BEMC

Bushfire
Environmental
Management
Consultancy

BUSHFIRE ASSESSMENT REPORT

3 Lot Subdivision

3611 The Lakes Way, Charlotte Bay, NSW, 2428

Lot 22 / DP 236679

Reference No# : 241574

FPA AUSTRALIA
BRONZE MEMBER
Fire Protection Association Australia

BPAD
Bushfire Planning & Design
Accredited Practitioner
Level 3

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Title	Bush Fire Assessment Report - Subdivision			
Description	Subdivision development – 3 Lot 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679			
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1	SJ	Draft	10/03/2024	Completed
2	DSL	Final	9/04/2024	Completed

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Abbreviations and Acronyms

APZ	Asset Protection Zone
AS/NZS 1221:1997	Australian Standard – Fire hose reels
AS1596-2014	Australian Standard – The storage and handling of LP Gas
AS2419-2021	Australian Standard – Fire hydrant installations
AS2441:2005	Australian Standard – Fire hose reels installation
AS3745:2010	Australian Standard – Planning for emergencies in facilities
BAL	Bush fire Attack Level
BCA	Building Code of Australia
BFAR	Bush Fire Assessment Report
BFSA	Bush Fire Safety Authority
BFSS	Bush Fire Strategic Study
BPA	Bush fire Prone Area (Also Bush fire Prone Land)
BPL Map	Bush fire Prone Land Map
BPMs	Bush fire Protection Measures
BV	Biodiversity Values
EP&A Act	*NSW Environmental Planning and Assessment Act 1979*
FFDI	Forest Fire Danger Index
GFDI	Grass Fire Danger Index
ha	Hectare
HOC	Heat Of Combustion
IPA	Inner Protection Area
kJ/kg	Kilo Joules per Kilo gram
LAT	Large Air Tanker
LGA	Local Government Area
NCC	National Construction Code
NoD	Notice of Determination
OPA	Outer Protection Area
PBP	Planning for Bush fire Protection
RF Act	*Rural Fires Act 1997*
RF Regs	*Rural Fires Regulations 2013*
RHG	Restricted Head Growth
SEED	Sharing and Enabling Environmental Data in NSW
SFR	Short Fire Run

1 EXECUTIVE SUMMARY AND RECOMMENDATIONS

BEMC Pty Ltd was engaged by Brett Phillips to complete a Bush Fire Assessment Report (BFAR) on proposed subdivision located at 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679 (**Figure 1, page 7).** The proposed development includes the subdivision of 1 Lot into 3 Lots.

BEMC has used Method 2 assessment pathway from AS3959:2018 to undertake this assessment and to prepare the Bush Fire Assessment Report (BFAR).

Based upon the assessment, perusal of the site plan prepared by xxxxx **(Appendix 1, page 35)**, and a site visit, it is recommended that development consent be granted subject to the following conditions to comply with PBP 2019:

Recommendation 1 - Asset Protection Zones and Landscaping
A potential building envelope of 500m2 is provided for all 3 lots.

Total clearance area which includes the APZ and 6m wide access for all 3 sites is of 16,000m2 or 1.6 ha.

Street tree plantings within 100m of the bushfire threat shall consider Huber-Smith et. al (2023) in the selection of tree species. A Landscaping plan is required to illustrate roadside vegetation is:

- Planting does not provide a continuous canopy (trees do no touch and trees or shrubs are isolated or located in small clusters).
- Roadside plants do not impede emergency vehicle access or the ability to maintain road verge to managed grasses.

Recommendation 2 - Construction
APZ have been established for 500m2 building envelopes to enable BAL 29 construction.

Recommendation 3 - Access
Access to the property and development site is noted on **Figure 2, page 8** of this report and in the site plan provided in **Appendix 1, page 35.**

The proposed subdivision does not provide more than one access to the public road system for the 3 lots, with lot 2 and 3 located >200m from the public road system.

A small variation for acceptable solutions is proposed. This include providing a larger APZ for lots 2 and 3 to accommodate an increased BAL construction level for 4.14 DA class 1a developments. Furthermore, the access is minimum 5.5 m wide to allow two-way access for the entire length.

Private property access shall comply with the below requirements:

- Private property access shall be two-wheel drive, all weather roads.
- The capacity of private property access of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating.
    - Property access roads are two-wheel drive, all-weather roads.
    - 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.
    - Turning area provided in lot 3 with the access clearly sign posted as a dead end.

- A development comprising more than three dwellings has formalised access by dedication of a road and not by right of way.
- Minimum 5.5m carriageway width kerb to kerb.
- Parking is provided outside of the carriageway width.
- 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.

Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.

Recommendation 4 - Water Supply
The proposed layout provides ample opportunity for future residential development to comply with static water acceptable solutions.

Recommendation 5 - Electricity services
Were possible electricity should be placed underground. If overhead power supply is provided, 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 accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

Recommendation 6 - Gas services
The proposed layout provides ample opportunity for future residential development to comply with gas acceptable solutions.

Furthermore, the applicant wishes the Commissioner, when determining the application, to consider whether it would be appropriate for the future erection of the dwelling houses, dual occupancies or secondary dwellings concerned to be excluded from the application of section 4.14 of the *Environmental Planning and Assessment* Act 1979.

Consent conditions referred to in this report can be applied for subsequent '*build-outs'*. Furthermore, BAL29 easements shall be identified on the title of individual lots to ensure '*build-outs'* conform with bushfire requirements.

Finally, the implementation of the adopted measures and recommendations forwarded within this report comply with Planning for Bush fire Protection (2019) and will contribute to the amelioration of the potential impact of any bush fire upon the development, but they do not and cannot guarantee that the area will not be affected by bush fire at some time.

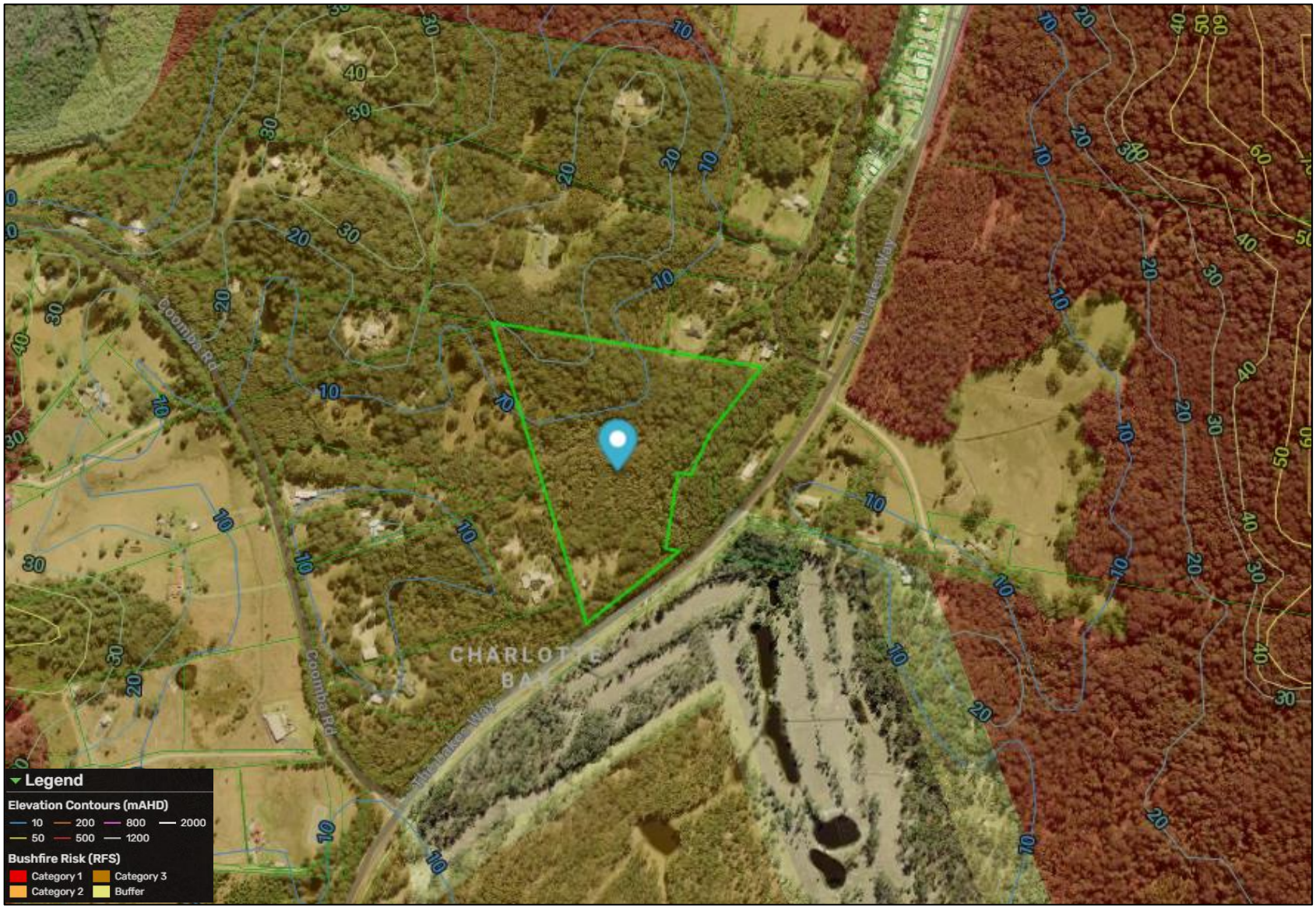

Figure 1 *Property Location of 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679 (Mecone Mosaic, 2024)*

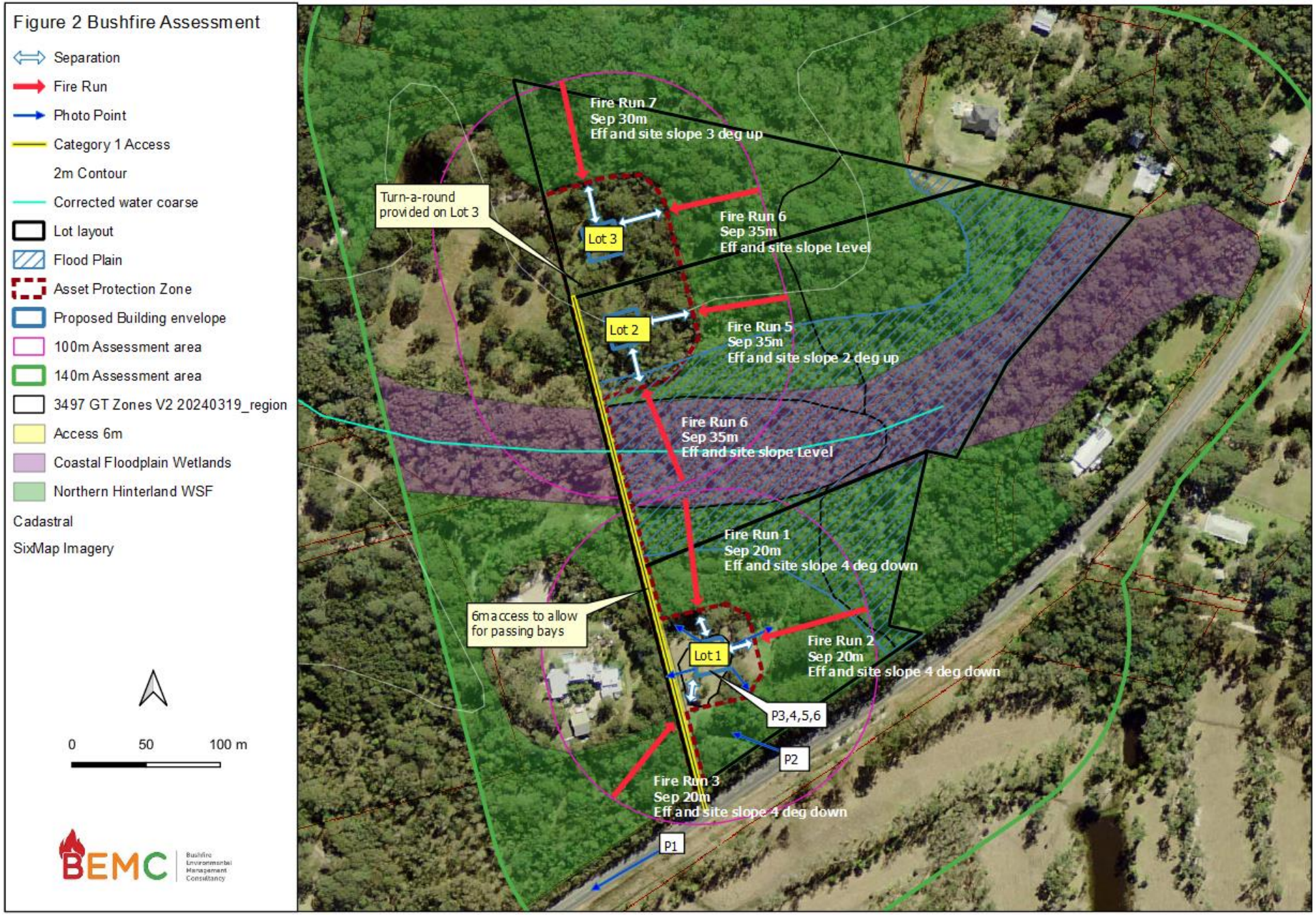
Figure 2 Bushfire Assessment
Separation
Fire Run
Photo Point
Category 1 Access
2m Contour
Corrected water coarse
Lot layout
Flood Plain
Asset Protection Zone
Proposed Building envelope
100m Assessment area
140m Assessment area
3497 GT Zones V2 20240319_region
Access 6m
Coastal Floodplain Wetlands
Northern Hinterland WSF
Cadastral
SixMap Imagery
0
50
100 m
BEMC
Bushfire Environmental Management Consultancy
Fire Run 7
Sep 30m
Eff and site slope 3 deg up
Turn-a-round provided on Lot 3
Lot 3
Fire Run 6
Sep 35m
Eff and site slope Level
Lot 2
Fire Run 5
Sep 35m
Eff and site slope 2 deg up
Fire Run 6
Sep 35m
Eff and site slope Level
Fire Run 1
Sep 20m
Eff and site slope 4 deg down
6m access to allow for passing bays
Lot 1
Fire Run 2
Sep 20m
Eff and site slope 4 deg down
P3,4,5,6
P2
Fire Run 3
Sep 20m
Eff and site slope 4 deg down
P1

2 INTRODUCTION

BEMC Pty Ltd was engaged by Brett Phillips to complete a Bush Fire Assessment Report (BFAR) to accompany a Development Application for a proposed subdivision at 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679, hereafter referred to as the 'site' (**Figure 1, page 7**).

The identification of bush fire prone lands (BPL Map) in NSW is required under s 10.3 of the *EP&A Act*. S. 4.14 of the *EP&A Act* requires development to compliance with Planning for Bushfire Protection, 2019 (PBP 2019) if any part of a development site is affected by bush fire hazard as indicated within the BPL Map.

It is clear from the investigation and assessment of proposal, the site is located within Bush fire Prone Land. This development falls within bush fire affected land within the Mid-Coast Council bush fire prone land map and the applicant is required to submit a bush fire assessment consistent with PBP 2019.

If the applicant determines that the project is integrated through the Development Application process, this document can support an application for *General Terms of Agreement* via a *Bush Fire Safety Authority* (BFSA) from NSW Rural Fire Service (RFS) as the report adheres to the requirements of s 45 of the *Rural Fires Regulation* 2013 (RF Regs), Appendix 1, A2.1, A2.1.1 of PBP 2019. The proposed development is not listed under s 46 of the Rural Fire Regulation 2013 (*RF Regs*) excluded from requirements for BFSA.

Site Particulars are illustrated within **Table 2 below** and **Figure 1, page 7,** and subdivision plans in **Appendix 1, page 35**.

2.1 DESCRIPTION OF PROPOSED DEVELOPMENT

The proposed development includes the subdivision of 1 Lot into 3 Lots. As a result, the required objectives subdivision Development have been considered in this assessment.

Table 1 *Description of Proposed development*

Boundaries	Rural land use in all directions. The Lakes Way east, forested vegetation in all directions.
Topography	Undulating country
Type of development	3 Lot subdivision.
Urban Release Area	No
Proposed dwellings	3 buildings envelopes (1 each lot).
Vegetation proposed to be cleared	Vegetation to be cleared in Lot 2 and 3
Current land-use	Residential.
Fire weather	Mid-Coast Council – FFDI – 100

2.2 OBJECTIVES OF ASSESSMENT

To assess the proposed development in consideration of s4.14 of the EP&A Act 1979, PBP 2019 and AS 3959:2018 to enable council to make a determination.

This report assesses whether the development meets the six objectives listed in section 1.1 of PBP 2019, which provide for the protection of human life and minimize impacts on property as follows:

1. Afford buildings and their occupants protection from exposure to a bushfire.
2. Provide for a defendable space to be located around buildings.
3. Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings.
4. Ensure appropriate operation access and egress for emergency services personnel and residents is available.
5. Provide for ongoing management and maintenance of Bush fire Protection Measures (BPMs); and
6. Ensure the utility services are adequate to meet the needs of firefighters.

2.3 Specific Objectives of Residential and Rural Residential Subdivisions

The aims and objectives listed in section 1.1 of PBP 2019 remain applicable to residential and rural residential development, however further consideration has been given to these types of developments to ensure BPMs are fully incorporated at the design stage of the development. The specific objectives of residential and rural residential development are outlined in section 5.2 of PBP 2019 are:

- 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.

2.4 Method 2 Fire Behaviour Calculations

The design fire methodology outlined in Appendix B of AS3959:2018, Detailed BAL Assessment, provides the mathematical methodology and accepted inputs of the simplified BAL assessment from which Method 1 matrix was derived. Method 2 fire design modelling consists of accurately determining input into nested calculations within the modelling to provide increased accuracy in determining radiant heat flux and flame length.

Furthermore, Method 2 can consider the impact of the Kataburn rate of spread, radiant heat shielding, and short fire runs which may have an impact on the radiant heat exposure of a proposed development.

Understanding the knowledge gaps for bush fire prediction is required to enable accurate interpretation of bush fire modelling and fire engineering calculations used through the Method 2 detailed assessment. The gaps in knowledge include:

- Duration of the initial fire growth phase.
- Fire spread on slopes, in complex terrain and extreme condition.
- Fire spread around the entire perimeter.
- Short-distance (wind-driven) spotting.
- Characteristics of flames in different fuel types.

When interpreting the results of the detailed method, each of these elements are considered when determining the effect of the outputs of the calculations.

3 BUSH FIRE RISK STRATEGIC STUDY

Planning for Bushfire Protection (2019) is based on the worst-case scenarios for each of the bush fire behaviour elements of fire weather, vegetation, slope and assumes not human intervention. All development shall be assessed on an individual basis as broad-brush approaches of documents such as PBP 2019 may not be applicable in every instance.

A Bush Fire Risk Strategic Study (BFRSS) was prepared to inform the context of the Bush Fire Assessment Report (BFAR). The level of information gathered and analysis within the BFRSS depends upon the nature and scale of the development. The BFRSS provides a broad-brush approach to determine landscape wildfire risk in considerations of vegetation continuity, distribution, and proximity to development; human intervention; access and evacuation. This enables an assessment the *actual* bushfire risk, determine if strict adherence to PBP 2019 is warranted, and if a proposed development is appropriate in the bush fire hazard context.

Table 2 *Bush fire risk strategic study*

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Adjoining Lands	The proposed development and changing land use will have positive impacts on the ability of adjoining landowners to implement Bush fire Protection Measures		The proposed development and changing land use do not impact on the ability of adjoining landowners to implement Bush fire Protection Measures	√	The proposed development and changing land use will impact on the ability of adjoining landowners to implement Bush fire Protection Measures		The proposed development will significantly impact on the wildfire risk profile of adjoining lands.	
Surrounding infrastructure	The proposed development does not significantly impact on community water, electricity, or gas services.		The proposed development is associated with community water, electricity, or gas services but will not have significant impact.	√	The proposed development impact on community water, electricity, or gas services.		The wildfire risk profile of significant infrastructure will increase due to this development.	
Emergency services	The proposed development does not significantly impact on the ability of emergency services to plan, prepare, respond, or recover prior, during or after a bush fire event.		The proposed development is located within 30-minute flight from a Large Air Tanker (LAT) airbase and within 30-minutes of multiple fire response units.	√	The proposed development is located more than 30-minute flight from a Large Air Tanker (LAT) airbase and only 1 or 2 fire response units within 30-minutes.		It is unlikely emergency services will respond to wildfire in this location during extreme and catastrophic events.	

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Access	Good, multiple route evacuation is possible and connects with the public road network in a direction away from the wildfire threat to shelter location.		More than one access or egress routes is provided from the property to a safer location which then can access the public road network with multiple access/egress routes o shelter location.		One access or egress routes is provided, which is <200m from the property to a safer location.		Only one access or egress route with no nearby safe location.	√
Emergency egress	Seamless integration with existing settlement - no effect on evacuation.		Short bushland pinch points that may restrict access temporarily or carry fire across roads. Unlikely impact on evacuation.		Pinch points that are likely to restrict access along evacuation routes for short periods (15-30mins) and carry fire across roads.	√	Large areas of bushland or multiple pinch points along evacuation routes that could block evacuation routes for an extended time.	
Vegetation continuity	Forested vegetation beyond 140m form the site is scattered with low continuity due to built development.		Forested vegetation beyond 140m form the site is scattered and isolated, forming a dominate fast moving grassland or open woodland fire event.		Patches of forested vegetation associated riparian and isolated ridgelines beyond 140m from the site may result in localised forest fire event.	√	Continuous forested areas within mountainous terrain beyond 140m from the site will result in broadscale landscape emergency management operations.	
Vegetation connectiveness	Forested vegetation corridors beyond 140m are restricted and do not enable landscape fire to enter and move through the site by a continuous fire path.		Forested vegetation corridors beyond 140m from the site exist, although grasslands >100m provide separations between forested vegetation restricting the fire head progression of landscape fire.		Forested vegetation corridors beyond 140m from the site exist, although grasslands <100m provide separations between forested vegetation restricting the fire head progression of landscape fire.	√	Forested vegetation corridors beyond 140m from the site provide for passage of landscape fire to enter and move through the site.	
Vegetation Location	Wildfire within forests can only approach from one direction surrounded by a suburban, township or urban area managed in a minimum fuel condition.		Wildfire within forests can only approach from two directions and the site is within a suburban, township or urban area managed in a minimum fuel condition.		Wildfire within forests can approach from several directions although gaps within forested vegetation or are present.	√	Wildfire within forests can approach from several directions and have hours or days to grow and develop before impacting and/or site is surrounded by unmanaged vegetation.	
Separation	Hazard separation between forested hazard and buildings of greater than 100m.		Hazard separation between forested hazard and buildings of 50-100m		Hazard separation between forested hazard and buildings of 30-50m		Hazard separation between forested hazard and buildings of <30m	√

ELEMENT	Low Threat		Moderate Threat		High Threat		Extreme Threat	
Vegetation flammability	Within the dominated fire direction, the fire fuel is restricted to surface, partially managed and separated through land use practises.		Within the dominated fire direction, the fire fuel is highly aerated, with significant separations (>50m) between these patches with partially managed vegetation between.		Within the dominated fire direction, the fire fuel is highly aerated, with <50m between these patches with partially managed vegetation between		Within the dominated fire direction, the fire fuel is highly aerated, continuous continuity vertically and horizontally with flammable species.	√
Wildfire Behaviour	Extreme Wildfire behaviour at the site is not possible given the broader landscape.		Extreme Wildfire behaviour at the site is unlikely given the broader landscape.		Extreme Wildfire behaviour at the site is likely given the broader landscape.	√	Extreme Wildfire behaviour at the site is very likely given the broader landscape.	
Overall Threat Rating:					Wildfire provides **HIGH** threat to this proposal	√		

Where a **extreme** threat is determined strict compliance with PBP 2019 is warranted. In these cases, meeting the broad aims and objectives and the specific objectives of rural residential infill and increased residential developments of PBP 2019 through providing separation between the wildfire threat and building, strict application of bushfire construction measures with access and water supplies to facilitate emergency management is required.

4 BUSHFIRE HAZARD ASSESSMENT

This section details the site assessment methodology in Appendix 1 of PBP2019 and includes the requirements of s44 of the RF Regs. It provides detailed analysis of the vegetation, slope, vegetation exclusions and downgrades to quantify the required Bush fire Protection Measures (BPMs).

4.1 FIRE DANGER INDEX

This assessment utilises Mid-Coast Council area with a FFDI 80.

4.2 ASSESSMENT METHODOLOGY

Vegetation classification over the site has been carried out as follows:

- Nearmap, sixmap aerial Photograph Interpretation.
- Kogan 6*25 Laser distance finder.
- Photo theodolite application supported by contour and LiDAR DEMs terrain profiles.
- SEED Portal - Sharing and Enabling NSW Environmental Data portal.
- Reference to regional vegetation community mapping, and
- Site assessment in March 2024.

4.3 VEGETATION ASSESSMENT

In accordance with PBP 2019, an assessment of the vegetation over 140m in all directions from the building was undertaken.

Vegetation that may be considered a bush fire hazard was identified and classification based on available fuel loads for sub-formations are provided through vegetation fuel monitoring project administered by the University of Wollongong, University of Melbourne and CSRO Ecosystems Science and Bush fire Dynamics and Applications. The results of this research are commonly referred to as the '*NSW Comprehensive Fuel Loads'*.

An arborist or biodiversity report has not been provided to inform the vegetation assessment.

There are no stream order watercourses within the 140m assessment area in accordance with the *Water Management Act 2000* (WM Act).

No vegetation within the 140m Assessment has been identified within the Biodiversity Values (BV) Map provided in **Appendix 4, page 40**.

The area is not identified within the Areas of Regional Koala Significance (ARKS).

Botanical assessment was completed by AEP in March 2024 with the vegetation mapping provide in **Figure 3, page 15**.

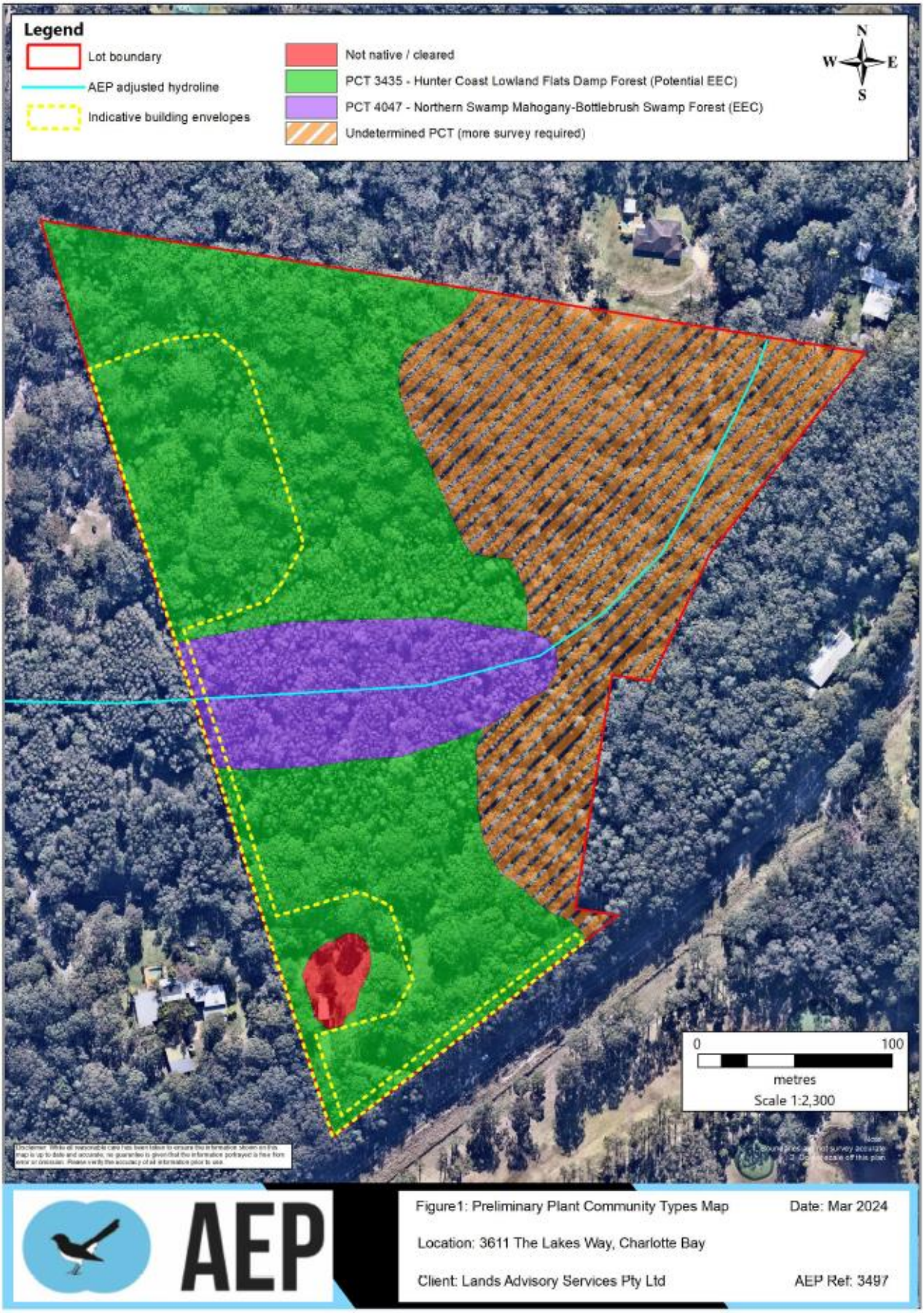

Figure 3 *Vegetation in and around the site (AEP, 2024)*

4.3.1 Vegetation classification, exclusions, and downgrades

An analysis of the vegetation in and around the site has determined that no vegetation exclusions or down grades are included in this assessment**.**

Research completed by Dr Andy Baker supported by Dr John Hunter has raised significant issues with the mapping of WSF within the SVTM accuracy issue applied within the vegetation mapping in SEED. This research has illustrated that there is a tendency for the SEED map DSF to wetter formations which is inaccurate.

The research indicates that canopy closure due to long term unburnt and low fire frequencies well documented and associated with elimination of shade-intolerant ground layer flora (Keith 1996; Baker *et al.* 2020); decline of ground layer mammals and birds (Laurance 1997; Stone *et al.* 2022); canopy tree dieback (Horton *et al.* 2013; Stone *et al.* 2008), which the is interpreted through aerial imagery analysis as Wet Sclerophyll Forest.

The standard differentiation between WSF and DSF in Australia is defined in Specht 1970; Ashton & Attiwill 1994 and the NSW & National Vegetation Information Systems (Keith 2004, DEWR 2007), which indicate WSF are >30m tall with soft-leaved floristics (rainforest) shrubs, grasses herbs and forbs, whereas DSF are <35m tall with hard-leaved (heathy) shrubs, grasses or ephemeral herbs.

In this case, the WSF mapped in SEED is deemed inaccurate due to the absence of the WSF characteristics (**Plate 3, 4, 5, and 6 page 37**) and the vegetation class of Hunter-Macleay DSF is applied and confirmed by AEP botanical survey.

4.3.2 Predominant Vegetation Classification

Vegetation north of the site is classified as PCTID: 3435 – Hunter Coast Lowland Flats Damp Forest, which is *Hunter-Macleay DSF* and PCTID: 4047 *Northern Swamp Mahogany-Bottlebrush Swamp Forest* which is *Coastal Floodplain Wetlands* south, in accordance with the '*NSW Comprehensive Fuel Loads'.*

4.4 Separation Assessment

The separation between the proposed building envelope and the classifiable vegetation that creates bush fire threat one of the significant BPMs to reduce the risk of bush fire impacting on the development. The land within the separation must conform to the standards of an Asset Protection Zones to be accepted within the separation areas.

The separations between the classifiable vegetation and the proposed dwellings are provided in **Table 3, page 21**, illustrated in **Figure 2 page 8.**

4.5 Slope Assessment

This section details the site assessment methodology in Appendix 1 of PBP2019 to assess the effective slope (under classified vegetation) and site slope (slope between the vegetation and proposed development) within the 100m of the proposed building envelope.

The effective and site slopes use within this assessment are provided in **Table 3, page 21** illustrated in **Figure 2 page 8.**

4.6 Effective and Site Slope Assessment

The slope of the land under the classified vegetation has a direct influence on the rate of fire spread, the intensity of the fire and the ultimate level of radiant heat flux.

The effective slope is the slope of the ground under the hazard (vegetation). The slope between the vegetation and the proposed building envelope is the site slope. When identifying the effective and site slopes, it may be found that there are a variety of slopes covering different distances. The effective slope is the slope under the vegetation which will most significantly influence the bush fire behaviour for each aspect.

The topography of the site and surrounds has been assessed to identify the maximum slope present under the classified vegetation (hazard). Slope data has been calculated from a 1m LiDAR Digital Elevation Model (DEM). The source data sets have been captured to standards that are generally consistent with the Australian ICSM LiDAR Acquisition Specifications with require a fundamental vertical accuracy of at least 0.30m (95% confidence) and horizontal accuracy of at least 0.80m (95% confidence). The slope arrows indicated in **Figure 4, below** represent the slope calculated across the length of the arrow utilising LiDAR data within ERSI software. These values help determine the vegetation that poses a bush fire threat and significantly influences fire behaviour. Figure 4 illustrates the analysis of the LiDAR DEMs terrain profiles to determine the slope of the potential fire runs towards the site.

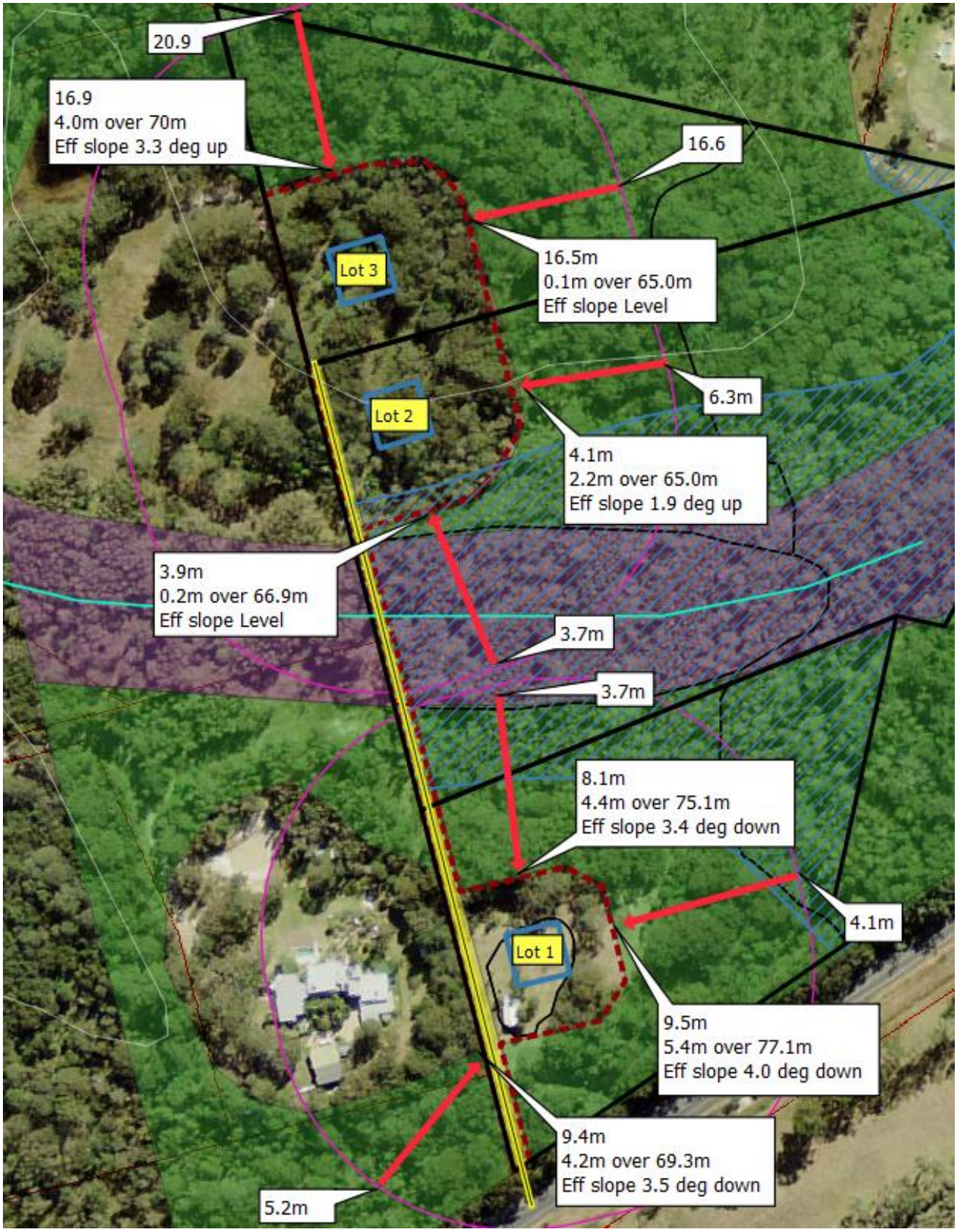

Figure 4 *LiDAR 1m DEMS slope analysis*

4.7 Wildfire Growth

An analysis of the size and shape of the classifiable vegetation in and around the site has determined no Short Fire Run (SFR) or Restricted Head Growth (RHG) considerations within this assessment.

4.8 Flame Length

Weise and Biging (1996) research Byram's original equation relating fireline intensity to flame length overestimated flame length.

The 'trench effect' arises because of the geometry affects the flames and hot plume attaching to the bottom surface Drysdale *et al*. (1992). Edgar *et al.* (2015) reported the flame and hot plume flow characteristics depended on the inclination, with the hot plume separating from the surface at 10 and 20 degrees, although a distinctly laminar structure developed, and the hot plume attached to the surface at 30 degrees which gave rise to hotter and faster moving fire. Grumstup *et al.* (2017), Drysdale and Macmillan (1992) and Wu *et al*. (2000) illustrate the plume commences a pronounced lean when slopes exceed 15° angle and ground attachment commences although detachment quickly from the surface.

Edgar et al. (2015) research supports Dold and Zinoviev (2009); Wu *et al.* (2000) of a threshold angle of inclination that demarcates the separation between turbulent and laminar flow regime that predominantly determine flame attachment to the ground. This threshold angle is around 24 to 26 degrees. Edgar *et al.* (2015b) reports the laminar flow, once established, was more stable within tunnels of greater inclination, indicating disruption of the laminar flow could be achieved at 20 degrees, although did not impact the laminar flow at 30 degrees. Edgar *et al.* (2016) illustrates the attachment of the plume for tunnel inclinations above 24° was associated with the development of a pressure deficit in the region immediately upslope of the heat source supporting the theory that the mechanism for flame attachment of the plume arises due to an imbalance between the upslope and downslope entrainment of air into the plume heat source and is independent of the convective intensity of the plume. Edgar *et al.* (2016) reported distinctly different plume behaviour depending on whether the trench was inclined above or below the critical angle of 24°.

The contemporary research illustrates flame length ground attachment is not possible at slopes below horizontal and below 15 degrees and is not considered further within this assessment.

4.9 Shielding

Where an elevation is shielded from direct radiant heat arising from bush fire attack, then the construction requirements for that elevation can be reduced to the next lower BAL. An elevation is deemed to be not exposed to the source of bush fire attack if all the straight lines between that elevation and the source of bush fire attack are obstructed by another part of the building.

The shielding of an elevation shall apply to all the elements of the wall but shall not apply to subfloors or roofs. The construction requirements for a shielded elevation shall be not less than that required for BAL-12.5 unless the building has been assessed as being BAL-LOW. The reduced construction requirements do not apply where any elevation is BAL-FZ.

4.10 Other Method 2 inputs

Elevation of Receiver

Elevation of Received it the height of the body that received the radiant heat flux. Within bushfire, we are concerned with the most vulnerable element of the building to a bushfire event which is glazing on windows and doors. For this assessment default maximum elevation of receiver has been applied as the future proposed building height is unknown.

Heat of Combustion

Heat of Combustion (HoC) is an important characteristic in the simulation of wildfires. It is frequently used in the assessment of fuel flammability and is a key input to calculate fire-line intensity which provides for flame length calculations. Despite the variability of natural fuels, HoC is considered a constant. Research since the development of the Method 2 calculations illustrates that fuel moisture content has a significant impact on the HoC and argues that lowering the current default heat of combustion of 18600 kJ/kg in forest fire behaviour models could be considered. In this case default heat of combustion of 18600 kJ/kg is applied.

Flame Emissivity

AS3959:2018 indicates a nominal flame emissivity of 0.95 is justified, as the bush fire flames under design fire weather scenarios are generally optically thick ($\varepsilon \approx 1$). The predicted flame emissive power is extremely sensitive to flame temperature. The selection of the nominal flame temperature for calculation is critical to make sure that the construction standard determined with this flame temperature together with other input parameters can provide an adequate bush fire construction level. In this case nominal flame emissivity of 0.95 is applied.

Moisture Factor

Fuel moisture factor is only used in the Marsden–Smedley and Catchpole (1995) fire model for Tussock Moorland and is default to 5. This input has no effect on fire modelling calculations in other vegetation and hence is not applicable to this study.

Ambient Temperature and Relative Humidity

The default value for ambient air temperature during worst-case scenario fire weather conditions defaults to 35°, or when converted to Kelvin is 308K. The default value for Relative Humidity is 25%. Worst case scenario fire weather conditions in NSW are generally from the North-west which have high temperatures and low relative humidity. For bush fire threats from directions other than the north, north-west, and west, the ambient temperature and relative humidity can significantly change, especially in coastal environments.

Outcomes of the Bushfire Attack Level assessment implementing Method 2 AS3959:2018 are outlined in **Table 3 and 4, page 21 and 22**.

Table 3 *Lot1 - Bushfire Hazard Assessment (Method 2 AS3959:2018)*

Elements	Method (unit)	Fire Run 1	Fire Run 2	Fire Run 3
Vegetation	NSW Comprehensive Fuel Loads	Hunter-Macleay DSF	Hunter-Macleay DSF	Hunter-Macleay DSF
Separation	Spatial analysis	20m	20m	20m
Site slope	Site visit – Theodolite (°)	4 deg down	4 deg down	4 deg down
Effective slope	Site visit – Theodolite (°)	4 deg down	4 deg down	4 deg down
Shielding width	Site Plans / Site Visit (m)	N/A	N/A	N/A
Shielding height	Site Plans / Site Visit (m)	N/A	N/A	N/A
Elevation of receiver	Site Plans (m)	default	default	default
Flame temperature	1090 / 1200 Kelvin	1090	1090	1090
Upslope fire	Kataburn correction	No	No	No
Fire Danger Index	Council Area	80	80	80
Heat of Combustion	Default at 18600 kJ/kg	18600	18600	18600
Flame Emissivity	Default at 0.95	0.95	0.95	0.95
Moisture Factor	Default at 5	5	5	5
Ambient temperature	BoM (Default at 308 Kelvin)	308	308	308
Relative Humidity	BoM (Default at 25%)	25	25	25
SFR Fire Model	Vesta / McArthur	Vesta	Vesta	Vesta
RHG / SFR length	Bush Fire Safety Study	N/A	N/A	N/A
OUTPUTS - Appendix 6, page 42				
	BAL FZ	<12m	<12m	<12m
	Separation to Achieve BAL40	12 - <16m	12 - <16m	12 - <16m
	Separation to Achieve BAL29	16 - < 23m	16 - < 23m	16 - < 23m
	Separation to Achieve BAL19	23 - < 33m	23 - < 33m	23 - < 33m
	Separation to Achieve BAL12.5	33 - < 100m	33 - < 100m	33 - < 100m
	Separation for BAL29 building @	**BAL 29**	**BAL 29**	**BAL 29**

Table 4 *Lot 2 and 3 - Bushfire Hazard Assessment (Method 2 AS3959:2018)*

Elements	Method (unit)	Fire Run 4	Fire Run 5	Fire Run 6	Fire Run 7
Vegetation	NSW Comprehensive Fuel Loads	Hunter-Macleay DSF	Hunter-Macleay DSF	Coastal Floodplain	Hunter-Macleay DSF
Separation	Spatial analysis	35m	35m	35m	30m
Site slope	Site visit – Theodolite (°)	Level	2 deg up	Level	3 deg up
Effective slope	Site visit – Theodolite (°)	Level	2 deg up	Level	3 deg up
Shielding width	Site Plans / Site Visit (m)	N/A	N/A	N/A	N/A
Shielding height	Site Plans / Site Visit (m)	N/A	N/A	N/A	N/A
Elevation of receiver	Site Plans (m)	default	default	default	default
Flame temperature	1090 / 1200 Kelvin	1090	1090	1090	1090
Upslope fire	Kataburn correction	No	Yes	No	Yes
Fire Danger Index	Council Area	80	80	80	80
Heat of Combustion	Default at 18600 kJ/kg	18600	18600	18600	18600
Flame Emissivity	Default at 0.95	0.95	0.95	0.95	0.95
Moisture Factor	Default at 5	5	5	5	5
Ambient temperature	BoM (Default at 308 Kelvin)	308	308	308	308
Relative Humidity	BoM (Default at 25%)	25	25	25	25
SFR Fire Model	Vesta / McArthur	Vesta	Vesta	Vesta	Vesta
RHG / SFR length	Bush Fire Safety Study	N/A	N/A	N/A	N/A
OUTPUTS - Appendix 6, page 42					
BAL FZ		<10m	<9m	<4m	<9m
Separation to Achieve BAL40		10 - <14m	9 - <13m	4 - <7m	9 - <12m
Separation to Achieve BAL29		14 - < 20m	13 - < 19m	7 - < 11m	12 - < 17m
Separation to Achieve BAL19		20 - < 28m	19 - < 27m	11 - < 18m	17 - < 25m
Separation to Achieve BAL12.5		28 - < 100m	27 - < 100m	18 - < 100m	25 - < 100m
Separation for BAL29 building @		**BAL 12.5**	**BAL 12.5**	**BAL 12.5**	**BAL 12.5**

5 ADDITIONAL S. 45 RURAL FIRES REG

S. 45 of the RF Reg indicates the assessment requirements for s 100B RF Act developments to obtain a bush Fire Safety Authority. This section illustrates the remaining elements identified within S. 45 of the RF Reg that are not covered within bush fire hazard assessment process (section 3 and 4 of this report) or within the performance criteria of PBP 2019 (section 6 of this report).

5.1 CL (2) (E) AND (F) S.45 RF REGS - THREATENED SPECIES, POPULATIONS AND COMMUNITIES

A search on the NSW Government Central Resource for Sharing and Enabling Environmental Data for significant environmental values was completed.

The search identified no Critical Endangered Ecological Communities (CEEC) or species listed under the *Biodiversity Conservation Act 2016* near or within the site.

The results of the Sharing and Enabling Environmental Data is provided in **Appendix 3, page 39.**

There will be no additional impacts on natural heritage values.

A search of the Aboriginal Historic Information Management System (AHIMS) was completed on the 10th March 2023 which indicated the site is not known to be of Aboriginal significance.

The output of the search is provided in **Appendix 5, page 41.**

There will be no additional impacts on cultural heritage values**.**

5.2 CL (2) (G) ADDITIONAL BUSH FIRE ASSESSMENT

The capacity of nearby public roads to handle increased volumes of traffic when a bush fire emergency occurs.

The surrounding public road system is two-way, sealed with multiple routes to safer places away from the bush fire threat. This designed will be able to accommodate the elevated level of traffic created by this development.

Whether or not nearby public roads that link with the fire trail network have two-way access.

No linkages between the public road system and fire trails exist within the assessment area.

The adequacy of sprinkler systems and other fire protection measures to be incorporated into the development.

There are no bushfire spray systems or fire protection measure proposed outside the performance criteria for subdivisions.

Registered fire trails on the property.

No registered fire trails are located on the property.

6 BUSHFIRE ASSESSMENT AND PERFORMANCE MEASURES

This section assesses Bushfire Performance Measures (BPMs) for the proposed development at 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679 in consideration of the acceptable solutions required for each performance criteria within PBP 2019. Outcomes are outlined in Table 4, below. Where acceptable solutions are not met details of the performance-based solution are provided.

Table 5 *Planning for bush fire protection compliance (PBP 2019) - Chapter 5 – Rural and Residential subdivisions developments on bushfire prone lands*

PERFORMANCE CRITERIA		ACCEPTABLE SOLUTION	COMPLIANCE for 3611 The Lakes Way, Charlotte Bay, NSW, 2428 - Lot 22 / DP 236679
APZs	Potential building footprints must not be exposed to radiant heat levels exceeding 29 kW/m² on each proposed lot.	• APZs are provided in accordance with Tables A1.12.2 and A1.12.3 based on the FFDI.	**COMPLIES - ACCEPTABLE SOLUTION** A >25m APZ is provided in accordance with Table A1.12.3. A potential building envelope of 500m2 is provided for all 3 lots. Total clearance area which includes the APZ and 6m wide access for all 3 sites is of 16,000m2 or 1.6 ha.
	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.	**REFER TO LANDSCAPING COMPLIANCE REQUIREMENTS**
	The APZs is provided in perpetuity	• APZs are wholly within the boundaries of the development site	**COMPLIES - ACCEPTABLE SOLUTION** The APZ on this site is wholly within the site boundaries.
	APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised.	• APZs are located on lands with a slope less than 18 degrees.	**COMPLIES - ACCEPTABLE SOLUTION** The APZ is not located on land >18 degrees slope.
ELECTRICITY	Location of electricity services limits the possibility of ignition of surrounding bush land or the fabric of buildings.	• Where practicable, electrical transmission lines are underground; and • Where overhead, electrical transmission lines are proposed as follows:	**COMPLIES - ACCEPTABLE SOLUTION** Were possible electricity should be placed underground. If overhead power supply is provided, 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

		○ 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 accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.	out in accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.
GAS	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	**COMPLIES - ACCEPTABLE SOLUTION** The proposed layout provides ample opportunity for future residential development to comply with gas acceptable solutions.
LANDSCAPING	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; and • Fencing is constructed in accordance with section 7.6.	**MADE CONDITION OF CONSENT** Street tree plantings within 100m of the bushfire threat shall consider Huber-Smith *et. al* (2023) in the selection of tree species. A Landscaping plan is required to illustrate roadside vegetation is: • Planting does not provide a continuous canopy (trees do no touch and trees or shrubs are isolated or located in small clusters). • Roadside plants do not impede emergency vehicle access or the ability to maintain road verge to managed grasses.
ACCESS	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.	**MADE CONDITION OF CONSENT** The proposed subdivision does not provide more than one access to the public road system for the 3 lots, with lot 2 and 3 located >200m from the public road system. A small variation for acceptable solutions is proposed. This include providing a larger APZ for lots 2 and 3 to accommodate an increased

		• 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.	BAL construction level for 4.14 DA class 1a developments. Furthermore, the access is minimum 5.5 m wide to allow two-way access for the entire length. The following shall be made conditions of consent: • Property access roads are two-wheel drive, all-weather roads. • 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. • Turning area provided in lot 3 with the access clearly sign posted as a dead end.
	The capacity of access roads is adequate for firefighting vehicles	• The capacity of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating.	**MADE CONDITION OF CONSENT** The capacity of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and 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 2419.1:2017 - Fire hydrant installations System design, installation and commissioning; and	**N/A** Hydrants are not proposed, ample space available within proposed clearance areas to meet static water acceptable solutions for 4.14 DA.

		• There is suitable access for a Category 1 fire appliance to within 4m of the static water supply where no reticulated supply is available.	
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 on the interface.	• Are two-way sealed roads. • Minimum 8m carriageway width kerb to kerb. • Parking is provided outside of the carriageway width. • Hydrants are located clear of parking areas. • 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 maximum grade road is 15 degrees and average grade of not more than 10 degrees. The road crossfall does not exceed 3 degrees; and • A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches, is provided.	**N/A** Perimeter road not provided
NON-PERIMETER 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. • 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.	**MADE CONDITION OF CONSENT** Access road shall be constructed to non-perimeter road requirements.

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. • Provide a suitable turning area in accordance with Appendix 3. • 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. *Note: Some short constrictions in the access may be accepted where they are not less than 3.5m wide,*	**MADE CONDITION OF CONSENT** Private property access shall comply with the below requirements: •A minimum vertical clearance of 4m to any overhanging obstructions, including tree branches. •Property access must provide a suitable turning area in accordance with Appendix 3 of PBP. •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°. •Maximum grades for sealed roads do not exceed 15° and not more than 10° for unsealed roads. •A development comprising more than three dwellings has formalised access by dedication of a road and not by right of way. *Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.*

		extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. The gradients applicable to public roads also apply to community style development property access roads in addition to the above.	
WATER SUPPLIES	Adequate water supplies is provided for firefighting purposes.	• Reticulated water is to be provided to the development where available. • A static water and hydrant supply is provided for non-reticulated developments or where reticulated water supply cannot be guaranteed; and static water supplies shall comply with Table 5.3d.	**COMPLIES - ACCEPTABLE SOLUTION** Static water supplied for firefighting purposes.
	Water supplies are located at regular intervals, and The water supply is accessible and reliable for firefighting operations.	• Fire hydrant, spacing, design and sizing complies with the relevant clauses of Australian Standard AS 2419.1:2021. • 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.	**N/A** Static water supplies proposed.
	Flows and pressure are appropriate	• Fire hydrant flows and pressures comply with Table 2.2 of AS 2419.1:2005.	**N/A** This report has not tested or determined if the fire hydrant flow and pressures to comply with Table 2.2 of AS 2419.1:2017.
	The integrity of the water supply is maintained	• All above-ground water service pipes are metal, including and up to any taps; and • Above-ground water storage tanks shall be of concrete or metal.	**N/A** Static water supplies proposed.

7 CONCLUSION AND RECOMMENDATIONS

It is clear from this investigation and assessment that the site is located within Bushfire Prone Land. An assessment in accordance with Appendix 1 of PBP2019 has been undertaken implementing detailed assessment pathway described in Appendix B of AS3959:2018. This BFAR found the classifiable vegetation of Hunter-Macleay DSF and Coastal Floodplain Wetlands as described by NSW Comprehensive Fuel Loads both up and downslope surrounding the site of the site creates the greatest bushfire threat.

In accordance with the provisions of PBP 2019, the recommendations outlined within this assessment will reduce the risk of damage and/or harm in the event of a bushfire event to acceptable levels. The following recommendations are provided to inform the planning of the development to obtain development consent.

Asset Protection Zones and Landscaping
A potential building envelope of 500m2 is provided for all 3 lots.

Total clearance area which includes the APZ and 6m wide access for all 3 sites is of 16,000m2 or 1.6 ha.

Street tree plantings within 100m of the bushfire threat shall consider Huber-Smith et. al (2023) in the selection of tree species. A Landscaping plan is required to illustrate roadside vegetation is:

- Planting does not provide a continuous canopy (trees do no touch and trees or shrubs are isolated or located in small clusters).
- Roadside plants do not impede emergency vehicle access or the ability to maintain road verge to managed grasses.

Construction
APZ have been established for 500m2 building envelopes to enable BAL 29 construction.

Access
Access to the property and development site is noted on **Figure 2, page 8** of this report and in the site plan provided in **Appendix 1, page 35.**

The proposed subdivision does not provide more than one access to the public road system for the 3 lots, with lot 2 and 3 located >200m from the public road system.

A small variation for acceptable solutions is proposed. This include providing a larger APZ for lots 2 and 3 to accommodate an increased BAL construction level for 4.14 DA class 1a developments. Furthermore, the access is minimum 5.5 m wide to allow two-way access for the entire length.

Private property access shall comply with the below requirements:

- Private property access shall be two-wheel drive, all weather roads.
- The capacity of private property access of road surfaces and any bridges/ causeways is sufficient to carry fully loaded firefighting vehicles (up to 23 tonnes); bridges and causeways are to clearly indicate load rating.
  - Property access roads are two-wheel drive, all-weather roads.
  - 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.
  - Turning area provided in lot 3 with the access clearly sign posted as a dead end.

- A development comprising more than three dwellings has formalised access by dedication of a road and not by right of way.
- Minimum 5.5m carriageway width kerb to kerb.
- Parking is provided outside of the carriageway width.
- 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.

Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. the gradients applicable to public roads also apply to community style development property access roads in addition to the above.

Water Supply

The proposed layout provides ample opportunity for future residential development to comply with static water acceptable solutions.

Electricity services

Were possible electricity should be placed underground. If overhead power supply is provided, 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 accordance with the specifications in ISSC3 Guideline for Managing Vegetation Near Power Lines.

Gas services

The proposed layout provides ample opportunity for future residential development to comply with gas acceptable solutions.

Emergency Management

There are no performance criteria requirements for this type of development within PBP 2019.

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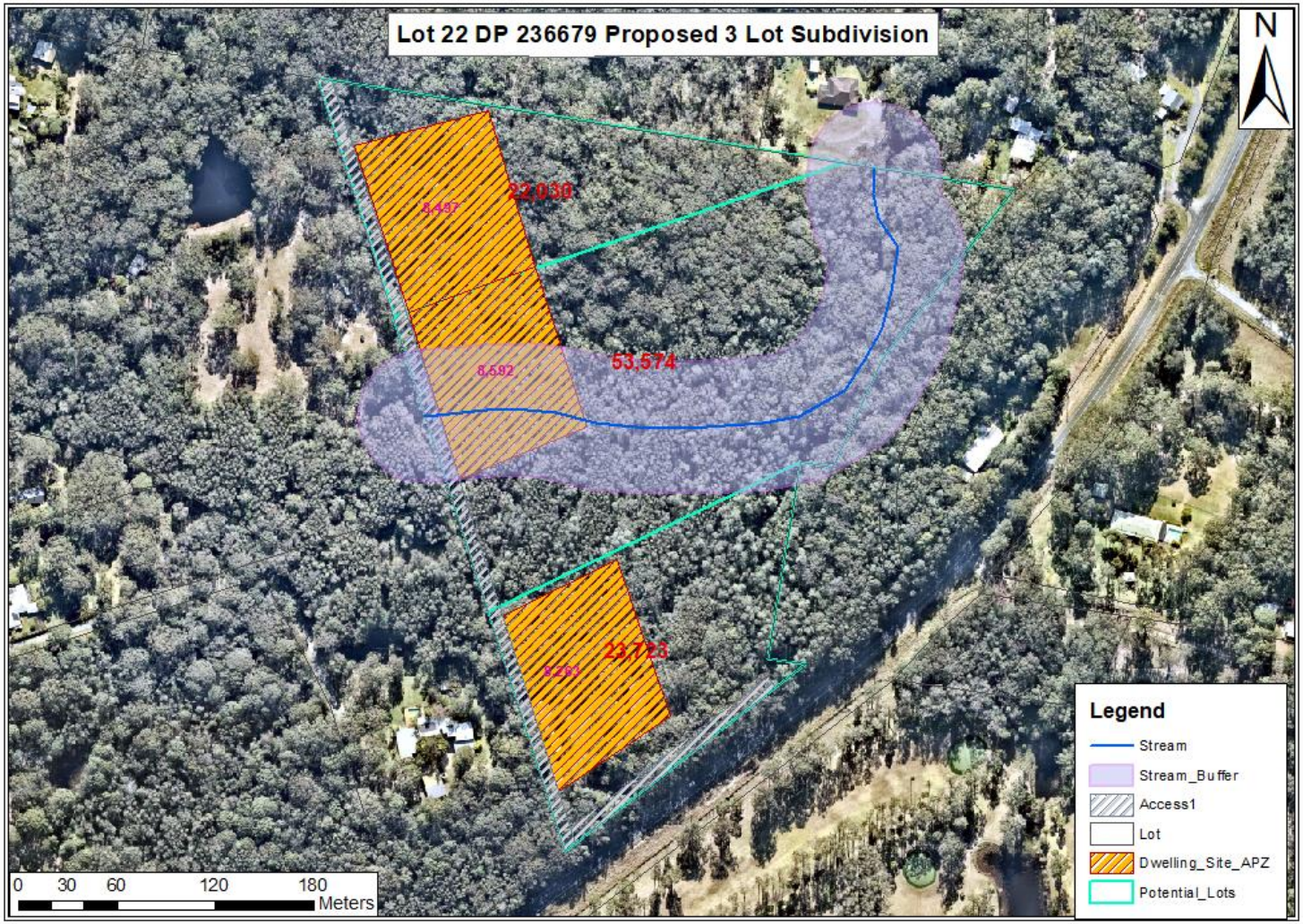
9 APPENDIX 1 SUBDIVISION PLANS



10 APPENDIX 2 PLATES (PHOTOGRAPHS)

Plates 1 – 6 depict the elements in and around the site that are considered within the bush fire hazard assessment. The classified vegetation, separations, effective and site slope are identified in **Table 3, page XX** and displayed in **Figure 2, page XX**.

Plate 1 *(P1) Access along The Lakes Way*

Plate 2 *(P2) Existing entrance into property from The Lakes Way*

Plate 3 *(P3) Existing clearance and vegetation on proposed lot 1*

Plate 4 *(P4) Existing clearance and vegetation on proposed lot 1*

Plate 5 *(P5) Existing clearance and vegetation on proposed lot 1*

Plate 6 *(P6) Existing clearance and vegetation on proposed lot 1*

11 APPENDIX 3 NSW SHARING AND ENABLING ENVIRONMENTAL DATA

12 APPENDIX 4 BIODIVERSITY MAP

Biodiversity Values Map and Threshold Tool

The Biodiversity Values (BV) Map and Threshold Tool identifies land with high biodiversity value, particularly sensitive to impacts from development and clearing.

The map forms part of the Biodiversity Offsets Scheme threshold, which is one of the factors for determining whether the Biodiversity Offset Scheme (BOS) applies to a clearing or development proposal. You can use the Threshold Tool in the map viewer to generate a BV Threshold Report for your nominated area. The report will calculate results for your proposed development footprint and determine whether or not you will need to engage an accredited assessor to prepare a Biodiversity Development Assessment Report (BDAR) for your development.

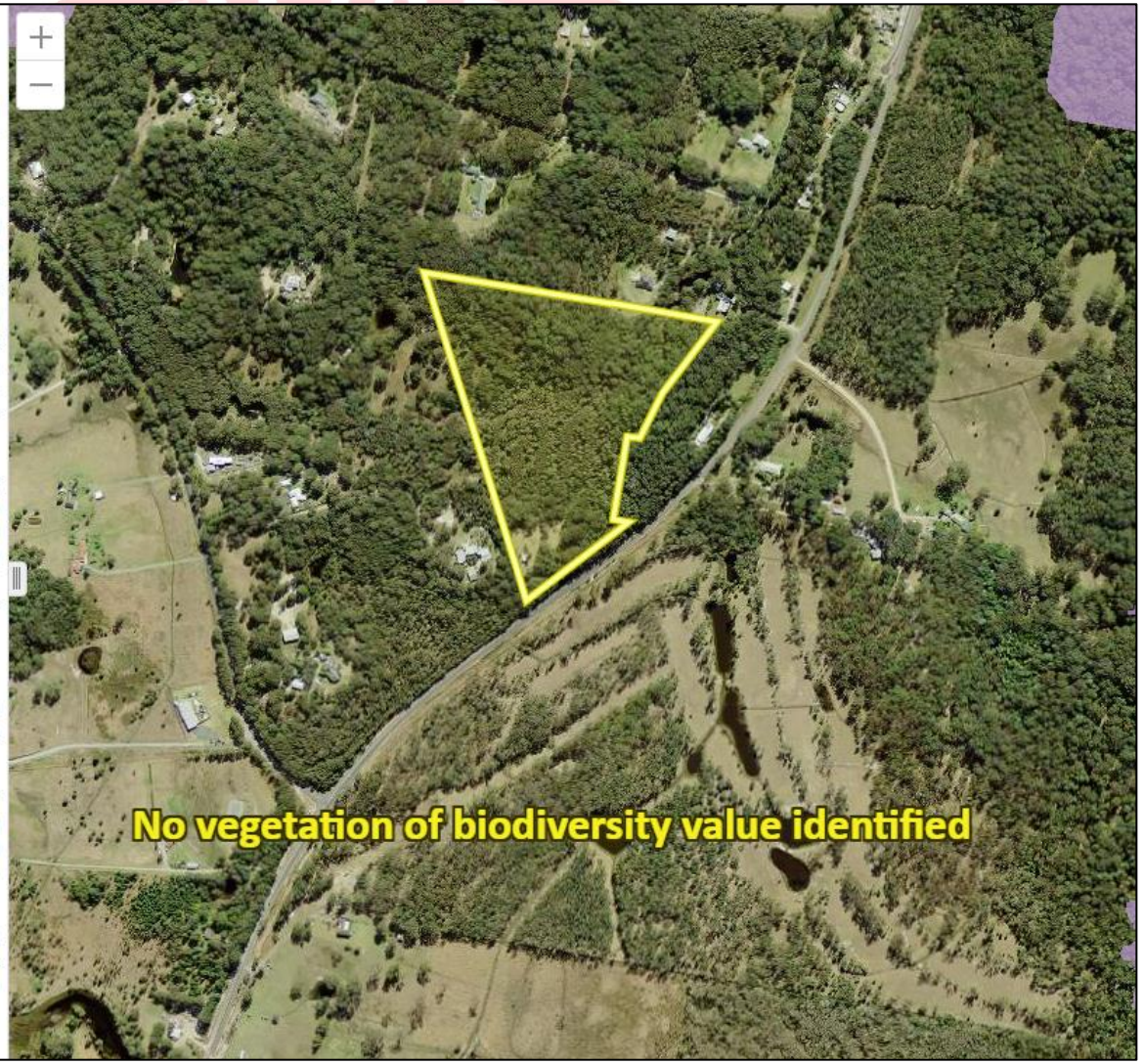
This report can be used as evidence for development applications submitted to councils, native vegetation clearing not requiring development consent in urban areas and areas zoned for environmental conservation under State Environmental Planning Policy (Biodiversity and Conservation) 2021 - Chapter 2 vegetation in non-rural areas.

What's new?

For more information about the latest updates to the Biodiversity Values Map and Threshold Tool go to the updates section on the Biodiversity Values Map webpage.

Map Review: Landholders can request a review of the BV Map where they consider there is an error in the mapping on their property. For more information about the map review process and an application form for a review go to the Biodiversity Values Map Review webpage.

If you need help using this map tool see our Biodiversity Values Map and Threshold Tool User Guide. or contact the Map Review Team at map.review@environment.nsw.gov.au or on 1800 001 490.



13 APPENDIX 5 AHIMS SEARCH

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Charlotte Bay
Client Service ID : 871654

Date: 10 March 2024

Salamander Bay New South Wales 2317
Attention: Duncan Scott-Lawson
Email: duncan@emconsultancy.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 22, DP:DP236679, Section : - with a Buffer of 50 meters, conducted by Duncan Scott-Lawson on 10 March 2024.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

14 APPENDIX 6 METHOD 2 OUTPUTS

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 9/04/2024 **Assessment Date:** 9/04/2024

Site Street Address:	3611 The Lakes Way, Charlotte Bay		
Assessor:	Duncan Scott-Lawson; BEMC P/L		
Local Government Area:	Mid-Coast	**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: Fire Run 1, 2 and 3

Vegetation Information

Vegetation Type:	Hunter Macleay DSF		
Vegetation Group:	Dry Sclerophyll Forests (Shrub/Grass)		
Vegetation Slope:	4 Degrees	**Vegetation Slope Type:**	Downslope
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:	4 Degrees	**Site Slope Type:**	Downslope
Elevation of Receiver(m):	default	**APZ/Separation(m):**	20

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:**	80

Program Outputs

Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	5.48
Radiant Heat(kW/m2):	22.15	**Flame Angle (degrees):**	72
Flame Length(m):	14.46	**Maximum View Factor:**	0.348
Rate Of Spread (km/h):	1.77	**Inner Protection Area(m):**	16
Transmissivity:	0.838	**Outer Protection Area(m):**	4
Fire Intensity(kW/m):	22512		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	12	16	23	33	51	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 9/04/2024 **Assessment Date:** 9/04/2024

Site Street Address:	3611 The Lakes Way, Charlotte Bay
Assessor:	Duncan Scott-Lawson; BEMC P/L
Local Government Area:	Mid-Coast
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: Fire Run 4

Vegetation Information

Vegetation Type:	Hunter Macleay DSF		
Vegetation Group:	Dry Sclerophyll Forests (Shrub/Grass)		
Vegetation Slope:	0 Degrees	**Vegetation Slope Type:**	Level
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:**	Level
Elevation of Receiver(m):	default	**APZ/Separation(m):**	35

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:**	80

Program Outputs

Level of Construction:	BAL 12.5	**Peak Elevation of Receiver(m):**	5.72
Radiant Heat(kW/m2):	9.26	**Flame Angle (degrees):**	78
Flame Length(m):	11.69	**Maximum View Factor:**	0.153
Rate Of Spread (km/h):	1.34	**Inner Protection Area(m):**	28
Transmissivity:	0.796	**Outer Protection Area(m):**	7
Fire Intensity(kW/m):	17082		

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

NBC Bushfire Attack Assessment Report V4.1

A S3959 (2018) Appendix B - Detailed Method 2

Print Date: 9/04/2024 **Assessment Date:** 9/04/2024

Site Street Address:	3611 The Lakes Way, Charlotte Bay
Assessor:	Duncan Scott-Lawson; BEMC P/L
Local Government Area:	Mid-Coast
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: Fire Run 5

Vegetation Information

Vegetation Type:	Hunter Macleay DSF		
Vegetation Group:	Dry Sclerophyll Forests (Shrub/Grass)		
Vegetation Slope:	2 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:	2 Degrees	**Site Slope Type:**	Upslope
Elevation of Receiver(m):	default	**APZ/Separation(m):**	35

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:**	80

Program Outputs

Level of Construction:	BAL 12.5	**Peak Elevation of Receiver(m):**	6.49
Radiant Heat(kW/m2):	8.62	**Flame Angle (degrees):**	77
Flame Length(m):	10.81	**Maximum View Factor:**	0.142
Rate Of Spread (km/h):	1.21	**Inner Protection Area(m):**	28
Transmissivity:	0.796	**Outer Protection Area(m):**	6
Fire Intensity(kW/m):	15374		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	9	13	19	27	43	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 9/04/2024 **Assessment Date:** 9/04/2024

Site Street Address: 3611 The Lakes Way, Charlotte Bay

Assessor: Duncan Scott-Lawson; BEMC P/L

Local Government Area: Mid-Coast **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: Fire Run 6

Vegetation Information

Vegetation Type: Coastal Floodplain Wetlands
Vegetation Group: Forested Wetlands

Vegetation Slope: 0 Degrees **Vegetation Slope Type:** Level
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:** Level
Elevation of Receiver(m): default **APZ/Separation(m):** 35

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:** 80

Program Outputs

Level of Construction: BAL 12.5 **Peak Elevation of Receiver(m):** 3.44
Radiant Heat(kW/m2): 5.46 **Flame Angle (degrees):** 83
Flame Length(m): 6.93 **Maximum View Factor:** 0.09
Rate Of Spread (km/h): 0.79 **Inner Protection Area(m):** 35
Transmissivity: 0.795 **Outer Protection Area(m):** 0
Fire Intensity(kW/m): 6141

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	4	7	11	18	30	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 9/04/2024 **Assessment Date:** 9/04/2024

Site Street Address:	3611 The Lakes Way, Charlotte Bay
Assessor:	Duncan Scott-Lawson; BEMC P/L
Local Government Area:	Mid-Coast
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: Fire Run 7

Vegetation Information

Vegetation Type:	Hunter Macleay DSF		
Vegetation Group:	Dry Sclerophyll Forests (Shrub/Grass)		
Vegetation Slope:	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:	3 Degrees	**Site Slope Type:**	Upslope
Elevation of Receiver(m):	default	**APZ/Separation(m):**	30

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:**	80

Program Outputs

Level of Construction:	BAL 12.5	**Peak Elevation of Receiver(m):**	6.39
Radiant Heat(kW/m2):	9.68	**Flame Angle (degrees):**	76
Flame Length(m):	9.94	**Maximum View Factor:**	0.158
Rate Of Spread (km/h):	1.08	**Inner Protection Area(m):**	24
Transmissivity:	0.808	**Outer Protection Area(m):**	6
Fire Intensity(kW/m):	13666		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	9	12	17	25	40	6

15 APPENDIX 7 NSW BUSHFIRE PLANNING PROTECTION MEASURES

The following information on building survivability and the application of Bushfire Protection Measures should be considered continually for the life of the development. These measures facilitate meeting the aims and objectives of PBP 2019 and mitigating bushfire risk and are provided to inform the client.

Why do buildings burn during bush fires?

Research has been undertaken to over the last decades to analysis and determine the elements that determine the survivability of a building during a bush fire event. As the research is validated, these elements are incorporated into planning documentation that guides construction in bush fire prone areas, such as Australian Standard 3959 and NSW RFS Planning for Bushfire Protection.

Research has illustrated that there are three ways a bush fire impacts a building:

1. Direct flame contact,
2. Radiant heat from the bush fire, and
3. Embers generated by the bush fire.

Most people expect direct flame contact to be the biggest risk to homes in a bush fire, but this is not the case. Over 80% of house loss during bush fires occurs because of ember attack; the burning firebrands of bark, leaves and twigs with winds drive away from the main fire front. They find weaknesses in houses such as gaps, cracks to combustible construction materials and can quickly lead to ignition of the building.

Significantly, vegetation that is established adjacent to the building and within the Asset Protection Zone following the construction of the building, which provides fuel for burning embers to ignite and increase the ignitability of the building. It is critical that the Asset Protection Zone are maintained throughout the life of the property, so that wildfire is not encouraged closer to the building.

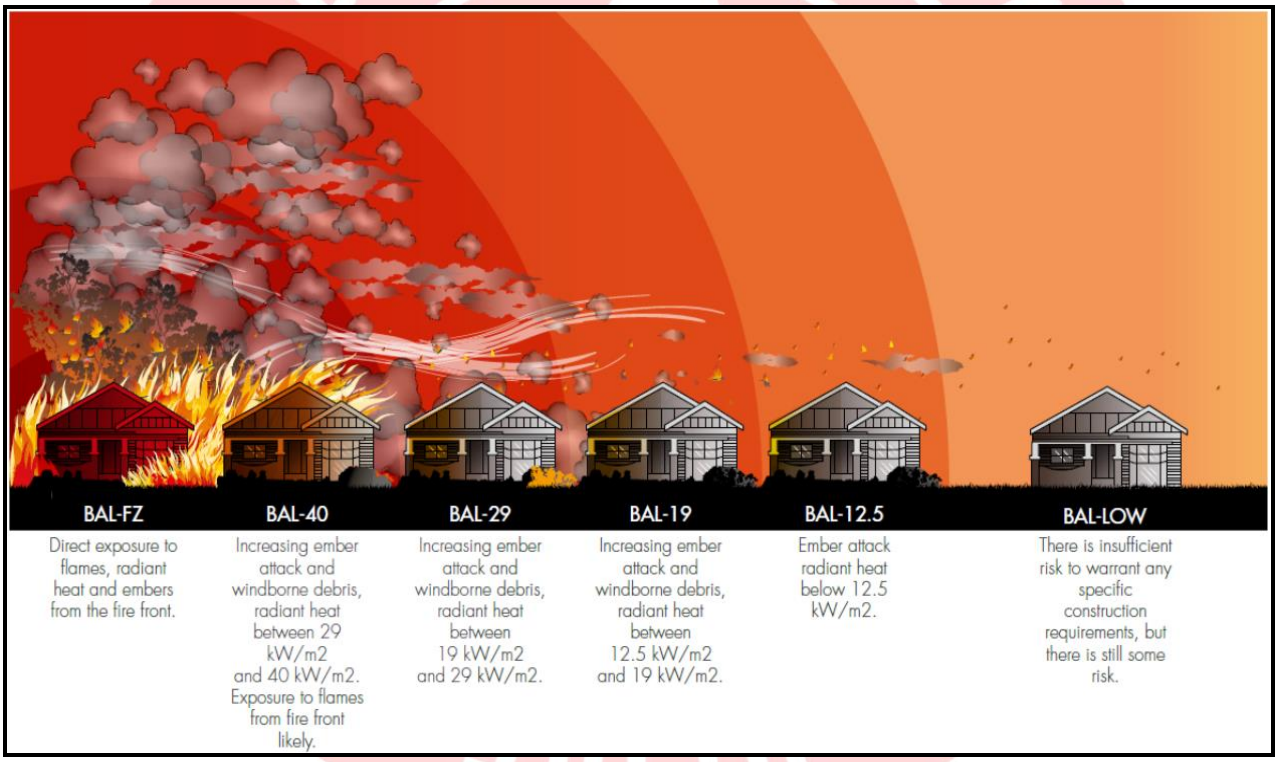
The research has illustrated the separation between the bushfire threat and building; and the construction standards of the building are the principal elements to building survivability. It is critical that:

1. Any future alterations and additions to the building are undertaken with materials that comply with the relevant BAL of the building.
2. The separations between the building and bush fire threat (known as the Asset Protection Zones (APZ)) are maintained to low flammability. This means restricted gardens and combustible elements, such as timber landscaping and furnishings. It is critical to maintain '*fire hygiene'* around the building.

Australia Standard 3959 Construction of buildings in Bush fire prone areas and Bush fire Attack Level (BAL)

Bush fire Attack Level (BAL) ratings refer to the fire intensity your house is likely to be subjected to in a bush fire, expressed in terms of radiant heat. The BAL assessment forms the construction component of the bush fire assessment process. The other component is the Bush fire planning, which includes Asset Protection Zones (APZ), separation to provide defendable spaces, access, water, electricity, gas, landscaping and emergency management.

Furthermore, the measures contained in the *Australian Standard 3959 Construction of buildings in Bushfire Prone Areas* for each BAL construction level are not for fire resistance. The building will burn. The construction standards are aimed at slowing the ignition and fire spread of the building to provide adequate time to enable occupants to shelter within the building as the bushfire front passes. The degree of vegetation management within the APZ, the unpredictable nature of behaviour of fire, and extreme weather conditions make building adjacent to vegetation very dangerous.



Relationship between fire behaviour and BAL (WA Guidelines for Planning in Bush fire Prone Areas, 2017)

Design and Siting

The design and siting of a building can be of critical importance during bush fire attack event. The appropriate design and siting can reduce the impact of bush fire attack mechanisms of direct flame, radiant heat, ember attack, smoke, and wind. Key principles to consider when designing and siting a new development include the following:

- Avoid building on ridges, saddles and build on level ground wherever possible.
- Utilise cut-in benches, rather than elevating the building when building on sloping land.
- Avoid raised floors and protect the sub-floor areas by enclosing or screening.

- Provide an appropriate shelter room that is located on the lowest or non-bush fire hazard side of the building, near building exits and provides the occupant views of the outside environment.
- Reduce bulk of building, limit re-entrant corners, and incorporate simplified roof that are able to self-clean of debris.
- No gutters on second or consecutive storeys of building and avoid box gutters.
- If gutters are installed, incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Limit glazing elements on the sides of the building exposed to the bush fire threat and use shutters to protect glazing elements.
- Carparking provided in a location that does not interfere with escape routes.
- Position development so any gas supplies and overhead electricity are positioned not to impede egress to and from the site.
- Class 10a buildings (such as shed, carport, and garages) should be a minimum of 6m away from any other building. Consider the storage of hazardous materials (petrol, kerosene, alcohol, LPG, natural gas, acetylene, vehicle, machinery etc.) within Class 10a buildings when siting in proximity to Class 1a occupied building and escape routes.
- Provide unobstructed access around the entire building supported by a minimum 1m wide concreted path to the external wall.

Asset Protection Zones

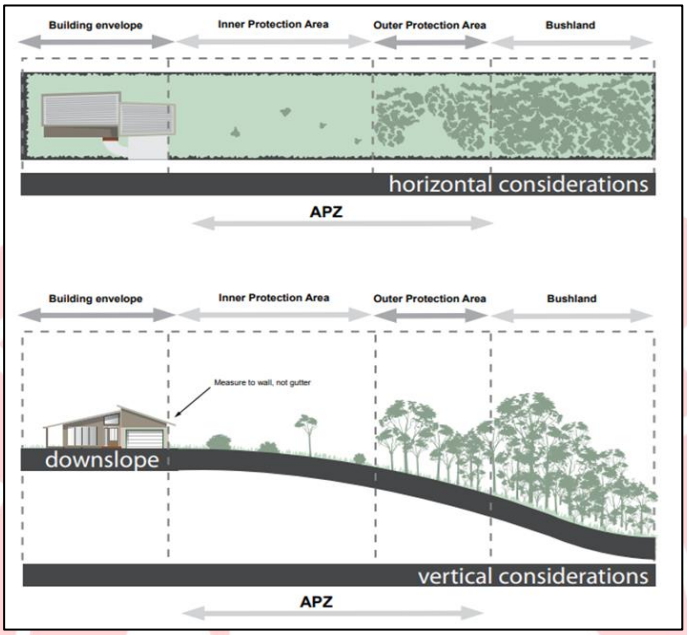
An APZ is an area surrounding a development that is managed to reduce the bushfire hazard to an acceptable level to mitigate the risk to life and property. The required width of the APZ varies with slope and the type of hazard. An APZ should be maintained in perpetuity to ensure ongoing protection from the impact of bush fires. Maintenance to the below standards should be undertaken on an annual basis, in advance of the fire season, as a minimum.

For a complete guide to APZs and landscaping, download the NSW RFS document Standards for Asset Protection Zones at www.rfs.nsw.gov.au/resources/publications .

An APZ can consist of both an Inner Protection Area (IPA) and an Outer Protection Area (OPA) as indicated below. An APZ can include the following:

Footpaths	Driveways
Lawns	Unattached non-combustible garages as long as suitably separated
Discontinuous gardens	Open space / parkland
Swimming pools	Car parking

Isolated areas of shrub and timbered vegetation are generally not a bush fire hazard as they are not large enough to produce fire of an intensity that will threaten dwellings. These areas include narrow strips of vegetation along road corridors.



Components of an APZ (Figure A4.1 - PBP 2019)

Any areas that are designated Asset Protection Zones, should be delineated by rural fencing, signposted or bollards (whatever is practical in the circumstances) to ensure vegetation creep does not occur and further landowners and ground management are aware that the area is to be maintained for Bush fire protection purposes. Examples are provided below:

Inner Protection Area (IPA)

The IPA extends from the edge of the OPA to the development. The IPA is the area closest to the asset and creates a fuel-managed area which can minimise the impact of direct flame contact and radiant heat on the development and be a defendable space. The intent of an IPA is to stop the transmission of flame and reduce the transmission of radiant heat by the elimination of available fire fuel. This area also allows

airborne embers to fall safely without igniting further outbreaks and provides a safer firefighting position and is operationally important for implementation of clear fire control lines.

In practical terms the IPA is typically the curtilage around the dwelling, consisting of a mown lawn and well-maintained gardens. When establishing and maintaining an IPA the following requirements apply:

- Vegetation within the IPA should be kept to a minimum level. Litter fuels (leaves and vegetation debris) within the IPA should be continually removed and kept below 1cm in height and be discontinuous. There is minimal fine fuel at ground level which could be set alight by a bushfire.
- Canopy cover should be less than 15% (at maturity). Trees (at maturity) should not touch or overhang the building and should be separated by 2 to 5m.
- Lower limbs of canopy trees should be removed up to a height of 2m above ground.
- Preference should be given to smooth barked and evergreen trees.
- Large discontinuities or gaps in the shrub vegetation shall be established to slow down or break the progress of fire towards buildings.
- Shrubs should not be located under trees and not form more than 10% ground cover
- Clumps of shrubs should be separated from exposed windows and doors by a distance of at least twice the height of the vegetation.
- Grasses should be kept mown (as a guide grass should be kept to no more than 100mm in height), and
- Woodpiles, wooden sheds, combustible material storage areas, large areas / quantities of garden mulch, stacked flammable building materials etc. are not permitted in the IPA.

Outer Protection Area (OPA)

An OPA is located between the IPA and the unmanaged vegetation. Vegetation within the OPA can be managed to a more moderate level. The reduction of fuel in this area substantially decreases the intensity of an approaching fire and restricts the pathways to crown fuels, reducing the level of direct flame, radiant heat and ember attack on the IPA.

Because of the nature of an OPA, they are only applicable in forest vegetation.

In practical terms the OPA is an area where there is maintenance of the understorey and some

separation in the canopy. When establishing and maintaining an OPA the following requirements apply:

- Tree canopy cover should be less than 30%, canopies should be separated by 2 to 5m
- Shrubs should not form a continuous canopy and form no more than 20% of ground cover
- Grasses should be kept to no more than 100mm in height with leaf and other debris should be mown, slashed or mulched.

Furthermore, the edge of the APZ should be clearly delineated to ensure vegetation creep does not occur over time, reducing the separation between the bushfire hazard and building.

Gardens and vegetation within the APZ

All vegetation will burn under the right conditions.

In choosing plants for landscaping consideration should be given to plants that possess properties, which help to protect buildings. If the plants themselves can be prevented from ignition, they can improve the defence of buildings by:

- Filtering out wind-driven burning debris and embers.
- Acting as a barrier against radiation and flame, and
- Reducing wind forces.

Consequently, landscaping with vegetation of the site should consider the following:

- Meet the specifications of an Inner Protection Area (IPA) detailed in PBP 2019.
- Priority given to retaining or planting species which have a low flammability and high moisture content.
- Priority given to retaining or planting species which do not drop much litter in the bushfire season, and which do not drop litter that persists as ground fuel in the bush fire season, and
- Create discontinuous or gaps in the vegetation to slow down or break the progress of fire towards the dwellings.
- Avoid gardens within 10m of the exterior building envelop.
- Trees and shrubs within 40m are not continuous, but instead arranged as discrete patches separated by a ground layer with low fuel hazard, such as mown grass.
- Position courtyards, gardens, and grassed areas in locations that facilitate the protection of the building.
- Install pebble/rock garden beds avoiding the use of mulch and wood chip.

Consideration should be given to vegetation fuel loads present on site. Careful thought must be given to the type and physical location of any proposed site landscaping.

Inappropriately selected and positioned vegetation has the potential to 'replace' any previously removed fuel load.

Whilst it is recognised that fire-retardant plant species are not always the most aesthetically pleasing choice for site landscaping, the need for adequate protection of life and property requires that a suitable balance between visual and safety concerns be considered. The below list of well know ground fire-retardant plants is intended as a guide only, check with your local council for information more specific to your area.

Lomandra longifolia	*Dampiera*
Lomandra hystrix	*Scaevola aemula*
Anigozanthos hybrids	*Succulents (most)*
Agapanthus orientalis	*Carpobrotus (Pigface)*
Liriope muscari	*Cotyledon*
Carpobrotus glaucescens	*Ajuga australis*
Casuarina glauca	*Myroporum*
Ajuga	*Nepeta* (catmint)
Brachyscome	*Mesembryanthemum*

Strategically positioned elevated vegetation (fire-retardant tree and shrub species) can act as 'windbreaks' and 'ember filter', reducing wind velocities and suppressing the density of embers attacking a building. It is critical that this vegetation is:

- On flat ground place >30m from the building (ideally 40m forming the outer perimeter of the IPA).
- >20m separation from the hazardous vegetation.
- Located on the side of the bush fire hazard.
- No gardens of shrubs under the trees.
- Shrub patches no greater than $10m^2$.

The below list of well know fire-retardant trees and shrubs is intended as a guide only, check with your local council for information more specific to your area:

Melia azederach (Cape Lilac)	*Citrus trees*
Brachychiton aecerifolius (Flame tree)	*Loquot*
Magnolia grandiflora	*Arbutus Quercus (only the deciduous oak)*
Pyrus (most ornamental pears)	*Feijoa*
Magnolia Little Gem	*Gleditzia*
Ulmus chinensis (Chinese Elm)	*Ficus (all including edible)*
Acacia howitii	*Aloe (all)*
Cercis (Judus Tree)	*Correa*
Acmena smithii (Lilypily)	*Acacia iteaphyla*
Prunus (all including ornamental)	*Scaevola crassifolia*
Cupaniopsis anacardiopsis (Tuckeroo)	*Viburnum tinus*
Malus (apple trees)	*Atriplex (saltbush)*
Eleocarpus	*Escallonia*
Mullbery	*Maireana (Cottonbush)*
Eremophila (Emu bush)	*Leucophyta brownii*
Melaleuca nodosa	*Plectranthus*
Syzygium (lilypilly)	*Santolina*
Photinia	*Coprosma*
Rhagodia (saltbush)	*Strelitzia*
Acacia Cyclops	*Senna (Silver Cassia)*

Recent post-fire research from the 2019/20 bushfire season suggests greenness factor (the extent to which plants are actively growing) had an impact on building survivability to a bushfire, indicating that maintained green grasses and landscape watering features are beneficial during a bushfire.

It is essential that any vegetation and landscaped areas and surrounds are subject to ongoing fuel management and reduction to ensure that fine fuels do not build up.

Landscaping features within the APZ

A combination of hard (materials) and soft (design) landscaping will benefit the survivability of a building during a bushfire event. The type, quantity and condition of fuel has a very important effect on bushfire behaviour in proximity to a building. Poorly located vegetation that burns readily may expose a house to increased levels of radiant heat and flame contact.

- Non-flammable features such as tennis courts, swimming pools, dams, patios, driveways or paths should be incorporated into the proposal, especially on the northern and western sides of the proposed building.
- Remove other flammable objects from around the house. These include sheds, caravans, outdoor furniture, barbeques, gas bottles, wood piles and organic mulch.
- Avoid flammable mulches within the APZ. Alternatives include gravel, scoria, pebbles, shells or recycled crushed bricks.
- Use non-combustible, moveable containers and pots that can be relocated in the summer.
- Restrict the use of door mats and place firewood stacks >10m from building.
- Restrict the use of timber and use materials such as brick, earth, stone, concrete and galvanised iron
- Metal screens can help to shield your house from radiant heat, direct flame contact and ember attack.
- An intensive area of planting centred on a contoured garden mound provide an effective screening.
- Fencing in BAL 29 or within 6m of a building should be of non-combustible materials.
- Establish a path immediately around the external wall of the building. Do not place garden beds adjacent to the external fabric of the building and under windows.
- Clumping shrubs and trees so they do not form a continuous canopy and are separated by areas of low fuel (maintained green grass lawn).

Further information can be found here - Landscaping for bushfires

Access Requirements

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/building design.

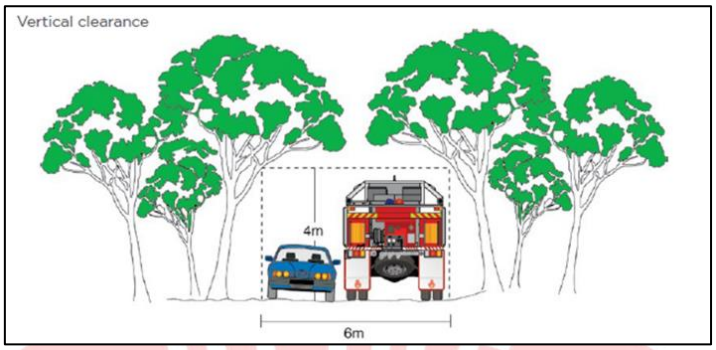
Local Area Traffic Management (LATM)

The objective of LATM is to attain an acceptable level of speed, volume, and composition of traffic within a local area and reduce the number of road accidents. This is achieved by modifying the street environment through the installation of various traffic control devices. LATM devices by their nature are designed to restrict and or impede the movement of traffic, especially large vehicles, which conflicts with the intent for access required by the NSW RFS and may significantly increase response times for emergency services.

Where LATM devices are provided they are to be designed so that they do not impede fire vehicle access.

Vertical clearance

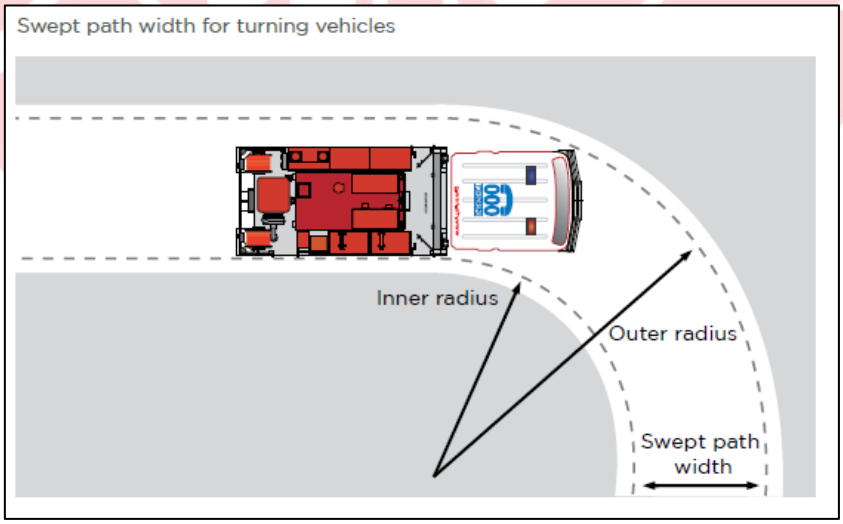
An unobstructed clearance height of 4 metres should be maintained above all access ways including clearance from building construction, archways, gateways/doorways, and overhanging structures (e.g., ducts, pipes, sprinklers, walkways, signs and beams). This also applies to vegetation overhanging roads and fire trails.

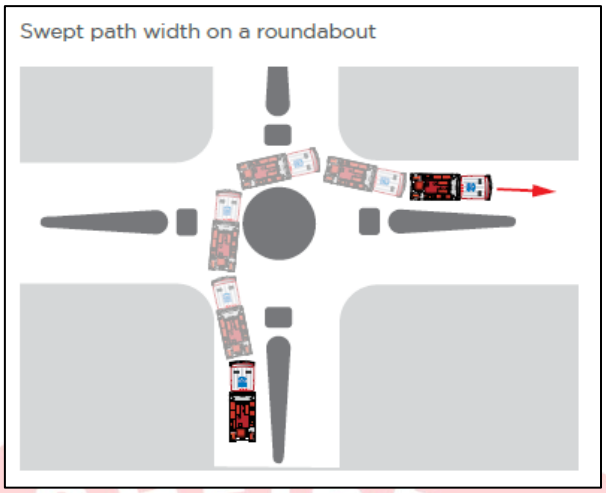


Vehicle Turning Requirements

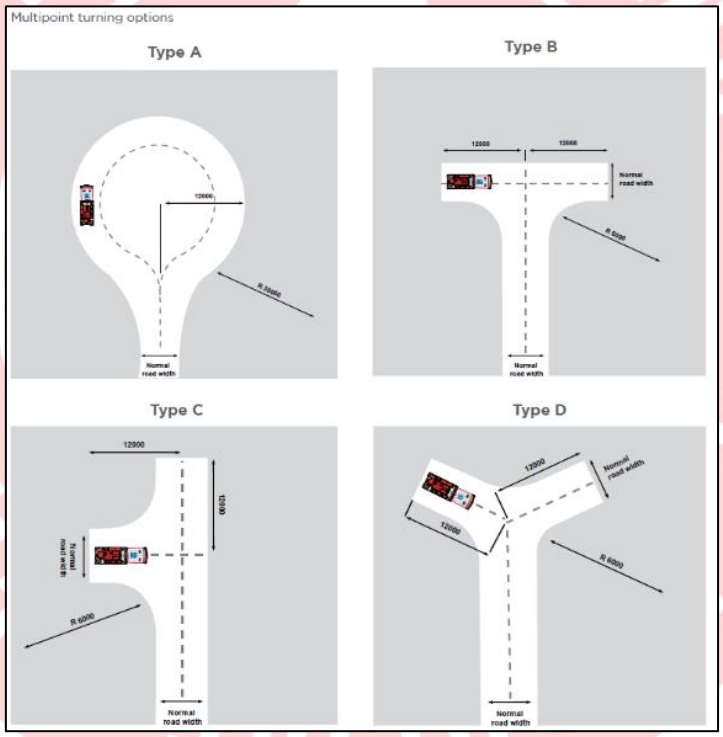
Fire crews must have rapid access and egress for vehicles, therefore curved carriageways should be constructed using the minimum swept path. The below diagrams from PBP2019 provide indication of the requirements to be achieved.

Minimum curve radius (inside edge (m))	Swept path (m) wide
<40	4.0
40 -69	3.0
70 - 100	2.7
>100	2.5





Where a turning head is proposed the NSW RFS requires that dead ends having a length greater than 20 metres should be provided with a turning head area which avoids multipoint turns.



Passing Bays

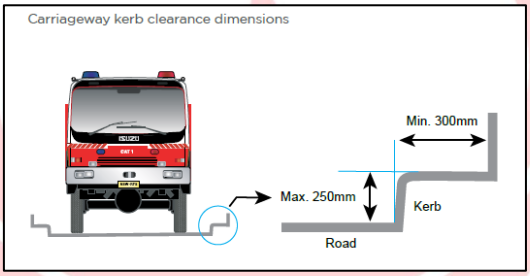
The construction of passing bays, where required, shall be 20m in length, provide a minimum trafficable width at the passing point of 6m.

Parking

Parking can create a pinch point within the road reserve. The location of parking should be carefully considered to ensure fire appliance access is unimpeded. Hydrants should be located clear of any parking areas to ensure that access is always available.

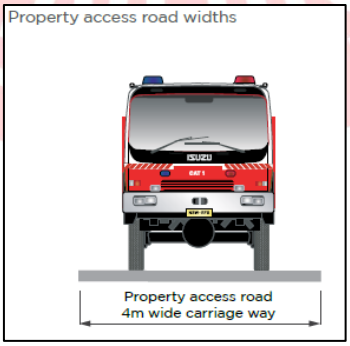
Kerb Dimensions

All kerbs constructed around access lanes should be no higher than 250mm and free of vertical obstructions at least 300mm back from the kerb face to allow clearance for front and rear body overhang.



Road Types

Property access is required to be 4m wide all-weather road. Can be sealed or unsealed.



Water Supply

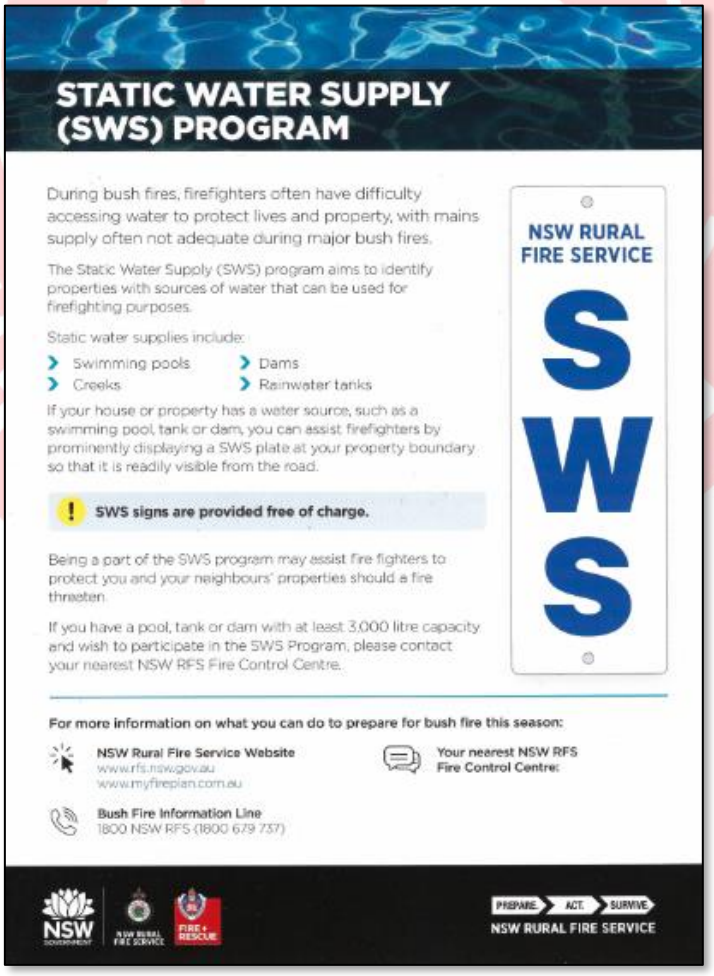
The intent of water measures is to provide adequate services of water for the protection of dwellings during and after the passage of a bush fire.

Where reticulated water supply is not provided, a static water supply for fire-fighting purposes should be above-ground, accessible, clearly marked and manufactured from concrete or metal. If raised, the tank stand should be made from non-combustible material. These static water supplies (tanks) should be positioned on the non-hazard side of the building and have 65mm Storz outlet with a ball valve fitted to the outlet within the IPA. If not appropriate, they should be appropriately shielded to protect the tank and fire fighters accessing the water. Category 1 fire appliances should be able to access within 4 m of static water supply with a hardened ground surface to support this access.

All exposed water pipes, values, taps and fittings should be metal and the supply line from tank to ball valve have the same bore size.

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 Fire hose reels and installed in accordance with AS 2441:2005 Installation of fire hose reels.

Where static water supply is provided the following signage should be installed at the front gate and at a location that is clearly visible (assume smoke) to approaching emergency services to guide them to the static water supply.



Electricity, Gas supplies and Hazardous materials

The intent of electricity, gas and hazardous material measures is to locate these utilities and materials so as not to contribute to the risk of fire to a building.

Electricity

Location of electricity services should limit the possibility of igniting the surrounding bush land or the fabric of buildings. Where practicable, electrical transmission lines are underground. If overhead, electrical transmission lines are installed with short pole spacing (30m), unless crossing gullies, gorges, or riparian areas, then 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.

For further information visit https://www.electricitysafety.com.au/

Gas

Any reticulated or bottled gas should be installed and maintained according to the requirements of the relevant authorities and AS/NZS 1596:2014. All fixed gas cylinders are kept clear of all flammable materials to 10m and shielded on the hazard side. All above-ground pipes and connections to and from gas cylinders are metal, and polymer-sheathed flexible gas supply lines to gas meters adjacent to buildings are not permitted. Furthermore, if gas cylinders need to be kept close to the building, safety valves are directed away from the building and at least 2m away from any combustible material, so they do not act as a catalyst to combustion. Gas utilities should be positioned to not impede fire fighters accessing water supplies while undertaking suppression operations.

Hazardous Materials

Hazardous materials are any materials that can fuel the fire, such as leaf litter, grass, garden mulch and woodpiles. They can also be made up of solid combustibles or flammable liquids and gases such as petrol, kerosene, alcohol, LPG, natural gas, and acetylene. Vehicle, machinery, and other mechanical equipment that utilise fuels for operations can also be considered hazardous. The incorrect design and placement of carport and garages in residential developments could propagate fire towards the residential dwelling. Any liquids or fuels that are considered hazardous should be positioned away from the dominant bush fire threat. If located in a building/structure, it should be a minimum of 6m away from any other building. Vegetation surrounding these locations shall be maintained to IPA standards and the construction standards shall minimise the impact of ember attack to ignite the structure.

Construction Requirements

Groundwork and Sub-structure construction phase

During the ground phase potential ignition sources of the subject development may include hot works, incorrect disposal of cigarette butts and hot exhausts from vehicles, electrical failures, and sparks from metal contact.

Groundwork and Sub-structure construction phase fire management plan should be developed. Preparation of the site should include mitigating fire ignition sources. This should include vegetation management such as slashing and mowing long grasses in and around the development site, car parking and access tracks. This is especially important during summer months where Rates of Spread of fire can significantly increase due to the prevailing weather condition.

Handheld fire extinguishers should be carried on each vehicle and on site for quick access and suppression of fires.

Where neither reticulated water nor an existing static water supply is available during the construction phase, a temporary 10,000 litre Static Water Supply within proximity of the development site shall be provided before the commencement of any construction works. This temporary supply will allow for the replenishment of attending fire services which will facilitate the rapid suppression of any potential ignitions. The temporary supply may be removed when the prescribed fire-fighting water supply is installed.

Ongoing Operations

Routine inspections of bush fire safety systems and equipment generally occur annually and are supported by a Bushfire Plan. Ideally these inspections should occur moving out of the colder months in preparation for the bushfire season. The most common types of inspections that are required are surface, near surface (grasses and debris) and elevated (shrub) fire fuel level accumulation in APZs, canopy separation reequipments in APZs, and maintaining building fire hygiene such as cleaning gutters and down pipes.

Developing and annually reviewing a bushfire plan, no matter how big or small the development, is critical to the ongoing maintenance of the Bushfire Protection Measures identified within this report.

Construction Standards

Australian Standard 3959 ''Construction of buildings in bushfire-prone areas" provides for six (6) levels of building construction these being BAL - Low, BAL - 12.5, BAL - 19, BAL - 29, BAL - 40 and BAL - FZ. The Australian Standard 3959 specifies construction standards for buildings within various Bushfire Attack Levels as determined by the Planning for Bushfire Protection – 2019 document.

Retrofitting

Any future alterations, extension to structures, even if they are complying, should consider the appropriate bushfire construction standards at that time. Homes built prior to August 2002 were not required to be built to meet bush fire construction standards. Constructions in Bush fire prone lands after August 2002 required bush fire construction standards, which have also changed over time.

The current construction standards are based on your Bush fire Attack Level (BAL). Evidence from large wildfire events over the last 20 years illustrate that house ignition is concentrated within 100m from the vegetation, although it can occur kilometres from the burning vegetation under worst case scenarios. Developments outside the bush fire prone area (100m from the vegetation) will benefit from increasing construction standards to withstand ember-attack to protect the building during a bush fire event.

When undertaking alterations and additions to a dwelling in Bush fire prone land only the new construction is required to conform with the current requirements, although this only partially protects your home.

Research has illustrated that ember-attack from the wildfire is the principal mechanism that ignites homes. The most vulnerable elements are timber decks, Eave fascia boards, gutters timber window frames and timber stairs. Furthermore, house-to-house fires occur following the ignition of a neighbouring property. Appropriate amount of effort should be placed to ensure that vegetation and landscaping should be maintained to reduce the likelihood of ember attack igniting fire fuels near the house, and separation between neighbouring houses is achieved to reduce house-to-house fires. The use of non-

combustible fencing and appropriately positioned windows can go a long way to reducing the risk of house-to-house fires.

While retrofitting identifies available construction protection methods as per *AS3959 – Construction of buildings in Bushfire Prone Area*, **it should be clearly understood that such building enhancements are complementary to good site preparation and vegetation management in the context of the bushfire survival plan**.

Routine maintenance is an important part of bushfire protection for your home, out-buildings and garden. For example, if a window/door metal shutter is fitted, it needs to work at the time of a bushfire threat just like your fire equipment needs to be ready to go.

Each retrofitting measure is a step towards making your home safer against the impact of embers and radiant heat in the event of a bushfire. If you want your home to be comparable to the construction requirements under AS 3959, then *ALL* the works associated with a particular BAL category will need to be undertaken.

Some of the basic retrofitting that can be undertaken:

- Enclose existing sub floors with suitable materials or construct the floor and structure with non-combustible materials
- Cover, seal, overlap, back or butt-joint all joints in the external surface material of walls to prevent gaps greater than 2mm.
- Seal vents, weepholes, breathers and openings with metal screens of aperture <2mm.
- Replace flammable external walls with non- combustible materials.
- Apply sarking-type material (flammability index >5) over the outer face of the building frame prior to re-fixing of any external cladding.
- Screen all windows and doors with metal screens of aperture <2mm and metal frames.
- Establish weather strips, draught excluders or draught seals around doors and panel lift garage doors.
- Garage roller doors could have guide tracks with a maximum gap area of 3mm and be fitted with a nylon brush in contact with the door.
- Above-ground, exposed water, gutter downpipes and gas supply pipes should be metal.
- incorporate gutter guards with a flammability index more than 5 when tested to AS1530.2, or aluminium, bronze, or stainless steel with maximum aperture of 5mm.
- Only use Bushfire resisting timber as specified in AS 3959 Appendix F.

Further information can be found at Guide-retrofit-your-home-for-better-bushfire-protection.

Electric Vehicles (EVs)

EVs are an ever-growing part of the transport environment with government aims of EV vehicles dominating throughout the 2030's. There are a variety of different technologies, battery types, and chemistries in vehicles, e-scooter and e-bikes creating complexity on the risk of '*thermal runaway'*.

Thermal runaway is an unstable chemical process that begins when heat generated within a battery exceeds the amount of heat that is dissipated to its surroundings, which can lead to the battery catch fire. EV batteries tend to put out toxic fumes resulting in suppression difficulties.

Although the chances of batteries catching fire is relatively small <0.1%, approximately 1/3rd of fires occur during charging. the location of residential parking of Plug-in Hybrid Electric Vehicles (PHEVs) vehicles

should be considered when planning inconsideration of occupied buildings and extinguishment requirements.

Having a smoke/heat alarm, a F-500 (class A, B and F) Lithium-Ion Battery fire extinguisher in an open-air charging station (unenclosed building) that is location >6m from any building or flammable vegetation will significantly mitigate risk of a EV fire spreading.

Further information can be obtained at: https://www.evfiresafe.com/

Bushfire Emergency / Survival Plan

No matter how big or small the development is within a bush fire prone area, a bush fire plan is critical to preparing the property in the event of a bush fire. To ensure appropriate measures are taken, the worst-case scenario bush fire behaviour should be used to determine the course of action.

There is extreme noise, smoke, heat, and wind during the passing of a bush fire front under worst-case conditions. Vision, hearing, breathing, and communication are significantly affected during this period.

State bush fire authorities have established kits to help residential and small property owners to develop appropriate plans to plan and prepare for bush fire events. In NSW Bush fire survival Plans can be accessed from https://www.rfs.nsw.gov.au/plan-and-prepare/bush-fire-survival-plan.

The principal elements of the Bush fire survival Plans are:

- Know your risk.
- Know and understand the bush fire alert levels.
- Access to 'Fires Near Me' app.
- Knowledge of Local radio, local ABC/emergency broadcaster frequency, and TV.
- Prepare yourself, your home and your family.
- Leave early or prepare to stay.
    - If leaving, when to leave, where will you go, how will I get there, what will I take, who will you call, what is your back-up plan.
    - If you stay, do you have all the equipment you need, what are the signal to start defending the dwelling, what to do before, during and after the passing of the fire front, do all members of the household know what to do, check your equipment, develop action checklist, what is your back-up plan.
- Discuss all elements with your family and neighbours.

Furthermore, knowledge of escape routes (generally the public road system around your dwelling), refuges and location of any nearby Neighborhood Safer Places is critical knowledge prior to a bush fire event.

A bushfire emergency management and evacuation plans are prepared consistent with Australian Standard AS 3745:2010 Planning for emergencies in facilities. State agencies also have developed guidelines to facilitate the development of the documents and other Australian Standards are relevant for different development type. Bushfire emergency management and evacuation plans should be complemented with a Bushfire Management Plan (BMP).

A simple 4 step process can be undertaken to develop a basic bushfire emergency survival plan:

DISCUSS

STEP 1

DISCUSS WHAT TO DO IF A BUSH FIRE THREATENS YOUR HOME

Many households find that having a discussion over dinner works best as everybody is together and focussed.

Download the Step 1 discussion guide (PDF, 985.3 KB).

PREPARE

STEP 2

PREPARE YOUR HOME AND GET IT READY FOR BUSH FIRE SEASON

There are simple things you can do around your home to prepare it for a bush fire, like keeping the grass low and having a cleared area around your home.

Download the Step 2 checklist (PDF, 595.5 KB).

KNOW

STEP 3

KNOW THE BUSH FIRE ALERT LEVELS

If there is a fire in your area you will find its alert level on the NSW RFS website and in the 'Fires Near Me' app. You need to keep track of the alert level so you know what you should do.

Download Step 3 (PDF, 166.1 KB).

KEEP

STEP 4

KEEP ALL THE BUSH FIRE INFORMATION NUMBERS, WEBSITES AND THE SMARTPHONE APP

In a bush fire, it's important that you stay up to date on conditions in your area.

Download Step 4 (PDF, 219.1 KB).

Bushfire Management Plan

No matter how big or small the development is within a bushfire prone area, a bushfire plan is critical to preparing the property in the event of a bushfire. To ensure appropriate measures are taken, the worst-case scenario bushfire behaviour should be used to determine the course of action.

State bushfire authorities have established kits to help residential and small property owners to develop appropriate plans to plan and prepare for bushfire events. These can be accessed by contacting your local fire authority.

For larger development such as industrial, commercial and developments that accommodate vulnerable people, more comprehensive emergency management requirements and procedures should be developed.

At a minimum, the Bushfire Management Plan should illustrate the Bushfire Protection Measures (location and type of hazard (vegetation), defendable space, access, water, and construction standards) that will be implemented as part of the development to reduce the risk from bushfire to an acceptable level and should be clearly displayed within the property to ensure current occupants are aware of the bush fire risk.

Furthermore, the BMP can provide information that assists in wildfire suppression operations, such as:

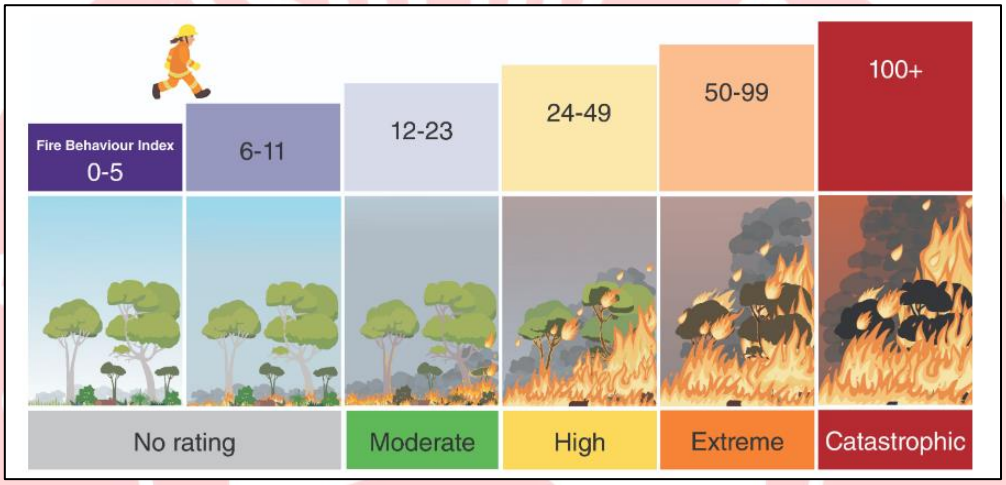
- 24/7 emergency contact details including alternative telephone contact.
- Location of site infrastructure and assets.
- Fire-fighting water supply plan.
- Site access and neighbour/ internal road plan.
- Identification of built, natural and cultural assets in and around the site.
- Emergency escape routes, refuges, and location of any nearby Neighbourhood Safer Places.
- Location of Fire Management Zone, specifically Asset Protection Zones.
- Location of hazards (Physical, Chemical and Electrical) that will impact on fire-fighting operations and procedures to manage identified hazards during fire-fighting operations.
- Aviation assets (helipads and aviation water supplies) and risks (powerlines).
- Fire history in and around the site, and
- Schedule of on-ground works and review and updating schedule.

Updated Australian Fire Danger Rating System

The principal objective of the new Australian Fire Danger Rating System (AFDRS) is to implement a more accurate and nationally consistent system that will enable improved decision-making by response agencies and industry and provoke the desired community response to messaging in order to improve public safety. More information at https://www.rfs.nsw.gov.au/news-and-media/newfdr and eLearning at https://www.afac.com.au/initiative/afdrs/afdrs-training .

The AFDRS uses the latest scientific understanding about weather, fuel and how fire behaves in different types of vegetation to improve the reliability of fire danger forecasts. This strengthens the ability of those working in emergency services to be better prepared, make improved decisions, and provide better advice to the community.

It is aimed at a simplified, action-oriented Fire Danger Rating System.



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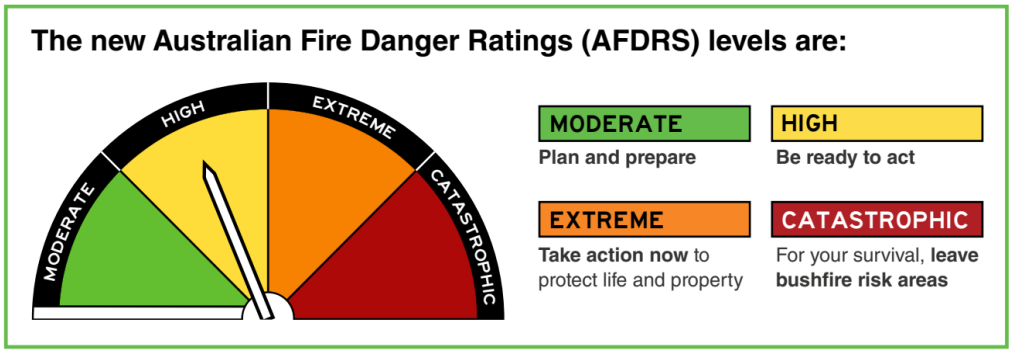

Accessed from AFAC: https://www.afac.com.au/initiative/afdrs/afdrs-faqs

MODERATE: *Plan and Prepare* - Have a plan and be ready to act if a fire starts.

HIGH: *Be ready to act* - Be alert for fires in your area and be ready to leave or be ready to defend.

EXTREME: *Take action* - Act before a fire starts.

CATASTROPHIC: *Leave high risk areas* - Protect your life, leave early.