ASSET PROTECTION ZONE ANALYSIS

Maslin Close and Seascape Drive, Redhead, NSW

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Title	APZ Analysis			
Description	Asset Protection Zone Analysis – Maslin Close and Seascape Drive, Redhead			
Created By	Duncan Scott-Lawson			
	T: +61 408 667 137 E: duncan@emconsultancy.com.au			
Prepared For	Mid-Coast Council			
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Table 1 Planning for bushfire protection compliance (PBP 2019)
Extract Chapter 6a - SFPP developments on bushfire prone lands

	PERFORMANCE CRITERIA	ACCEPTABLE SOLUTION	COMPLIANCE
APZs	APZs are provided commensurate with the construction of the building and defendable space is provided	• An APZ is provided in accordance with Tables A1.12.2 or A1.12.4 in Appendix 1 of PBP 2019.	**Performance solution – Method 2 calculations**
	APZs are managed and maintained to prevent the spread of a fire towards the building	• APZs are managed in accordance with the requirements of 'Asset protection zone standards' of Appendix 4 of PBP 2019. •	**Made Condition**
	The APZ is provided in perpetuity APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is minimised.	• APZs are wholly within the boundaries of the development site • APZ are located on lands with a slope less than 18 degrees	**Acceptable Solution**

1 INTRODUCTION

BEMC Pty Ltd was engaged by Mid Coast Council to complete an analysis of the Asset Protection Zones private properties along Maslin Close and Seascape Drive, Redhead associated with council reserve within Lot 81 DP1096579 and Lot 271 DP1152386, hereafter referred to as the 'site' (**Figure 1**).

The identification of Bushfire Prone Areas (BPA) in NSW is required under section 10.3 of the *Environment Planning and Assessment Act 1979* (EP&A Act). Section 4.14 of the EP&A Act requires developments to comply with NSW Rural Fire Service, PBP 2019 if any part of a development site is affected by bush fire hazard as indicated within the BPA Map. This area falls within the Bushfire Vegetation Buffer zone on the Mid Coast Council Bushfire Prone Land Map.

In accordance with the conditions of consent for DA 208-9-2004 a Fuel Management Strategy, Koala Plan of Management and Vegetation management & Riparian Plan was developed

- The Fuel Management Strategy for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006 provides '*a 20 metres Asset Protection Zone consisting of 6 metres within the affected private lots and 14 metres within the adjoining reserve land, however in several situations the composition of the asset protection zones are reversed and 14 metres falls within the lots and 6 metres within the adjoining reserve*'.
- The Koala Plan of Management for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006 provides '*a range of measures for the consideration of Koala management and maintenance of Koala habitat connectivity within the locality*'.
- The Vegetation management & Riparian Plan for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006 provides '*appropriate revegetation, bush regeneration to fine-tune the riparian rehabilitation for the best possible environmental outcomes*'.

Since the completion of the subdivision, residential development continues to occur and community actions and local landcare groups together with Mid-Coast Council have been implementing the Vegetation management & Riparian Plan.

A bushfire Asset Protection Zone analysis has been performed in November 2021 to determine if the Asset Protection Zones identified within the Fuel Management Strategy remain applicable.

Performance-based approach utilising contemporary scientific and evidence-based fire behaviour research applied through Appendix B of *Australia Standard 3959:2018 Construction of Buildings in Bushfire Prone Areas* is implemented to determine the separation to achieve a BAL 29 construction standards, which forms the Asset Protection Zones.

1.1 Objectives of Assessment

This assessment has been undertaken to inform the client of the separations (Asset Protection Zone) required to achieve a BAL29 construction standard in consideration of the requirements of s4.14 of the *Environmental Planning and Assessment Act* 1979, *Rural Fire Act* 1997, PBP 2019 and AS 3959-2018.

The report assesses to requirements of the development to meet four (4) of the six (6) objectives listed in section 1.1 of PBP 2019, which provide for the protection of human life and minimize impacts on property.

- Afford buildings and their occupants protection from exposure to a bushfire.
- Provide for a defendable space to be located around buildings.
- Provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent the likely fire spread to buildings, and
- Provide for ongoing management and maintenance of Bush fire Protection Measures (BPMs).

1.2 Method 2 assessment pathway

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

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

Understanding the knowledge gaps for bushfire prediction is required to enable accurate interpretation of bushfire modelling and fire engineering calculations used through the detailed assessment (Method 2). 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 should be analysed to determine its effect on the outputs for the calculations.

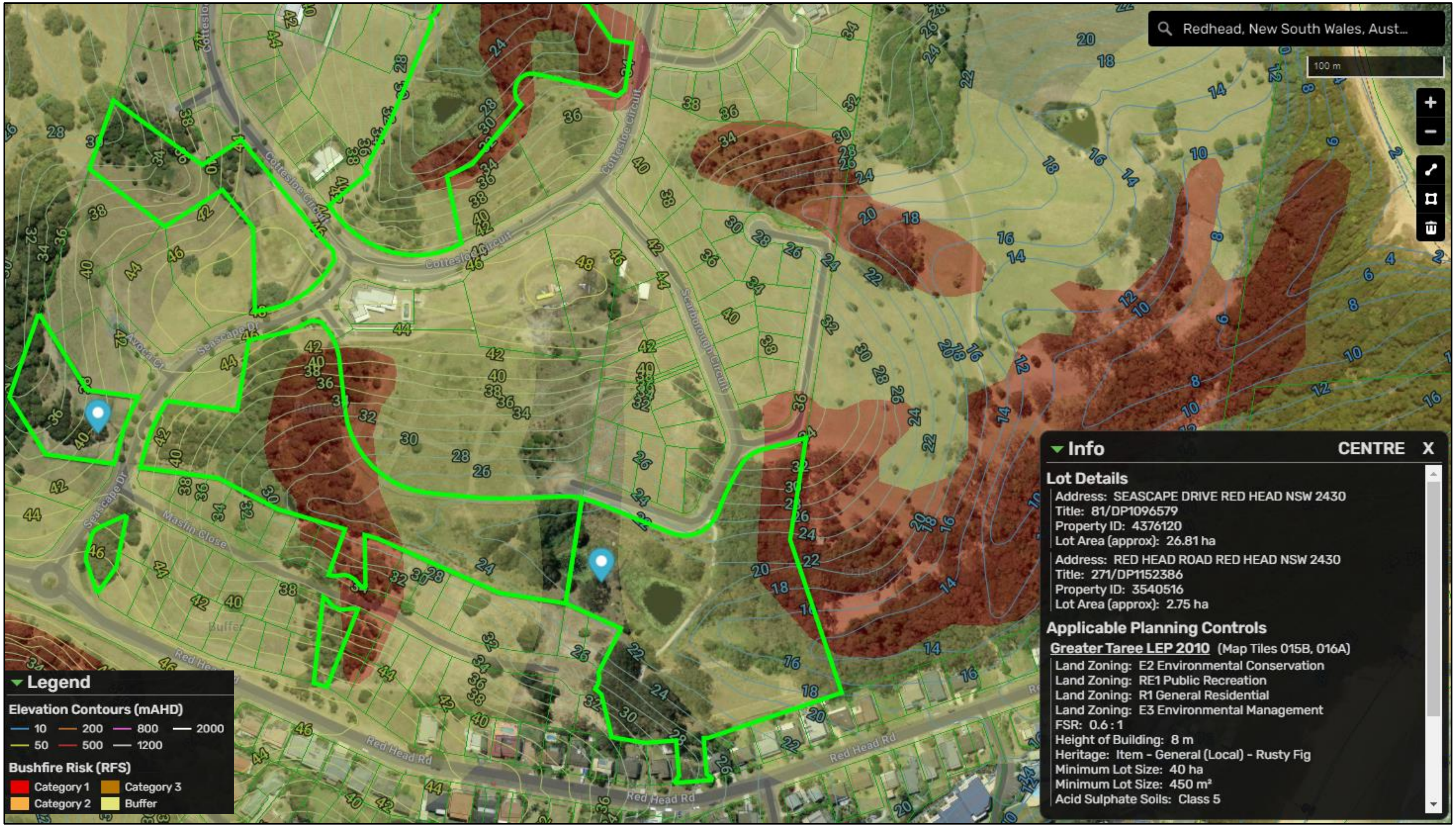

Figure 1 Site Location of council reserve within Lot 81 DP1096579 and Lot 271 DP1152386, Redhead, NSW (Mecone Mosaic, 2021)

2 BUSHFIRE HAZARD ASSESSMENT

This section details the site assessment methodology in Appendix 1 of PBP2019. It provides detailed analysis of the vegetation, slope, exclusions, vegetation downgrades and shielding elements to provide the required Bush fire Protection Measures.

2.1 FIRE DANGER INDEX

Method 2 assessment considers the worst-case scenario for bushfire impacts and calculates fire behaviour determined from specific inputs. This assessment utilises council area FFDI 80.

The fire runs have been chosen are from the west, north-west and north to demonstrate worst-case scenario fire weather conditions.

2.2 ASSESSMENT METHODOLOGY

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

- Aerial Photograph Interpretation to map the vegetation classification and extent.
- Kogan 6*25 Laser distance finder.
- Photo Theodolite application supported by contour and terrain profiles.
- On site vegetation assessment (September 2021) and
- Reference to regional vegetation community mapping.

The classified vegetation, separations, effective and site slope are identified in **Table 2** and displayed in **Figure 4**.

2.3 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 bushfire 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 Bushfire Dynamics and Applications. The results of this research are commonly referred to as the '*NSW Comprehensive Fuel Loads'*.

SEED Portal - Sharing and Enabling NSW Environmental Data portal and regional vegetation community mapping has been analysed to determine the vegetation in and around the development which is illustrated in **Figure 2**.

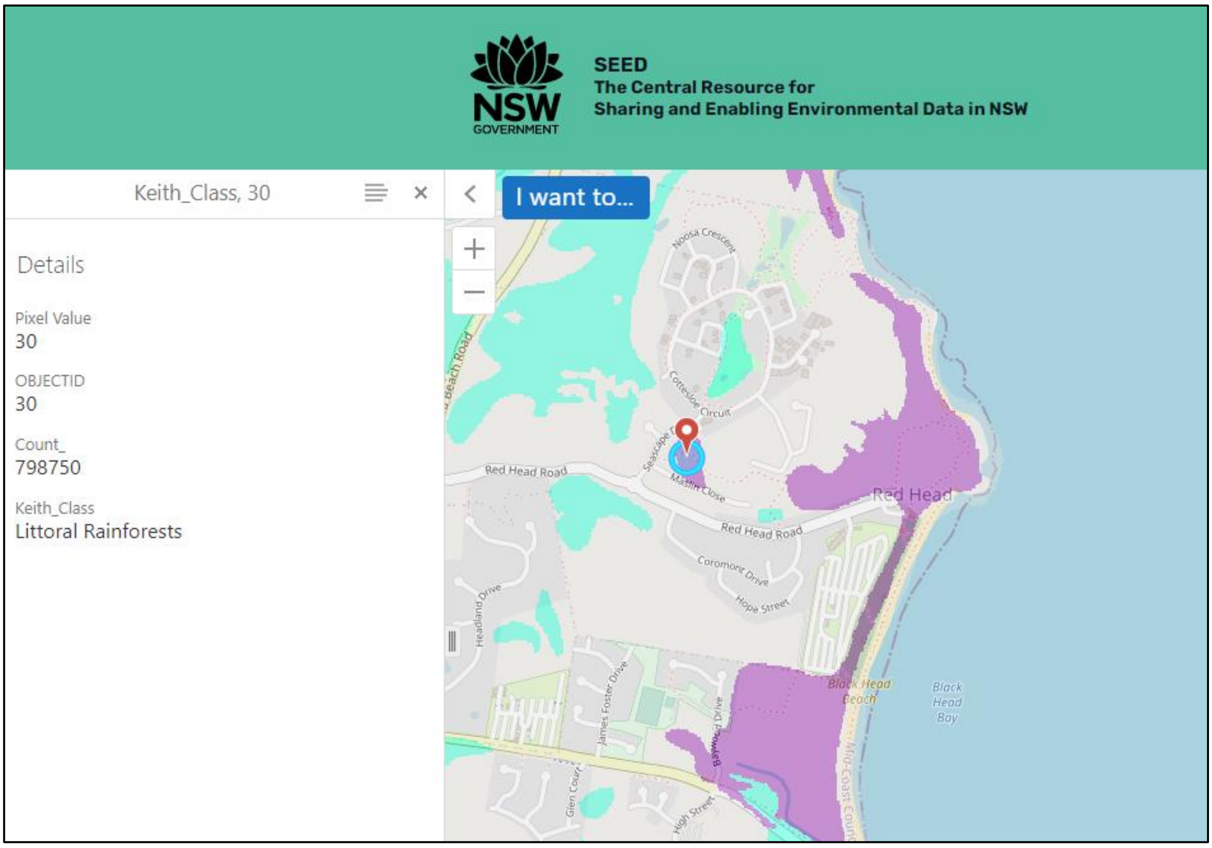

Figure 2 Extract from SEED portal (2021)

2.3.1 Vegetation classification, exclusions, and downgrades

The size and shape of small areas of vegetation influences the behaviour of bush fires and the associated risk to the built environment. Small or narrow parcels of vegetation have less opportunity to support fully developed bush fires because of their limited size. Modified landscapes, coastal wetlands and riparian areas vary significantly in structure and composition, but are generally considered as bush fire hazards, except for saline wetlands. Non-hazard and non-vegetated area are not required to be considered for the purposes of PBP 2019.

Anecdotal evidence obtained from previous fire events indicates that exotic vegetation species (weed species) support intense surface fires. Under adverse fire weather conditions these plants can contribute to the intensity of bush fires due to additional fuel loads. Exotic vegetation species display similar fire behaviour characteristics to some native vegetation classifications with lower fuel loads. Table A1.9 of PBP 2018 can be used to convert the Exotic vegetation to native vegetation formations and fuel loads. Where a mixture of exotic and native vegetation exists, the native vegetation fuel loads will apply.

The vegetation with Lot 81 DP1096579 and Lot 271 DP1152386 is restricted by residential development and managed lands and consists of littoral Rainforest species, dams and associated riparian vegetation. These restrictions have been considered with the fire behaviour analysis and are indicated within **Table 2**.

2.3.2 Predominant Vegetation Classification

Vegetation in and around the site is classified *Northern Hinterland Wet Sclerophyll Forest* and *Littoral Rainforest* in accordance with the '*NSW Comprehensive Fuel Loads'.*

2.4 Separation Assessment

Measuring the distance between the proposed building envelop and bushfire threat (vegetation) provides one of the Bushfire Protection Measures (BPMs) to reduce the risk from bushfire attack. The land within the separation must conform to the standards of an Asset Protection Zones to be accepted within the separation areas.

The Fuel Management Strategy for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006 applies '*a 20 metres Asset Protection Zone consisting of 6 metres within the affected private lots and 14 metres within the adjoining reserve land, however in several situations the composition of the asset protection zones are reversed and 14 metres falls within the lots and 6 metres within the adjoining reserve'.*

The current Asset Protection Zones provided a private lot adjoining to Lot 81 DP1096579 along Maslin Close and Seascape Drive have a 6m APZ on private lots and 14m within council managed land and the two private lots adjoining Lot 271 DP1152386 Maslin Close has a 14m APZ on private lots and 6m within council managed land.

The separation to achieve BAL 29 construction standards is measured maintaining the APZ on private property.

2.5 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.

2.6 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 effective slope has been calculated utilising photo Theodolite application and confirmed through contour slope analysis. The site slope varies from upslope and down slope from the bushfire hazard. To provide consistency with the analysis across different lots the site slope has been assessed as' level' with the elevation of the receiver increased to 6m (double storey building) to ensure the peak radiation is considered.

2.7 Short Fire Run and Restricted head growth

NSW RFS Rural Fire Service (2019a). Short Fire Run - Methodology for Assessing Bush Fire Risk for Low-Risk Vegetation demonstrates the size and shape of a bush fire hazard will influence the behaviour of bush fire and the associated risk to the built environment. Small or narrow parcels of vegetation have less opportunity to support fully developed bush fires because of their limited size. These areas are referred to in this document as a Short Fire Run (SFR) or Restricted Head Growth (RHG).

The SFR and RHG fire calculates the head width and flame length to determine the radiant heat likely to impact a building. The proposed model relies on several assumptions to calculate the modified fire shape and flame height, these are:

- Wind direction and speed is constant in the direction of fire spread.
- Slope is considered relatively flat and uniform throughout the length of the fire run.
- Fuel load is distributed equally and is continuous for the entire fire run length.
- The shape of the fire is based on a uniform slope.
- The fire develops from a single ignition point and does not consider time of ignition or fire growth.
- Flaming is restricted to surface, near surface and elevated fuels.
- The fire does not become a crown fire (scorching and intermittent involvement of the canopy fuels permitted, no sustained crown fire). A nominal fire run of 150 metres has been assumed as is measured on the effective slope.
- Fire run is measured perpendicular to contours, and
- No allowance for ember showers has been considered.

Restricted Head Growth Analysis has been performed on the Transects impacted on by managed lands.

2.8 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.

2.9 OTHER METHOD 2 INPUTS

Heat of Combustion

Heat of Combustion (HoC) is an important characteristic I the simulation of wildfires. It is frequently used in the assessment of fuel flammability and 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 illustrate that fuel moisture content has a significant impact of HoC and argue that lowering the current default heat of combustion of 18600 kJ/kg in forest fire behaviour models.

Flame Emissivity

AS3959:2018 indicates a nominal flame emissivity of 0.95 is justified as the bushfire flames under design fire weather scenarios are generally optically thick ($\varepsilon \approx 1$). The predicted flame emissive power is very 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.

Moisture Factor

Fuel moisture factor is only used in Marsden–Smedley *et al*, (1995) fire model for Tussock Moorland, and is default to 5. This input has no effect on fire modelling calculations in other vegetation.

Ambient temperature and Relative Humidity

The default value for ambient air temperature during worst-case scenario fire weather conditions defaults to 35°, 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 bushfire threats a from directions other than the north, north-west, and west the ambient temperature and relative humidity can significantly change, especially in coast environments.

2.10 TRANSECT ANALYSIS

Transect 1

Transect 1 runs upslope from the west within *Northern Hinterland Wet Sclerophyll Forest* with continuity to forests to the west and is restricted by residential land use to the north and south. Direct fire run from the north-west is possible with worst-case scenario weather conditions.

Transect 2

Transect 2 runs downslope from the west within *Northern Hinterland Wet Sclerophyll Forest* separated from transect 1 by 20m associated with Seascapes Drive and is restricted by residential land use to the north and south.

Transect 3

Transect 3 runs downslope from the north within *Littoral Rainforest* and is restricted by residential land use to the west and managed lands to the east. There is no continuity with bushfire hazardous vegetation to the north, and point ignition is the likely ignition potential.

Transect 4

Transect 4 runs downslope from the north-west within *Littoral Rainforest* and is not restricted with full head growth possible during worst-case scenario weather conditions.

Transect 5

Transect 5 runs upslope from the west within *Littoral Rainforest* and is restricted by residential land use to the north and south, and dams embedded within the vegetation. Direct fire run from the west is possible with worst-case scenario weather conditions, although the high moisture content of the littoral vegetation and associated soil moistures will restrict fire behaviour.

Plate 1 Effective slope Transect 1

Plate 2 Effective slope Transect 2

Plate 3 Effective slope Transect 3

Plate 4 Effective slope Transect 4

Plate 5 Effective slope Transect 5

Plate 6 Current condition of APZ E, note wooden fence line

Plate 7 Current condition of APZ A, note wooden fence line

Plate 8 Current condition of APZ D, note wooden fence line

Plate 9 Current condition of APZ F, note wooden fence line

Plate 10 Current condition of western end of APZ G, note seedling plantings

Plate 11 Example of Excluded vegetation

Plate 12 Restricted fire growth associated with the western end of APZ G

Plate 13 Residential development along Maslin Close

Table 2 Bushfire Hazard Assessment (Method 2 AS3959:2018)

Elements	Method (unit)	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
Vegetation (Keith 2004)	NSW Comprehensive Fuel Loads	NH WSF	NH WSF	Littoral	Littoral	Littoral
Site slope	Site visit – Theodolite (°)	Level	Level	Level	Level	Level
Effective slope	Site visit – Theodolite (°)	8 deg down	7 deg up	6 deg up	1 deg up	1 deg up
Shielding Width	Site Plans / Site Visit (m)	N/A	N/A	N/A	N/A	N/A
Shielding Height	Site Plans / Site Visit (m)	N/A	N/A	N/A	N/A	N/A
Elevation of receiver	Site Plans (m)	6	6	6	6	6
Flame temperature	1090 / 1200 Kelvin	1090	1090	1090	1090	1090
Upslope fire	Kataburn correction	No	Yes	Yes	Yes	Yes
Fire Danger Index	Council derived	80	80	80	80	80
Heat of Combustion	Default at 18600 kJ/kg	18600	18600	18600	18600	18600
Flame Emissivity	Default at 0.95	0.95	0.95	0.95	0.95	0.95
Moisture Factor	Default at 5	5	5	5	5	5
Ambient temperature	BoM (Default at 308 Kelvin)	308	308	308	308	308
Relative Humidity	BoM (Default at 25%)	25	25	25	25	25
OUTPUTS (Appendix 2)						
	Separation to Achieve BAL 29	21m	13m	3m	8m	8m

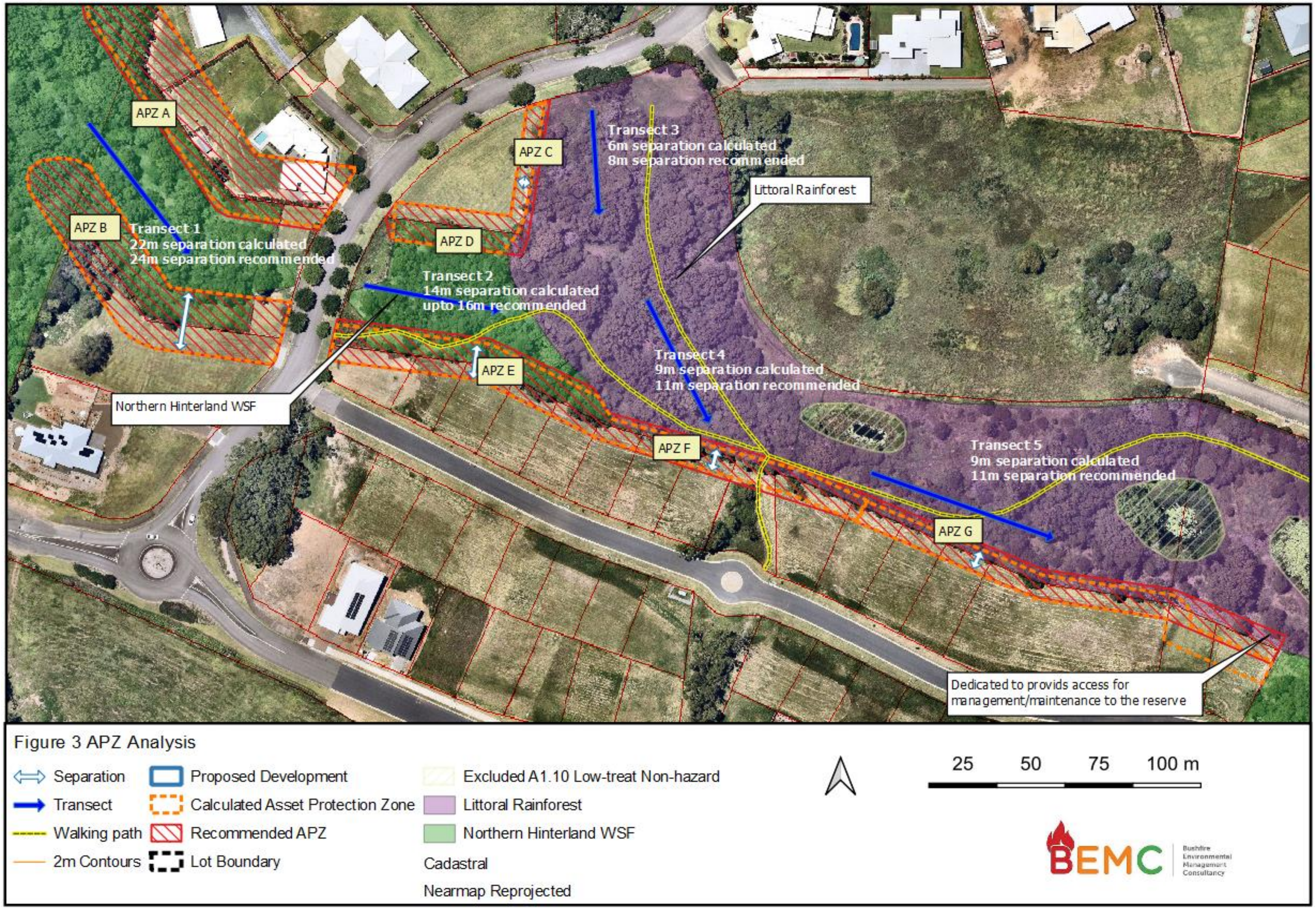

Figure 3 APZ Analysis

3 PERFORMANCE-BASED ASSESSMENT

This section assesses performance-based measures to mitigate bushfire risk and the requirement to meet the setbacks for residential developments for the proposed development in consideration of the acceptable solutions required for Assets Protection Zones each in Table 6.8a of PBP 2019.

3.1 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 due to lower radiant heat exposure. 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.

Metal fencing, although non-combustible, is a poor radiant heat shield, as it will emit radiation once heated.

This performance measure will only be effective if a masonry wall is constructed no less that 5m in height to achieve a reasonable reduction is radiant heat load to reduce the APZ within Lot 28 and 29 DP252725 & Lot 12 DP878230.

3.2 WATER SPRAY SYSTEMS

Australian Standard (AS) 5414 'Bushfire water spray systems' was published in 2012 to provide standards for the application of external sprinklers to protect buildings from low level radiant heat exposure and ember attack. The standard provides for design of the system elements such as nozzle, pressures, spacing, piping, signage, water supply, testing and maintenance.

Bushfire Sprinkler/Spray Systems (BSS) assist in the protection of assets by:

- Hydrating potential fuels, thus making them less susceptible to ignition.
- Increasing humidity immediately adjacent to the asset, and
- Creating a cooler microclimate around the assets.

Research following major bushfire incidences over the last 20 years have demonstrated that ember attack as the predominant ignition mechanism for most houses destroyed in bushfire. The house generally survives the passage of a fire front but burn down during the following hours either due to direct ember attack or by attack from surrounding elements that were ignited by an ember attack. Radiant heat exposure, igniting fabric of the building followed as the next bushfire attack mechanism that caused housing loss. Glazing is the dominate building component that fails during radiant heat exposure. Glazing breaks easily when exposed to fire, which creates two types of thermal stresses: membrane and bending (Kim *et al.* 1998). The application of a BSS needs to:

- Mitigate ember attack (through removing the heat from the ember through conduction to a level that the ember is unable to ignite building elements), and
- Reducing exposure to vulnerable building fabric of the house through removing radiant heat from the fire.

AS 5414 provides prescription for BSS, although limitation exist within this standard. The application of BSS is relatively new, based on experimental results, with limited post-fire assessment available.

This lack of evaluation of BSS performance within bushfires scenarios creates a vacuum of knowledge concerning the application of this bushfire protection measure. Some of the known failures of BSS are:

- Inappropriate system.
  - System does not activate.
  - Water does not reach the fire.
  - Not enough water release at correct droplet size.
- Faulty construction.
- Damage component during fire event.
- Lack of maintenance.

Wang and Wang (2016) indicate that with recent development in sprinkler technology, BSS are become more acceptable if targeted directly to protect the most vulnerable building elements, being the windows.

Water spray systems are considered a last resort with increases success when placed on the building directly protecting the glazing. In this case, placing a water spray system on the fence to suppress wildfires within Lot 81 DP1096579 and Lot 271 DP1152386 is not considered an effect fire suppression mechanism.

3.3 Access

Access along the boundary of Lot 81 DP1096579 and Lot 271 DP1152386 will facilitate land management programs, such as weed, pest animal, APZ management and maintenance of boundary fencing infrastructure. To ensure management of the APZ can be completed effectively and efficiently mechanic access is required.

APZ G provides both asset protection and ensures access to the reserve for management and maintenance is provided from the east.

The width of the APZ has been considered to ensure pragmatic management of the land use can be achieved. Existing walking tracks and gates shall remain within Lot 81 DP1096579 and Lot 271 DP1152386 to facilitate access for management purposes.

3.4 Redundancies

When implementing fire engineering solutions, designs should incorporate sensitivity analysis, redundancies to compensate for uncertainties, potential failures of components of the design.

In the wildfire environment fluctuations in weather, vegetation fuel loads, fuel and soil moisture degradation of construction levels and materials over time call all impact on the certainty of the calculations.

To ensure the recommendations within this report will mitigate risk to acceptable levels a sensitivity analysis with redundancies have been included.

3.5 Burning Fuel Reduction

The application of fire to reduce fuel loads is an effective temporary measure to protect the built environment. The effect of a prescribed burn is between 3 to 5 years, dependant on growth rates post treatment.

Prescribed burning in certain vegetation communities can also be used as an ecological management tool to facilitate rejuvenation and growth. Burning within rainforest vegetation is not recommended. A prescribed burn could be considered for ecological outcomes within the Northern Hinterland Wet Sclerophyll Forest when ecological values will benefit from a low to moderate intensity burn. Canopy height of 8m is required to ensure canopy scorch does not kill sub-adult canopy species.

Although prescribed burning is a tool to mitigate bushfire risk, it is not recommended a principal risk mitigation tool within this scenario.

4 ASSET PROTECTION ZONE ASSESSMENT

This section assesses performance-based measures to mitigate bushfire risk and the requirement to meet the setbacks for residential developments for the proposed development in consideration of the acceptable solutions required for Assets Protection Zones each in Table 6.8a of PBP 2019

4.1 APZS ARE PROVIDED COMMENSURATE WITH THE CONSTRUCTION OF THE BUILDING AND DEFENDABLE SPACE IS PROVIDED.

The APZs are not provided in accordance with Tables A1.12.2 or A1.12.4 in Appendix 1 of PBP 2019. A performance-based assessment in accordance with Appendix B of *AS3959:2018 Construction of Buildings in Bushfire Prone Areas* has been completed. The results of this analysis are provided in **Table 2**.

The APZ are provided to accommodate a BAL 29 Construction standard at the 6m private property APZ.

Ecological assessment is required to determine the appropriate amount of vegetation clearing within the APZ. The remaining vegetation must comply with Inner Protection Area Standards of PBP 2019 (provided in **Appendix 2** of this report).

4.2 APZS ARE MANAGED AND MAINTAINED TO PREVENT THE SPREAD OF A FIRE TOWARDS THE BUILDING

The vegetation management & Riparian Plan for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead shall be updated to ensure any revegetation within the accepted APZ within Lot 28 and 29 DP252725 & Lot 12 DP878230 comply with Inner Protection Areas requirements of Appendix 4 of PBP 2019 (provided in **Appendix 2** of this report).

4.3 THE APZ IS PROVIDED IN PERPETUITY APZ MAINTENANCE IS PRACTICAL, SOIL STABILITY IS NOT COMPROMISED AND THE POTENTIAL FOR CROWN FIRES IS MINIMISED.

The APZ is not locate on slope greater than 18 degrees and is within boundaries identified with the Fuel Management Strategy for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006

5 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 to determine the separation distance to achieve BAL29 construction level within private property associated with Lot 28 and 29/DP252725 & Lot 12/DP878230.

Redundancies in the separations and consideration of access, defendable space and operational area are accounted in the recommended APZ within Lot 81 DP1096579 and Lot 271 DP1152386. Furthermore, these APZ are should only be applied when IPA and landscaping features comply with PBP 2019, specifically:

- All wooden fencing shall be removed when becomes non-functional or unsafe. If replaced, shall be with non-combustible fencing.
- No class 10 buildings permitted within 6m of a class 1a building in the adjacent private property.
- All landscaping features (including walking track) within the APZ on Lot 81 DP1096579 and Lot 271 DP1152386 and adjacent private property comply with PBP 2019.
- The extent of the APZ within Lot 81 DP1096579 and Lot 271 DP1152386 be clearly marked to ensure vegetation creep does not occur over time.
- The APZ on private lots 545 and 546 /DP1276749 be reduced to be consistent with the adjoining lots, as the calculated radiant heat level is consistent throughout. An APZ of 6m should be applied within lots 545 and 546 /DP1276749.

APZ location	APZ required on Council Lands	APZ required on PP
APZ A	7m	17m
APZ B	14m	10m
APZ C	2m	6m
APZ D	8m	6m
APZ E	10m	6m
APZ F	5m	6m
APZ G	5m	6m

Recommendations made within this report shall be reflected in amendments to:

- Fuel Management Strategy for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006.
- Koala Plan of Management for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006.
- Vegetation management & Riparian Plan for Lot 28 and 29 DP252725 & Lot 12 DP878230 Figtree Hill Estate Redhead Road, Redhead developed by Conacher Travers Environmental Consultants (2004) amended March 2006.

Furthermore, condition of consent of future s4.14 EP&A Act development applications for Class 1a developments on the private property lots adjacent to 81 DP1096579 and Lot 271 DP1152386 shall restrict the establishment of class 10a structures within the 6m IPA to the rear of the property.

References

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

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APPENDIX 1 STUDY SITE


Development Application Imminent
Development Application Imminent
Development Application Imminent
Subject to re-planting in accordance with Figure 4
Subject to re-planting in accordance with Figure 4
Original plan produced in A3 colour
Legend
Property Boundary
Asset Protection Zone
Waterbody
Watercourse
Management Treatment
Maintained as Inner Protection Area (in accordance with PBP, 2001)
Mown by Ride-On Mower / Slasher (to maintain area as Group 3 vegetation category)
Slashed by Tractor / Slasher (to maintain area as Group 3 vegetation category)
Burnt in accordance with ecological requirements (aprox. 8-30 year rotation)
No treatment required (Riparian Protection)
Note:
Management Zones to be managed in accordance with the Vegetation Restoration and Riparian Management Plan (Conacher Travers, 2003)
50 0 50 100 150 metres
Scale 1:4,000
N
CONACHER TRAVERS
Bushfire & Environmental Consultants
Old Sydney Town, Pacific Highway
Somersby NSW 2250
Ph (02) 4340 0677 Fax (02) 4340 2367
e-mail: ecology@conachertravers.com.au
Ver.F3
05/08/04
Ref.No.2435
Figure 3
Fuel Management Treatments
"Figtree Hill Estate"
Lot 28 & 29 DP252725 & Lot 12 DP878230 Redhead Road, Redhead
Source: Degotardi, Smith & Partners Pty. Ltd

APPENDIX 2 METHOD 2 OUTPUTS

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 1/12/2021 **Assessment Date:** 1/12/2021

Site Street Address:	Maslin Close and Seascape Drive, Redhead		
Assessor:	Duncan Scott-Lawson; BEMC		
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: Transect 1

Vegetation Information

Vegetation Type:	Northern Hinterlands WSF (Grassy)		
Vegetation Group:	Wet Sclerophyll Forests (Grassy)		
Vegetation Slope:	8 Degrees	**Vegetation Slope Type:**	Downslope
Surface Fuel Load(t/ha):	20	**Overall Fuel Load(t/ha):**	33.1
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):	6	**APZ/Separation(m):**	22

Fire Inputs

Veg./Flame Width(m):	18	**Flame Temp(K):**	1090

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	316
Moisture Factor:	5	**FDI:**	80

Program Outputs

Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	7.89
Radiant Heat(kW/m2):	24.12	**Flame Angle (degrees):**	35
Flame Length(m):	25.65	**Maximum View Factor:**	0.379
Rate Of Spread (km/h):	3.33	**Inner Protection Area(m):**	14
Transmissivity:	0.838	**Outer Protection Area(m):**	8
Fire Intensity(kW/m):	57026		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	18	21	25	29	38	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 1/12/2021 **Assessment Date:** 1/12/2021

Site Street Address: Maslin Close and Seascape Drive, Redhead

Assessor: Duncan Scott-Lawson; BEMC

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: Transect 2

Vegetation Information

Vegetation Type:	Northern Hinterlands WSF (Grassy)		
Vegetation Group:	Wet Sclerophyll Forests (Grassy)		
Vegetation Slope:	7 Degrees	Vegetation Slope Type:	Upslope
Surface Fuel Load(t/ha):	20	Overall Fuel Load(t/ha):	33.1
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):	6	APZ/Separation(m):	14

Fire Inputs

Veg./Flame Width(m):	36	Flame Temp(K):	1090

Calculation Parameters

Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	316
Moisture Factor:	5	FDI:	80

Program Outputs

Level of Construction:	BAL 29	Peak Elevation of Receiver(m):	5.1
Radiant Heat(kW/m2):	24.39	Flame Angle (degrees):	63
Flame Length(m):	11.67	Maximum View Factor:	0.383
Rate Of Spread (km/h):	1.18	Inner Protection Area(m):	7
Transmissivity:	0.838	Outer Protection Area(m):	7
Fire Intensity(kW/m):	20257		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	10	13	17	23	32	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 1/12/2021 **Assessment Date:** 1/12/2021

Site Street Address: Maslin Close and Seascape Drive, Redhead

Assessor: Duncan Scott-Lawson; BEMC

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: Transect 3

Vegetation Information

Vegetation Type:	Rainforest		
Vegetation Group:	Forest and Woodland		
Vegetation Slope:	6 Degrees	Vegetation Slope Type:	Upslope
Surface Fuel Load(t/ha):	10	Overall Fuel Load(t/ha):	13.2
Vegetation Height(m):	2	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope:	0 Degrees	Site Slope Type:	Level
Elevation of Receiver(m):	6	APZ/Separation(m):	6

Fire Inputs

Veg./Flame Width(m):	75	Flame Temp(K):	1090

Calculation Parameters

Flame Emissivity:	95	Relative Humidity(%):	25
Heat of Combustion(kJ/kg	18600	Ambient Temp(K):	316
Moisture Factor:	5	FDI:	80

Program Outputs

Level of Construction:	BAL 29	Peak Elevation of Receiver(m):	2.52
Radiant Heat(kW/m2):	21.89	Flame Angle (degrees):	82
Flame Length(m):	5.71	Maximum View Factor:	0.334
Rate Of Spread (km/h):	0.63	Inner Protection Area(m):	6
Transmissivity:	0.862	Outer Protection Area(m):	0
Fire Intensity(kW/m):	4328		

BAL Thresholds

	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	3	3	8	14	24	6

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 1/12/2021 **Assessment Date:** 1/12/2021

Site Street Address: Maslin Close and Seascape Drive, Redhead

Assessor: Duncan Scott-Lawson; BEMC

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: Transect 4

Vegetation Information

Vegetation Type:	Rainforest		
Vegetation Group:	Forest and Woodland		
Vegetation Slope:	1 Degrees	**Vegetation Slope Type:**	Upslope
Surface Fuel Load(t/ha):	10	**Overall Fuel Load(t/ha):**	13.2
Vegetation Height(m):	2	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope:	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m):	6	**APZ/Separation(m):**	9

Fire Inputs

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

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	316
Moisture Factor:	5	**FDI:**	80

Program Outputs

Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	3.38
Radiant Heat(kW/m2):	23.92	**Flame Angle (degrees):**	75
Flame Length(m):	7.41	**Maximum View Factor:**	0.369
Rate Of Spread (km/h):	0.9	**Inner Protection Area(m):**	9
Transmissivity:	0.852	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	6111		

BAL Thresholds

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

NBC Bushfire Attack Assessment Report V4.1

AS3959 (2018) Appendix B - Detailed Method 2

Print Date: 1/12/2021 **Assessment Date:** 1/12/2021

Site Street Address: Maslin Close and Seascape Drive, Redhead

Assessor: Duncan Scott-Lawson; BEMC

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: Transect 5

Vegetation Information

Vegetation Type:	Rainforest		
Vegetation Group:	Forest and Woodland		
Vegetation Slope:	1 Degrees	**Vegetation Slope Type:**	Upslope
Surface Fuel Load(t/ha):	10	**Overall Fuel Load(t/ha):**	13.2
Vegetation Height(m):	2	Only Applicable to Shrub/Scrub and Vesta	

Site Information

Site Slope:	0 Degrees	**Site Slope Type:**	Level
Elevation of Receiver(m):	6	**APZ/Separation(m):**	9

Fire Inputs

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

Calculation Parameters

Flame Emissivity:	95	**Relative Humidity(%):**	25
Heat of Combustion(kJ/kg	18600	**Ambient Temp(K):**	316
Moisture Factor:	5	**FDI:**	80

Program Outputs

Level of Construction:	BAL 29	**Peak Elevation of Receiver(m):**	3.38
Radiant Heat(kW/m2):	23.92	**Flame Angle (degrees):**	75
Flame Length(m):	7.41	**Maximum View Factor:**	0.369
Rate Of Spread (km/h):	0.9	**Inner Protection Area(m):**	9
Transmissivity:	0.852	**Outer Protection Area(m):**	0
Fire Intensity(kW/m):	6111		

BAL Thresholds

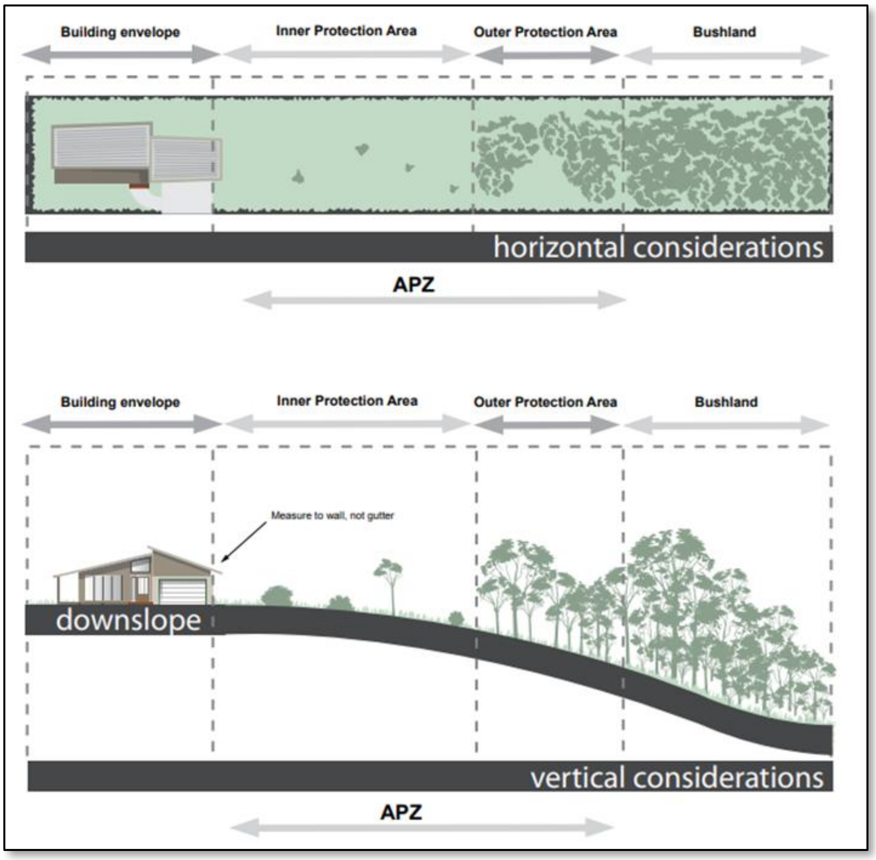
	BAL-40:	BAL-29:	BAL-19:	BAL-12.5:	10 kw/m2:	Elevation of Receiver:
Asset Protection Zone(m):	5	8	12	18	31	6

APPENDIX 3 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.



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

An APZ can include the following:

- Footpaths.
- Lawns.
- Discontinuous gardens.
- Swimming pools.
- Driveways.
- Unattached non-combustible garages with suitable separation from the dwelling.
- Open space / parkland; and
- Car parking.

Isolated areas of shrub and timbered vegetation are generally not a bushfire 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.

Any areas that are designated Asset Protection Zones, should be signposted (as indicated below) to ensure community is aware that the area is to be maintained for Bush fire protection purposes.

Furthermore, the edge of the APZ should be clearly delineated (as indicated below) to ensure vegetation creep does not occur over time, resulting in the reduction of the separation between the bushfire hazard and building.

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.

Landscaping and vegetation management on private property within Bushfire prone lands

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 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.

Specific landscaping commitments from the project include the following features:

- Setbacks which wrap around three sides of the development for bushfire management.
- A combination of hard and soft landscaping.
- An intensive area of planting centred on a contoured garden mound on the southern boundary of the site to provide an effective screening of the development from future residential development, and
- A selection of plants suitable to the landscape objectives based on native species.

Consideration should be given to vegetation fuel loads present on site with particular attention to APZs. 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.
Bearing in mind the desired aesthetic and environment sought by site landscaping, some basic principles help minimise the chance of such works contributing to the potential hazard on site.

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.

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.