL KERB AND GUTTER
E: 367640.076
N: 6381981.556
PROPOSED TOP OF ROLL KERB TO MATCH EXISTING KERB HEIGHT (TYP.)
11
DP849379
19
DP1044338
ROAD 01
ROLL KERB AND GUTTER
PROPOSED 1:5 FILL BATTER
PROPOSED 1:5 / 1:3 CUT BATTER
7.5m AHD 1% AEP FLOOD LEVEL FROM PATERSON RIVER FLOOD STUDY
8.0m FLOOD PLANNING LEVEL
20m RIPARIAN OFFSET
4% SITE REGRADE
7.5m AHD FLOOD LEVEL FROM PATERSON RIVER FLOOD STUDY
LOCALLY STEEPEN BATTER TO 1:4 TO AVOID IMPACT ON RIPARIAN CORRIDOOR
TRANSITION FROM 1:5 FILL BATTER TO 1:4 FILL BATTER BETWEEN CH 120-135.
PROPOSED 1:4 FILL BATTER
GPT MAINTENANCE PAD
GROSS POLLUTANT TRAP
TWIN 2.7m WIDE x 1.2m HIGH REINFORCED CONCRETE BOX CULVERT
ANGLE HEADWALL PERPENDICULAR TO WATERCOURSE
PROVIDE SCOUR PROTECTION IN ACCORDANCE WITH MOES STD DWG SD045
PROPOSED 3m WIDE STORMWATER EASEMENT
WATERCOURSE
EXISTING EASEMENT FOR PRESSURE SEWER MAIN 4m WIDE
12.5m APZ
18.5m APZ
22
DP818584
JOINS DWG C02
A
DP163627
JOINS INSERT
INSERT
Ø1200 RCP
CONSTRUCT 2m WIDE TRAPEZOIDAL CHANNEL WITH 1:4 BATTERS TO DIVERT EXTERNAL STORMWATER FLOW TO HEADWALL
MATCH LEVELS AT PROPERTY BOUNDARY
PRELIMINARY ISSUE
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Amendment	Description	Drawn	App'd	Date
3	LAYOUT AMENDMENT	A.M	I.H	22.06.23
2	LAYOUT AMENDMENTS	A.M	I.H	23.03.23
1	ORIGINAL ISSUE	R.M	I.H	30.08.22

North
Scale 1:500 (A1) 1:1000 (A3)

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Scale 1:500
A1 SHEET
Project Approval
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PROPOSED SUBDIVISION
27 LANG DRIVE
BOLWARRA HEIGHTS
PLAN SHEET (SHEET 1 OF 2)

Project No 22218C
Drawing No C02
Revision 3

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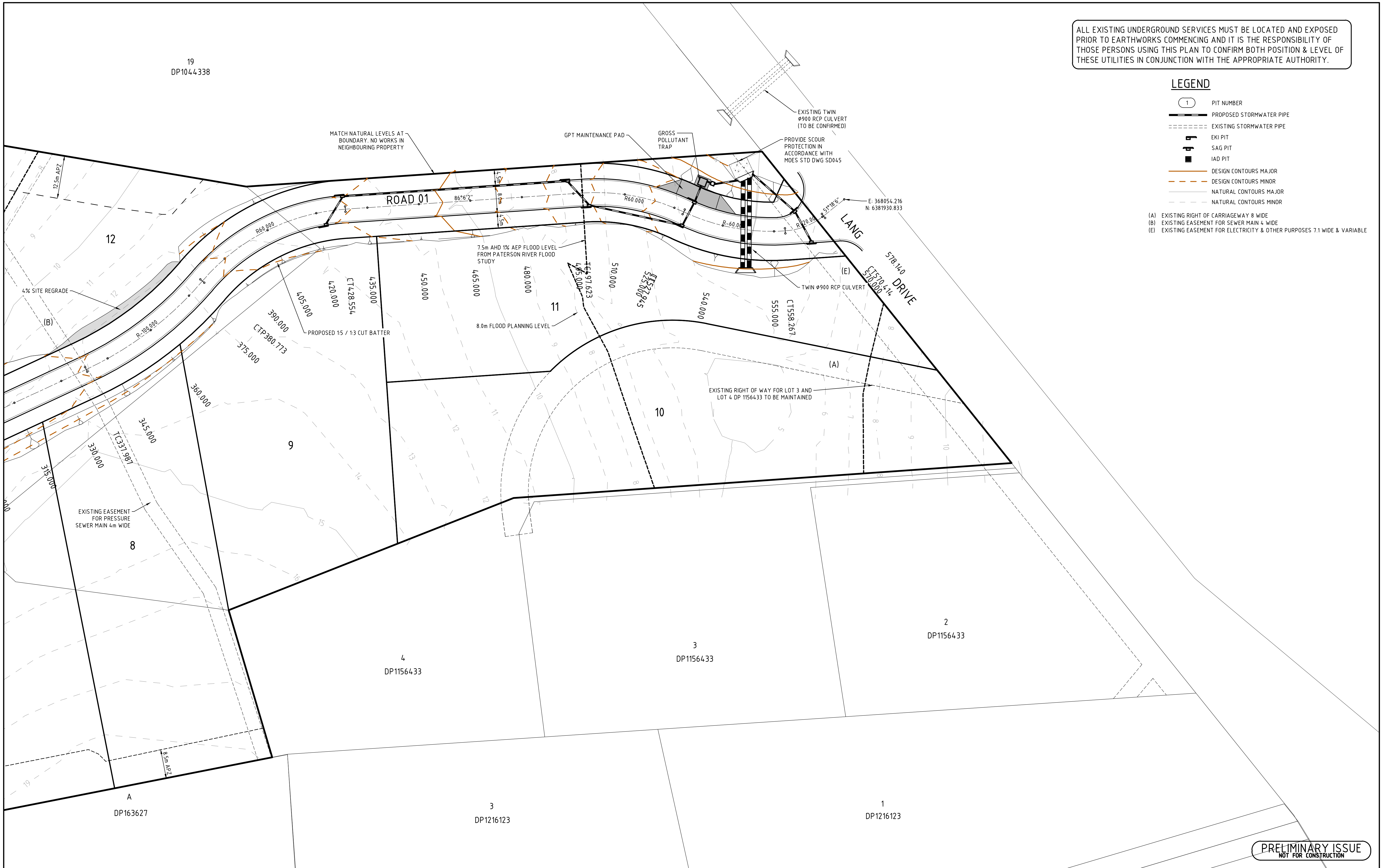

ALL EXISTING UNDERGROUND SERVICES MUST BE LOCATED AND EXPOSED PRIOR TO EARTHWORKS COMMENCING AND IT IS THE RESPONSIBILITY OF THOSE PERSONS USING THIS PLAN TO CONFIRM BOTH POSITION & LEVEL OF THESE UTILITIES IN CONJUNCTION WITH THE APPROPRIATE AUTHORITY.
LEGEND
PIT NUMBER
PROPOSED STORMWATER PIPE
EXISTING STORMWATER PIPE
EKI PIT
SAG PIT
IAD PIT
DESIGN CONTOURS MAJOR
DESIGN CONTOURS MINOR
NATURAL CONTOURS MAJOR
NATURAL CONTOURS MINOR
(A) EXISTING RIGHT OF CARRIAGEWAY 8 WIDE
(B) EXISTING EASEMENT FOR SEWER MAIN 4 WIDE
(E) EXISTING EASEMENT FOR ELECTRICITY & OTHER PURPOSES 7.1 WIDE & VARIABLE
19
DP1044338
MATCH NATURAL LEVELS AT BOUNDARY. NO WORKS IN NEIGHBOURING PROPERTY
GPT MAINTENANCE PAD
GROSS POLLUTANT TRAP
EXISTING TWIN Ø900 RCP CULVERT (TO BE CONFIRMED)
PROVIDE SCOUR PROTECTION IN ACCORDANCE WITH MOES STD DWG SD045
E: 368054.216
N: 6381930.833
ROAD 01
LANG DRIVE
7.5m AHD 1% AEP FLOOD LEVEL FROM PATERSON RIVER FLOOD STUDY
TWIN Ø900 RCP CULVERT
4% SITE REGRADE
PROPOSED 1:5 / 1:3 CUT BATTER
8.0m FLOOD PLANNING LEVEL
EXISTING RIGHT OF WAY FOR LOT 3 AND LOT 4 DP 1156433 TO BE MAINTAINED
EXISTING EASEMENT FOR PRESSURE SEWER MAIN 4m WIDE
12
11
10
9
8
4
DP1156433
3
DP1156433
2
DP1156433
A
DP163627
3
DP1216123
1
DP1216123
PRELIMINARY ISSUE
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Amendment	Description	Drawn	App'd	Date
2	LAYOUT AMENDMENTS	A.M	I.H	23.03.23
1	ORIGINAL ISSUE	R.M	I.H	30.08.22

North

Scale 0 10 20 30 40m
1:500 (A1) 1:1000 (A3)

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Designed: R.M
Cad Reference: 22218C dC03 r3
Scale: 1:500
A1 SHEET
Project Approval: IAN HILL (B.E) Consulting Civil Engineer
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PROPOSED SUBDIVISION
27 LANG DRIVE
BOLWARRA HEIGHTS

PLAN SHEET (SHEET 2 OF 2)

Project No: 22218C
Drawing No: C03
Revision: 2

PLOT DATE: 23/06/2023 11:30:33 AM CAD FILE: Q:\22\22218 Hilldale Drive, Bolworra Heights\02_CAD\AutoCAD\Civil\22218C dC03 r3.dwg

VOLUMES

TOTAL CUT = 3830m³
TOTAL FILL = 11870m³

(VOLUMES ABOVE DO NOT INCLUDE STRIPPING OR PAVEMENT VOLUMES)

ESTIMATED PAVEMENT VOLUME = 3805m³ (750mm DEPTH)

HILLDALE DRIVE

ROAD 01

ROAD 01

LANG DRIVE

CUT/FILL DEPTH	
	to -2.90 m
-2.90	to -2.80 m
-2.80	to -2.70 m
-2.70	to -2.60 m
-2.60	to -2.50 m
-2.50	to -2.40 m
-2.40	to -2.30 m
-2.30	to -2.20 m
-2.20	to -2.10 m
-2.10	to -2.00 m
-2.00	to -1.90 m
-1.90	to -1.80 m
-1.80	to -1.70 m
-1.70	to -1.60 m
-1.60	to -1.50 m
-1.50	to -1.40 m
-1.40	to -1.30 m
-1.30	to -1.20 m
-1.20	to -1.10 m
-1.10	to -1.00 m
-1.00	to -0.90 m
-0.90	to -0.80 m
-0.80	to -0.70 m
-0.70	to -0.60 m
-0.60	to -0.50 m
-0.50	to -0.40 m
-0.40	to -0.30 m
-0.30	to -0.20 m
-0.20	to -0.10 m
-0.10	to 0.00 m
0.00	to 0.10 m
0.10	to 0.20 m
0.20	to 0.30 m
0.30	to 0.40 m
0.40	to 0.50 m
0.50	to 0.60 m
0.60	to 0.70 m
0.70	to 0.80 m
0.80	to 0.90 m
0.90	to 1.00 m
1.00	to 1.10 m
1.10	to 1.20 m
1.20	to 1.30 m
1.30	to 1.40 m
1.40	to 1.50 m
1.50	to 1.60 m
1.60	to 1.70 m
1.70	to 1.80 m
1.80	to 1.90 m
1.90	to 2.00 m
2.00	to 2.10 m
2.10	to 2.20 m
2.20	to 2.30 m
2.30	to 2.40 m
2.40	to 2.50 m
2.50	to 2.60 m
2.60	to 2.70 m
2.70	to 2.80 m
2.80	to 2.90 m
2.90	to

PRELIMINARY ISSUE
NOT FOR CONSTRUCTION

Amendment	Description	Drawn	App'd	Date
3	LAYOUT AMENDMENT	A.M	I.H	22.06.23
2	LAYOUT AMENDMENTS - DRAWING NUMBER CHANGE	A.M	I.H	23.03.23
1	ORIGINAL ISSUE	R.M	I.H	30.08.22

North

Scale
0 15 30 45 60m
1:750 (A1) 1:500 (A3)

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Designed	Cad Reference
A.M	22218C dC12 r3
Scale	A1 SHEET
1:750	

Project Approval
IAN HILL (B.E)
Consulting Civil Engineer

Client

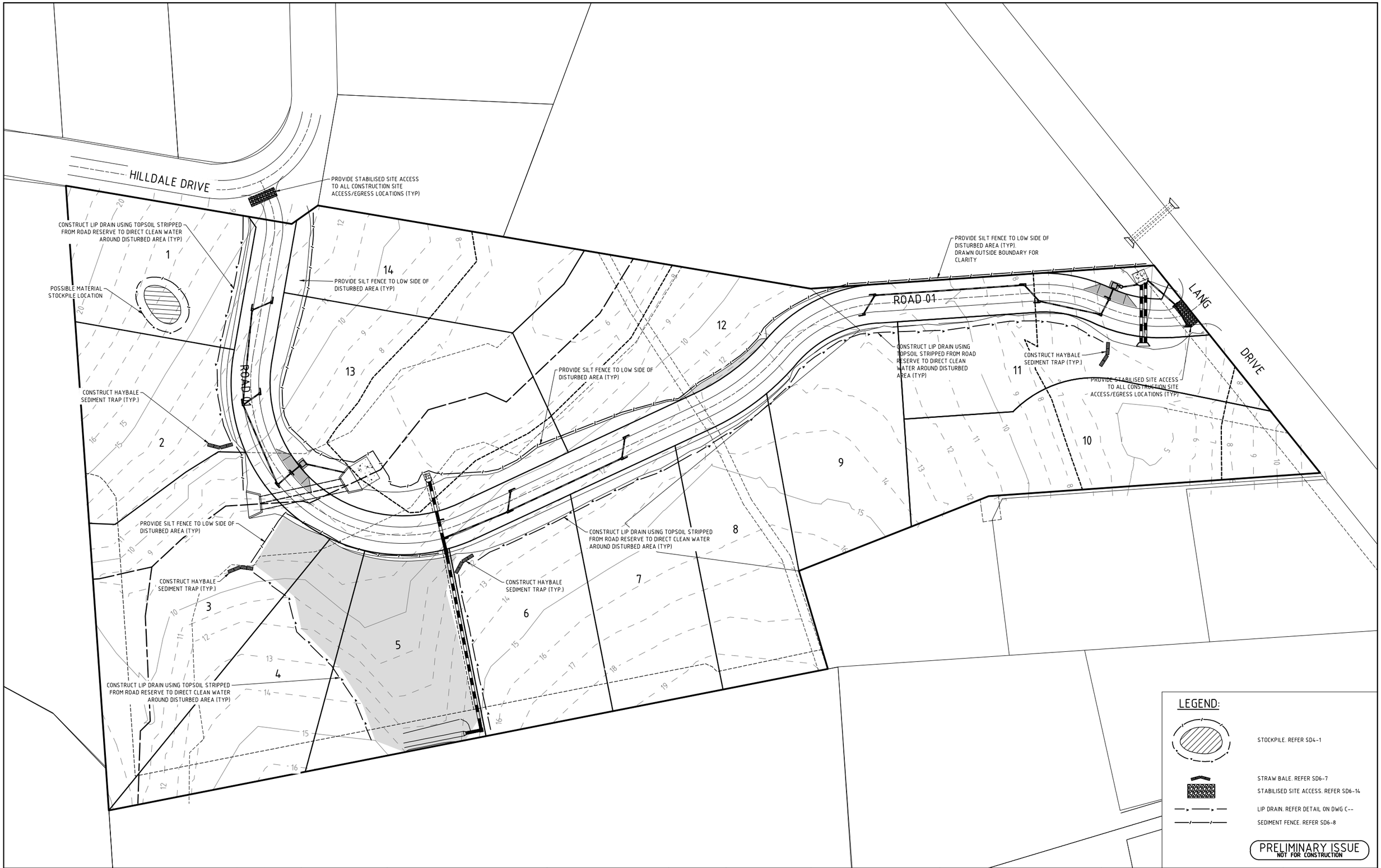
GCA ENGINEERING SOLUTIONS
A.B.N. 92 086 017 745
1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811

PROPOSED SUBDIVISION
27 LANG DRIVE
BOLWARRA HEIGHTS

EARTHWORKS PLAN

Project No	
22218C	
Drawing No	Revision
C12	3

PLOT DATE: 23/06/2023 11:31:00 AM CAD FILE: Q:\22\22218 Hilldale Drive, Bolwarra Heights\02_CAD\AutoCAD\Civil\22218C dC12 r3.dwg



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North

Scale
0 15 30 45 60m
1:750 (A1) 1:500 (A3)

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Designed	A.M
Cad Reference	22218C dC13 r3
Scale	1:750
	A1 SHEET
Project Approval	IAN HILL (B.E) Consulting Civil Engineer
Client	

GCA ENGINEERING SOLUTIONS
A.B.N. 92 086 017 745
1 HARTLEY DRIVE, THORNTON NSW 2322
PO BOX 3337, THORNTON NSW 2322
PHONE: (02) 4964 1811

PROPOSED SUBDIVISION
27 LANG DRIVE
BOLWARRA HEIGHTS
SOIL AND WATER MANAGEMENT PLAN

Project No	
22218C	
Drawing No	Revision
C13	3

PLOT DATE: 23/06/2023 11:31:03 AM CAD FILE: Q:\22\22218 Hilldale Drive, Bolworra Heights\02_CAD\AutoCAD\Civil\22218C dC13 r3.dwg

Appendix B NBC Bushfire Attack Assessment Report V4.1

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 24/01/2023 **Assessment Date:** 24/01/2023

Site Street Address: MD 27 Lang Drive, Bolwarra

Assessor: Stuart Greville; Bushfire Planning Australia

Local Government Area: Maitland **Alpine Area:** No

Equations Used

Transmissivity: Fuss and Hammins, 2002
Flame Length: RFS PBP, 2001/Vesta/Catchpole
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: T01

Vegetation Information

Vegetation Type: Grassland
Vegetation Group: Grassland
Vegetation Slope: 0.6 Degrees **Vegetation Slope Type:** Downslope
Surface Fuel Load(t/ha): 6 **Overall Fuel Load(t/ha):** 6
Vegetation Height(m): 0 Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees **Site Slope Type:** Downslope
Elevation of Receiver(m): Default **APZ/Separation(m):** 11

Fire Inputs

Veg./Flame Width(m): 100 **Flame Temp(K):** 1090

Calculation Parameters

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

Program Outputs

Level of Construction: BAL 29 **Peak Elevation of Receiver(m):** 3.96
Radiant Heat(kW/m2): 29 **Flame Angle (degrees):** 64
Flame Length(m): 8.81 **Maximum View Factor:** 0.438
Rate Of Spread (km/h): 17.61 **Inner Protection Area(m):** 0
Transmissivity: 0.871 **Outer Protection Area(m):** 0
Fire Intensity(kW/m): 54604

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	0	0	0	0	0	0

Run Description:	T02		
Vegetation Information			
Vegetation Type:	Grassland		
Vegetation Group:	Grassland		
Vegetation Slope:	3.2 Degrees	**Vegetation Slope Type:**	Upslope
Surface Fuel Load(t/ha):	6	**Overall Fuel Load(t/ha):**	6
Vegetation Height(m):	0	Only Applicable to Shrub/Scrub and Vesta	
Site Information			
Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	9
Fire Inputs			
Veg./Flame Width(m):	100	**Flame Temp(K):**	1090
Calculation Parameters			
Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	130
Program Outputs			
Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	3.47
Radiant Heat(kW/m2):	29	**Flame Angle (degrees):**	64
Flame Length(m):	7.73	**Maximum View Factor:**	0.436
Rate Of Spread (km/h):	13.55	**Inner Protection Area(m):**	0
Transmissivity:	0.875	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	42010		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	0	0	0	0	0	0

Run Description: T03

Vegetation Information

Vegetation Type: Grassland

Vegetation Group: Grassland

Vegetation Slope: 3.9 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 6

Overall Fuel Load(t/ha): 6

Vegetation Height(m): 0

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 9

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 130

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.39

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 7.54

Maximum View Factor: 0.435

Rate Of Spread (km/h): 12.91

Inner Protection Area(m): 0

Transmissivity: 0.875

Outer Protection Area(m): 0

Fire Intensity(kW/m): 40029

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	0	0	0	0	0	0

Run Description: T04

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 1.8 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 9

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.36

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 7.47

Maximum View Factor: 0.436

Rate Of Spread (km/h): 0.87

Inner Protection Area(m): 0

Transmissivity: 0.876

Outer Protection Area(m): 0

Fire Intensity(kW/m): 6780

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	5	8	13	19	32	6

Run Description:	T05		
Vegetation Information			
Vegetation Type:	Grassland		
Vegetation Group:	Grassland		
Vegetation Slope:	3.2 Degrees	**Vegetation Slope Type:**	Upslope
Surface Fuel Load(t/ha):	6	**Overall Fuel Load(t/ha):**	6
Vegetation Height(m):	0	Only Applicable to Shrub/Scrub and Vesta	
Site Information			
Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	9
Fire Inputs			
Veg./Flame Width(m):	100	**Flame Temp(K):**	1090
Calculation Parameters			
Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	130
Program Outputs			
Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	3.47
Radiant Heat(kW/m2):	29	**Flame Angle (degrees):**	64
Flame Length(m):	7.73	**Maximum View Factor:**	0.436
Rate Of Spread (km/h):	13.55	**Inner Protection Area(m):**	0
Transmissivity:	0.875	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	42010		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	0	0	0	0	0	0

Run Description:	T06		
Vegetation Information			
Vegetation Type:	Hunter Macleay DSF		
Vegetation Group:	Dry Sclerophyll Forests (Shrub/Grass)		
Vegetation Slope:	3.3 Degrees	**Vegetation Slope Type:**	Upslope
Surface Fuel Load(t/ha):	14	**Overall Fuel Load(t/ha):**	24.6
Vegetation Height(m):	0.9	Only Applicable to Shrub/Scrub and Vesta	
Site Information			
Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	14
Fire Inputs			
Veg./Flame Width(m):	100	**Flame Temp(K):**	1090
Calculation Parameters			
Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	100
Program Outputs			
Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	5.2
Radiant Heat(kW/m2):	29	**Flame Angle (degrees):**	63
Flame Length(m):	11.66	**Maximum View Factor:**	0.442
Rate Of Spread (km/h):	1.34	**Inner Protection Area(m):**	0
Transmissivity:	0.862	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	17005		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	10	14	20	28	45	6

Run Description: T07

Vegetation Information

Vegetation Type: Hunter Macleay DSF

Vegetation Group: Dry Sclerophyll Forests (Shrub/Grass)

Vegetation Slope: 4 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 14

Overall Fuel Load(t/ha): 24.6

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 13

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 4.99

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 63

Flame Length(m): 11.21

Maximum View Factor: 0.442

Rate Of Spread (km/h): 1.27

Inner Protection Area(m): 0

Transmissivity: 0.864

Outer Protection Area(m): 0

Fire Intensity(kW/m): 16203

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	10	13	19	27	44	6

Run Description: T08

Vegetation Information

Vegetation Type: Hunter Macleay DSF

Vegetation Group: Dry Sclerophyll Forests (Shrub/Grass)

Vegetation Slope: 2.6 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 14

Overall Fuel Load(t/ha): 24.6

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 14

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 5.37

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 63

Flame Length(m): 12.05

Maximum View Factor: 0.443

Rate Of Spread (km/h): 1.4

Inner Protection Area(m): 11

Transmissivity: 0.861

Outer Protection Area(m): 3

Fire Intensity(kW/m): 17846

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	10	14	20	29	46	6

Run Description: T09

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 2.1 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 9

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.3

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 7.34

Maximum View Factor: 0.435

Rate Of Spread (km/h): 0.85

Inner Protection Area(m): 0

Transmissivity: 0.876

Outer Protection Area(m): 0

Fire Intensity(kW/m): 6641

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	5	8	12	18	31	6

Run Description: T10

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 1.1 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 9

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.47

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 7.73

Maximum View Factor: 0.436

Rate Of Spread (km/h): 0.91

Inner Protection Area(m): 0

Transmissivity: 0.875

Outer Protection Area(m): 0

Fire Intensity(kW/m): 7116

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	5	8	13	19	33	6

Run Description: T11

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 0.5 Degrees

Vegetation Slope Type: Upslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 10

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.59

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 7.99

Maximum View Factor: 0.436

Rate Of Spread (km/h): 0.95

Inner Protection Area(m): 0

Transmissivity: 0.874

Outer Protection Area(m): 0

Fire Intensity(kW/m): 7417

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	6	9	14	20	33	6

Run Description: T12

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 0.5 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 10

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.79

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 8.44

Maximum View Factor: 0.437

Rate Of Spread (km/h): 1.02

Inner Protection Area(m): 0

Transmissivity: 0.872

Outer Protection Area(m): 0

Fire Intensity(kW/m): 7946

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	6	9	14	21	35	6

Run Description: T13

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 0.9 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 10

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 3.88

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 8.64

Maximum View Factor: 0.438

Rate Of Spread (km/h): 1.05

Inner Protection Area(m): 0

Transmissivity: 0.872

Outer Protection Area(m): 0

Fire Intensity(kW/m): 8169

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	7	10	15	22	36	6

Run Description: T14

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 3.1 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 12

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 4.38

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 64

Flame Length(m): 9.74

Maximum View Factor: 0.439

Rate Of Spread (km/h): 1.22

Inner Protection Area(m): 0

Transmissivity: 0.868

Outer Protection Area(m): 0

Fire Intensity(kW/m): 9508

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	8	11	17	24	39	6

Run Description:	T15		

Vegetation Information

Vegetation Type:	Coastal Floodplain Wetlands		
Vegetation Group:	Forested Wetlands		
Vegetation Slope:	2.1 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	8.2	**Overall Fuel Load(t/ha):**	15.1
Vegetation Height(m):	0.9	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope:	0 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	Default	**APZ/Separation(m):**	11

Fire Inputs

Veg./Flame Width(m):	100	**Flame Temp(K):**	1090

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	308
Moisture Factor:	5	**FDI:**	100

Program Outputs

Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	4.14
Radiant Heat(kW/m2):	29	**Flame Angle (degrees):**	64
Flame Length(m):	9.22	**Maximum View Factor:**	0.439
Rate Of Spread (km/h):	1.14	**Inner Protection Area(m):**	0
Transmissivity:	0.87	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	8874		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	7	11	16	23	37	6

Run Description: T16

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands

Vegetation Group: Forested Wetlands

Vegetation Slope: 6.7 Degrees

Vegetation Slope Type: Downslope

Surface Fuel Load(t/ha): 8.2

Overall Fuel Load(t/ha): 15.1

Vegetation Height(m): 0.9

Only Applicable to Shrub/Scrub and Vesta

Site Information

Site Slope: 0 Degrees

Site Slope Type: Downslope

Elevation of Receiver(m): Default

APZ/Separation(m): 14

Fire Inputs

Veg./Flame Width(m): 100

Flame Temp(K): 1090

Calculation Parameters

Flame Emissivity: 95

Relative Humidity(%): 25

Heat of Combustion(kJ/kg 18600

Ambient Temp(K): 308

Moisture Factor: 5

FDI: 100

Program Outputs

Level of Construction: BAL 29

Peak Elevation of Receiver(m): 5.32

Radiant Heat(kW/m2): 29

Flame Angle (degrees): 63

Flame Length(m): 11.95

Maximum View Factor: 0.443

Rate Of Spread (km/h): 1.56

Inner Protection Area(m): 0

Transmissivity: 0.861

Outer Protection Area(m): 0

Fire Intensity(kW/m): 12189

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	10	14	20	28	45	6