

BUSHFIRE PROTECTION ASSESSMENT

THE PROPOSED SUBDIVISION AND RESIDENTIAL DEVELOPMENT

OF

**LOT 1 (DP 1087105) & LOT 4 (DP 1087106)
LEO DRIVE, NARRAWALLEE**

**MARCH 2007
(REF: 7060)**

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EXECUTIVE SUMMARY

A Bushfire Protection Assessment Report has been prepared by *Conacher Travers Pty Ltd* at the request of *Hazcorp* for the proposed subdivision and residential development of Lot 1 (DP1087105) and Lot 4 (DP1087105) Leo Drive, Narrawallee.

The development is to be assessed under the provisions of Section 3A of the *Environmental Planning and Assessment Act* and is therefore not regarded as being integrated development and subject to assessment under Section 100B of the *Rural Fires Act*.

Notwithstanding the method of assessment the proposed development will be subject to the requirements of '*Planning for Bushfire Protection 2006*' and advice from the Rural Fire Service is expected to be sought by the Department of Planning.

This report therefore provides an assessment of the bushfire protection measures required for the development to guard against the potential impact of bushfires. Recommendations have been made in respect of fuel management, construction standards / building protection, access, bushfire education and land ownership responsibility.

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SECTION 1

INTRODUCTION

Conacher Travers Pty Ltd has been requested by *Hazcorp* to provide a Bushfire Protection Assessment for the proposed subdivision and residential development of Lot 1 (DP1087105) and Lot 4 (DP1087105) Leo Drive, Narrawallee.

1.1 AIMS OF THE ASSESSMENT

The aims of the bushfire protection assessment are to:

- Review the bushfire threat to the property
- Review the capability of the property to provide a safe development
- Review the potential to carry out hazard management over the landscape
- Provide advice on mitigation measures including the provision of asset protection zones and construction standards in accordance with '*Planning for Bushfire Protection, 2006*'
- Advise on specific fire management issues

1.2 PLANNING RELATIONSHIPS

This report has been prepared having regard to the following legislative and planning requirements.

1.2.1 Legislation

The development is to be assessed under the provisions of Section 3A of the *Environmental Planning and Assessment Act* and is not subject to assessment under the provisions of Section 100B of the Rural Fires Act in this case.

The Department of Planning is expected to rely upon the NSW Rural Fire Service for advice and subsequently the advice expoused within '*Planning for Bushfire Protection 2006*'.

1.2.2 Planning Policies

Planning for Bushfire Protection – 2006 (PBP 2006). *Rural Fire Service* - This document was prepared by the Rural Fire Service and provides planning controls for development proposal with a designated Bushfire Prone Area.

1.3 INFORMATION COLLATION

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

- Site Plans prepared by *Rygate & West Pty Ltd, 2006*
- Vegetation Management Plan, *Planscapes 2007*
- Shoalhaven Aerial photograph DLWC 1:25,000
- Milton Topographical map DLPI of NSW 1:25,000
- Australian Standard 3959 '*Construction of Buildings in Bush Fire Prone Areas*'

John Travers of *Conacher Travers Pty Ltd* first visited the site in January 2003, and undertook several additional inspections thereafter.

An inspection of the proposed development site and surrounds was undertaken to assess the topography, slopes, aspect, drainage, vegetation and adjoining land use. The identification of existing bush fire protection advantages and a visual appraisal of bush fire hazard and risk were also undertaken. (Bush fire protection advantages are those landscape features which act to suppress or mitigate a fire e.g. escarpments, creeks, roads and fire breaks etc.)

1.4 PROJECT SYNOPSIS

It is proposed to create a residential subdivision Leo Drive, Narrawallee inclusive of two public reserves.

The northern reserve will be 750 me is size and will also be native bushland.

The southern reserve is 1.5 ha in size and will be native bushland. A second portion of the southern reserve will be for active public use and comprise play grand equipment and some clumps of native vegetation. This portion is south of a road that separates the northern portion – see Schedule 1 attached.

The proposed subdivision is an extension of the existing residential areas that are already established within the Narrawallee urban development area.

A previous development application has been withdrawn and a new subdivision plan has been prepared in accordance with the requirements of the Department of Planning.

1.5 SITE DESCRIPTION

Location and Surrounding Land Use

The site is located to the west of the Leo Drive, and is situated to the north of the Princes Highway within the Local Government Area of Shoalhaven. The site is bounded to the east and south by existing residential development. Whilst to the south west, west, north west and north the site is bounded by bushland. This bushland is also currently present throughout the site. At a broader scale, further to the west there are large expanses of cleared grasslands used for agricultural purposes.

The township of Milton is located approximately 2 kilometres to the south west of the site. Croobyar Creek is situated further to the north of the site and flows from west to east into the Pacific Ocean. Much of the surrounding area to the south east and south consists of residential areas within the townships of Narrawallee and Mollymook further to the south.

Topography and Drainage

The site straddles a south-north running ridgeline with lands sloping away to the east into existing development and to the west into a moist gully area and associated drainage line. There is also a small peak in the north of the site, before the land gently slopes into Croobyar Creek to the north of the site. Aspect is generally northerly.

The topography within and surrounding the site has average slopes of 5-10° to the West and 0-5° to the North.

Vegetation

Vegetation both within the site and across surrounding lands to the north, north west, west, and south west consists predominantly of Tall Open Forest vegetation. The proposed two public reserves will retain forest vegetation within the subdivision.

Lands to the east and south present no threat in relation to bushfire due to the presence of existing residential development to those aspects. The main area of concern in terms of bushfire impact upon the proposed residential subdivision are the large areas of Tall Open Forest to the west and north of the site with a high level of connectivity to other areas of Tall Open Forest further to the north. This high connectivity within the canopies coupled with moderately dense vegetation creates a potentially significant bushfire hazard to the proposed subdivision.

SECTION 2

BUSHFIRE PROTECTION ASSESSMENT

Developing in bushfire prone areas requires consideration of the overall threat upon a site and the way occupants of a site / dwelling(s) are able to cope in the event of a bushfire. To assess the bushfire threat that is likely to occur and affect this property, and the eventual dwelling occupiers, a review of the elements that comprise the overall threat needs to be completed.

These elements include the presence of hazardous fuels on site, the extent of the bushfire risk and the expected level of vulnerability of any proposed dwellings and other infrastructure.

2.1 HAZARDOUS FUELS

The bushfire hazard is defined as the potential severity of a fire. It is usually measured in terms of the potential intensity of the fire i.e. k/w m^2 (Kilowatts per square metre of fire front). The factors that influence bushfire hazard are primarily the nature of the vegetation (fuel) and the slope. Factors such as wind and fuel dryness also contribute to the hazard achieving maximum intensity levels.

The Rural Fire Service require that a Development Application that is submitted for their assessment must include an assessment of the effective slope for up to 100 metres and vegetation for up to 140 metres external to the proposed development area when such an area is located within a designated bushfire prone area – see Table 1 below.

Table 1 – Vegetation and Slope Information

Aspect	Vegetation within 140m of Development	Effective Slope of Land
North	Forest	0-5 ^{oD}
East	Existing Development	5-10 ^{oD}
South	Existing Development	0-5 ^{oD}
West	Forest	5-10 ^{oD}

^U – denotes upslope
^D – denotes downslope
^C – denotes cross-slope

2.1.1 Potential Bushfire Risk

Bushland to the north, north west, west and south west of the property poses a potential bushfire threat to the proposed subdivision due to the presence of tall open forest. In addition the presence of forested vegetation within the two public reserves will require asset protection zones.

2.1.2 Level of Development Vulnerability

Vulnerability is the likely exposure of the intended development site to the expected fire behaviour that could impact life and / or property.

It would be expected that a fire burning within the open forest vegetation from the north, through north west to the south west of the proposal could develop significant intensities due to the total area and continuity of unmanaged vegetation and the exposure to hot dry winds.

It is possible that fires could occur within the surrounding bushland with the potential impact in the form of radiant heat, flame impact and potentially ember attack. Therefore asset protection zones will be required to provide defensible space between the bushfire hazard and the development.

2.2 BUSHFIRE PROTECTION ASSESSMENT

PBP 2006 provides concepts for building in bushfire prone areas and guidance on the planning and development control processes in relation to bushfire protection measures. This document also provides a methodology for determining asset protection zones.

Table 2 below provides a summary of the assessment relative to slope and vegetation characteristics.

Table 2 – Bushfire Protection Assessment

Aspect	Vegetation within 140m of Development	Effective Slope of Land	Recommended Width of Asset Protection Zone (<i>PBP, 2006</i>)	Width of Asset Protection Zone Provided
North	Forest	0-5° ^D	25 metres	36 metres
East	Existing Development	5-10° ^D	No Requirement	No Requirement
South	Existing Development	0-5° ^D	No Requirement	No Requirement
West	Forest	5-10° ^D	28 metres	36 metres
Northern reserve	Forest	0-2° ^c	10 metres	10 metres
Southern reserve	Forest	0-2° ^c	25 metres	22 metres

2.3 BUSHFIRE ATTACK ASSESSMENT

PBP 2006 provides a methodology for assessing possible bushfire attack. This assessment is then used to determine the appropriate 'level of construction' for a building within a designated bushfire prone area. This identifies the level in accordance with AS3959 'Construction of buildings in bushfire prone areas'.

Table 3 below provides a summary of 'bushfire attack' and the construction standards required for this development.

A Fire Danger Index (FDI) of 100 is required to be used as the site is within the Shoalhaven LGA.

Table 3 – Bushfire Attack Assessment

Aspect	Vegetation within 140m of Development	Effective Slope of Land	APZ Provided	Level of Bushfire Attack	Construction Standard
North	Forest	0-5 ^{oD}	36 metres	High	Level 2
East	Existing Development	5-10 ^{oD}	No Requirement	No requirement	No requirement
South	Existing Development	0-5 ^{oD}	No Requirement	No requirement	No requirement
West	Forest	5-10 ^{oD}	28 metres	High	Level 2
Northern reserve	Forest	0-5 ^{oD}	10 metres	Extreme	Level 3
Southern reserve	Forest	0-5 ^{oD}	22 metres	Extreme	Level 3

SECTION 3

SPECIFIC PROTECTION ISSUES

3.1 ASSET PROTECTION ZONES

APZ's for Western Aspect

Class 1, 2 & 3 buildings constructed within a bushfire prone area are required to be provided with asset protection zones in accordance with Table A2.4 of *PBP 2006*. The following advice is provided in direct accordance with *PBP 2006*.

The proposed development has been assessed as having a theoretical High level of vulnerability from the impact of bushfires burning within the adjacent bushland to the north, north west, west and south west of the site.

The implementation and maintenance of the asset protection zones in accordance with Table 2 will provide compliance with the asset protection zone measures required by *PBP 2006*.

In essence the peripheral asset protection zone of 36 metres is comprised of the roadway (20 metres), lot setback of 6 metres and a 10 metre wide drainage swale on the western side of the road carriageway.

APZ's for the two internal Public Reserves

Planscapes have prepared a *Vegetation Management Plan* for the two public reserves. This plan has nominated the required asset protection zones. Shoalhaven Council have indicated that will not allow hazard management within the public reserves. There is a difference between the two reserves in terms of bushfire risk.

- The southern reserve is 1.5 hectares in size and has a square shape such that it must be viewed as requiring full compliance with *PBP 2006* because it is in excess of 1 hectare in size.
- On the other hand the northern reserve is smaller at 750 m² and is therefore less than 1 hectare and may be considered to be remnant vegetation and categorised as Rainforest (Group 3 vegetation).

3.2 BUILDING PROTECTION

Dwellings

The Bushfire Attack Assessment (Part 2.3 of this report) has found that the northern, north western, western and south western aspects of the proposed dwelling will potentially be exposed to a High level of bushfire attack. Thus all future dwellings within the subdivision will be required to comply with the Level 2 construction standards of AS3959 – 1999.

In addition, gutters and valleys to the proposed dwelling should be fitted with a protection device which prevents the build up of leaf and other combustible material within the gutters/valleys.

Southern Public Reserve

The Bushfire Attack Assessment (Part 2.3 of this report) has found that there is an Extreme level of construction required for the dwellings that adjoin the southern public reserve.

The proposed 22 metre APZ is less than the required *deemed to satisfy* 25 metre APZ required by PBP 2006. However in this case the 22 metres can be constructed as being entirely Inner protection Zone as opposed to a mix of IPA and OPA. This IPA landscape will allow a lesser distance such that a 22 metre APZ is recommended.

The extension to the southern reserve (south of the road) will be a mix of bushland and playground such that the area can be classified as being an insitu APZ and therefore no dwelling construction category is necessary.

Indeed Lot 116, 117 and 213 do not require a level of construction assigned as a result of this small reserve extension. However Lot 213 and 713 will require a level of construction arising from their proximity to the larger reserve.

Northern Public Reserve

The northern reserve is classified as rainforest and subsequently a 10 metre APZ still is required coupled with an Extreme dwelling construction category.

At the appropriate time a *performance based assessment* may be undertaken by a bushfire protection specialist to determine the appropriate level of building construction.

Note: There is no benefit to such an assessment at this point in time, as any reduction in the length of the APZ is not likely to reduce the level of construction from Extreme to either High and or Low. Factors that assist that assessment relate specifically to the final design location of the dwelling on the allotment. This can not be determined at this time.

3.3 HAZARD MANAGEMENT

The land owners and / or future managers (Council) will have an ongoing liability to ensure the management of the lands within the property to prevent the build up of combustible fuel. Section 63 of the *Rural Fires Act* requires hazard management to occur.

The grassed swale to the immediate west of the perimeter road will be managed by Council as part of their stormwater management regimes. This comprises some 10 metres of the 36 metre APZ on the western portion of the development.

The APZ within the southern portion of the southern public reserve will also be managed by Council as part of the open space program.

The APZ off the main portion of the southern public reserve will mostly be within the road corridor within a small portion within the front allotment setback of individual lots.

The APZ within the northern public reserve will be within the road corridor on the west and eastern aspects whilst to the north and south the APZ will occur within the four dwelling allotments.

There is no physical reason that could constrain hazard management in any potential asset protection zone from being successfully carried out by normal means e.g. mowing / slashing following initial clearing works.

3.4 EVACUATION SAFETY

The development will provide adequate and safe evacuation via Seaspray Street, Gemini Way and Leo Drive into the adjacent residential areas to the east and south east of the property. This route is unlikely to be impacted directly by fire due to the existing residential development already established within the township of Narrawallee. It is unlikely that an alternative evacuation route will be required due to the extensive internal road network proposed for the subdivision which provides for multiple safe egress routes.

3.5 AVAILABILITY OF FIRE FIGHTING SERVICES

There is a Rural Fire Brigade located at Ulladulla approximately 7.5 kilometres to the south of the site (road distance). The Ulladulla RFS Brigade would have a response time of approximately 15-20 minutes to service the development if they are not assisting elsewhere.

There is a NSW Fire Brigade also located at Ulladulla approximately 8.0 kilometres to the south of the site (road distance). The Ulladulla NSW Fire Brigade would have a response time of approximately 15-20 minutes to service the development if they are not assisting elsewhere.

3.6 ACCESS FOR FIRE FIGHTING OPERATIONS

The primary access points to the development will be through existing residential development onto the proposed internal road system for the subdivision. These entry points are unlikely to be impacted by bushfire hence, additional emergency access/egress for emergency services is not required.

The proposed public/emergency access roads should be 8 metres wide with 6 metre internal radii to corners and a turning radius of 12 metres to roundabouts/cul-de-sacs. Roads should be constructed to carry fully laden Category 1 Bushfire Tankers with a G.V.M. of 15 tonnes.

Access is compliant with the provisions of *PBP 2006*.

3.7 WATER SUPPLIES

Town reticulated water supply is available to the proposed development, therefore a supplementary form of water supply will not be necessary for fire fighting purposes.

However, a reticulated hydrant supply should be installed at various locations within the proposed subdivision in accordance with the requirements of Australian Standard AS2419.1 (2005).

3.8 COMMUNICATIONS

Telephone communications can be provided for this development to aid in communications during a bushfire incident.

SECTION 4

CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSION

The assessment of bushfire protection has found that *PBP 2006* can be complied with for this proposed development.

The following recommendations are provided to ensure that the development is in accord or greater than the requirements of *PBP 2006*.

4.2 RECOMMENDATIONS

Recommendation 1 - The development of the proposed dwelling should be sited as indicated on Schedule 1 'Plan of Bushfire Protection Measures'.

Recommendation 2 - Asset protection zones should be provided to the proposed development. They shall take the form of Inner Protection Areas, measured from the exposed wall of the any dwellings. The asset protection zones shall be as nominated in Table 3 and also as depicted in Schedule 1 and as explained with Section 3.1 and 3.2 herein.

Recommendation 3 - Fuel management within the asset protection zones should be maintained by regular maintenance of the landscaped areas / mowing of lawns in accordance with the guidelines provided in Appendix 1, and or as generally advised by Rural Fire Service in their publications.

Recommendation 4 - Construction standards as per Australian Standard AS3959 '*Construction of Buildings in Bushfire Prone Areas*', in accordance with Part 2.3.4 of the '*Building Code of Australia*', should apply to all proximate dwellings to the asset protection zones.

Recommendation 5 - Roof gutters and valleys to all dwellings proximate to the asset protection zones should be leaf proofed by the installation of an external gutter protection shroud or a gutter system that denies all leaves from entering the gutter and building up on that gutter. Any material used in such a system should have a flammability index of no greater than 5 (as measured against AS 1530.2).

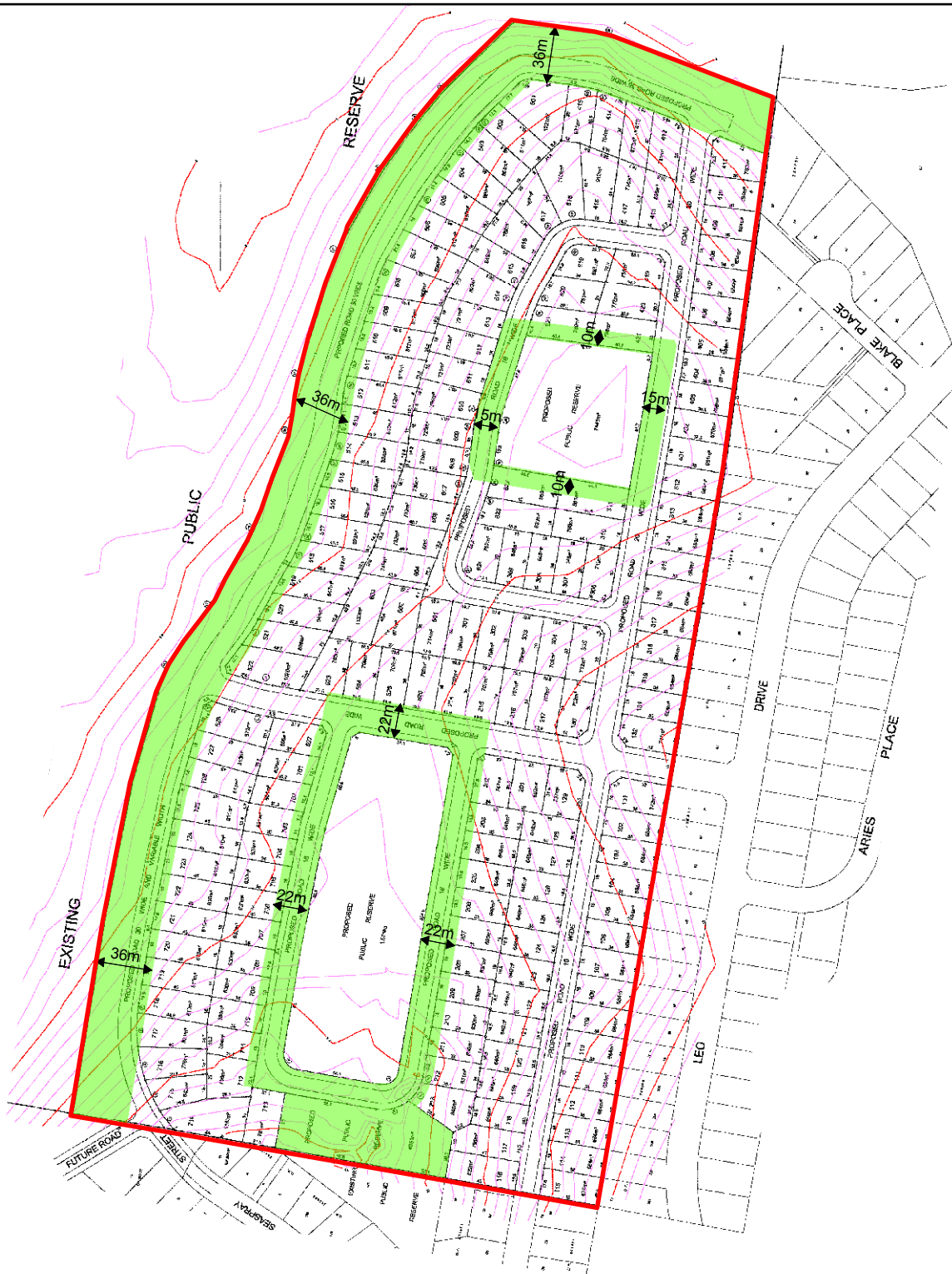
Recommendation 6 - A hydrant water supply should be installed in accordance with Australian Standard AS2419.1.

REFERENCES

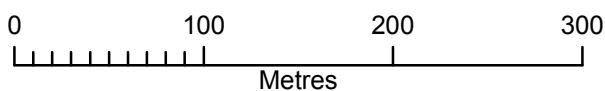
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SCHEDULE 1

PLAN OF BUSHFIRE PROTECTION MEASURES



*Subject Site boundary subject to final survey



1:4,000

Original plan produced in A4 colour

Legend

- Subject Site Boundary
- Asset Protection Zone



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Schedule 1 - Bushfire Protection Measures

Leo Drive - Narawallee

Source: DLWC 1:25,000 Aerial Photograph,

APPENDIX 1

DETAILS OF ASSET (FIRE) PROTECTION ZONES

APPENDIX 1 – DETAILS OF ASSET (FIRE) PROTECTION ZONES

1.0 INTRODUCTION

The major mitigating factor that limits the effects of wildfire is the amount of fuel available to burn. By reducing the amount of fuel there will be a reduction in the intensity of the fire.

The area in which the fuel reduction occurs is referred to as an Asset Protection Zone. Asset Protection Zones are areas that are usually shown on 'plans' adjacent to either cultural or natural assets (eg. dwelling, rainforest). They act to significantly lessen the impact of intense fire. The Asset Protection Zone can be further identified by two sub-zones.

Each has a specific role to play within an asset protection zone. These sub-zone areas are called the Inner Protection Area (Fuel Free Zone) and the Outer Protection Area (Fuel Reduced Zone). The sub-zones characterise the physical appearance of the landscape and in particular the way the combustible fuels shall appear after they are modified. (See Photos 1 - 6).

The Inner Protection Area is always located immediately adjacent to the asset/value at risk. The Outer Protection Area is located between the Inner Protection Area and the bushland.

When considering bush fire fuel it is important to understand that it occurs in our native bushland in three vertical layers – see Table 1.

Table 1 – Fuel Layers

Fuel Layer Name	Location of Layer in vertical Column	Type of Fuel
Ground Fuels	Below ground level	Peatmoss (always below the surface)
Surface Fuels	0-200 mm	Litter layer (leaves & twigs)
Aerial Fuels	200 – 3000 mm	Shrubs and grasses
Canopy Fuels	> 3000 mm	Tree canopy

2.0 INNER PROTECTION AREA (I.P.A)

This area is *almost free* of all fuels, it usually takes the form of grassy areas, car parks, roads, concrete areas, track or trails. It does not imply the wholesale removal of all or every tree - see Table 2 for guidelines on the extent of trees that can occur within this zone.

Rationale: By its very nature this zone is intended to stop the transmission of flame and reduce the transmission of radiated heat by the elimination of available fuel. Thus its Inner Protection Area name. This area also allows airborne embers to fall safely thus stopping further outbreaks of fire to begin.

Fire Fighting Advantage: This zone allows safe fire fighting operations to occur and clear fire control lines to be implemented by fire fighters.

Measurability: A fuel free Inner Protection Area is measured in two ways. The weight of the fuel and the width of the zone. Practitioners measure fuel load in *tonnes per hectare*. It is assessed by measuring the weight of fuel in a small quadrat eg. 300mm by 300mm and equating that to a hectare. The width of the zone is the separating distance between an asset and the bushland.

Performance Standard: A safe load is between 0-3 t/Ha.

Photographic Montage Depicting Inner Protection Area

PHOTO – 1



Site Description: The site is a paved roadway. It separates two areas of bushland and is normally called in this instance a fire break.

Fire Behaviour: No fire could occur on this fire break but the narrow nature of the break would allow fire to pass between the two bushland areas without difficulty.

Maintenance: None required due to paved surface. Do not allow shrubs to grow.

Fuel Weight: Zero

PHOTO – 2



Site Description: The site is mineral earth. There is no fuel on this narrow strip. The narrow strip forms a narrow fire break between two areas of unmanaged bushland.

Fire Behaviour: No fire could occur on this mineral earth but the narrow nature of the fire break would allow fire to pass between the two bushland areas without difficulty.

Maintenance: Regular raking and removal of litter layer. Do not allow shrubs to grow.

Fuel Weight: Zero

PHOTO – 3



Site Description: This is a grassed fire trail on level land adjacent to unmanaged bushland. The grass height on the level lands is 20-50 mm.

Fire Behaviour: This area, if mowed regularly, would exhibit flame heights not above 300 mm (12 inches). Note: The grass in the bushland zone is approx' 400-500mm in height and would achieve flame heights approximate to 750 –1200mm (depending on fuel loadings and Fire Danger Index).

Maintenance: This fuel free zone is able to be managed by normal mowing means. Raking and removal of litter layer; and/or mowing of grasses; and raking and/or mowing. Fuel Weight in photo 4: < 2 T/Ha.

Fuel Weight: < 2 T/Ha.

PHOTO – 4



Site Description: This is a grassed Inner Protection Area with scattered trees, no shrub larger and minimal understorey. The grass height is maintained to provide < 3 tonnes per hectare.

Fire Behaviour: This area, if maintained regularly, would exhibit flame height not above 300mm.

Maintenance: This Inner Protection Area is managed by mowing, raking and removal of the litter layer.

Fuel Weight: < 3 tonnes/hectare.

Photographic Montage Depicting Inner Protection Area

PHOTO – 5



Site Description: The site is a grassed Inner Protection Area with large smooth barked tree 5 metres clear of the dwelling.

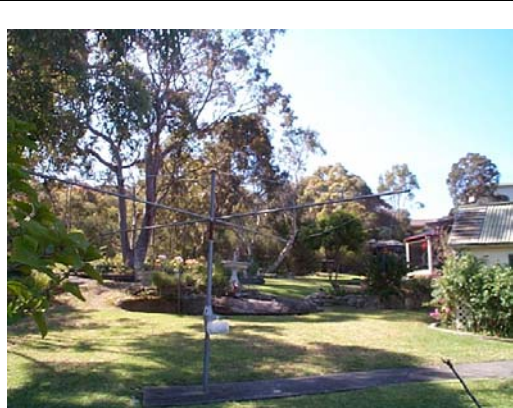
The grass height is maintained to provide < 3 tonnes per hectare.

Fire Behaviour: This area, if maintained regularly, would exhibit flame height not above 300mm.

Maintenance: This Inner Protection Area is managed by mowing, raking and removal of the litter layer.

Fuel Weight: < 3 tonnes/hectare

PHOTO – 6



Site Description: This site shows a grassed Inner Protection Area with rock and landscaped areas constituting approximately 15% of the Inner Protection Area. Tree more than 5 metres from dwelling with no canopy connection to adjoining trees.

Fire Behaviour: This area, if maintained regularly, would exhibit flame height not above 300mm.

Maintenance: This Inner Protection Area is managed by mowing, raking and removal of the litter layer.

Fuel Weight: < 3 tonnes/hectare to grass areas landscaped areas 3-4 tonnes/hectare.

PHOTO – 7



Site Description: This site shows an Inner Protection Area which includes a paved Access/Fire Trail. Smooth barked trees < 5 metres from fire aspect of dwelling. Fuel loading to trail zero with grassed areas displaying approximately 3 tonnes/hectare.

Fire Behaviour: Fires impacting the bushland to the left of the Access/Fire Trail would loose intensity with the provision of the Inner Protection Area.

Maintenance: This Inner Protection Area is managed by mowing, raking and removal of the litter layer.

Fuel Weight: Nil to Access/Fire Trail. 3 tonnes/hectare to grassed area.

PRESENCE OF SHRUBS IN AN INNER PROTECTION AREA

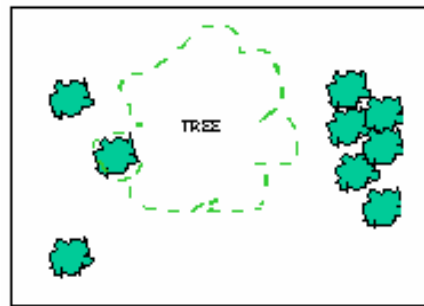
Shrubs may occur within an Inner Protection Area, but only where it is recommended by an experienced bush fire protection manager.

Thus landscaping works within the Inner Protection Area may occur in some instances. Where it is approved to occur, some 10-15 % and in some cases up to 30% of the Inner Protection Area may be able to be landscaped but always away from glass in buildings.

The design of the Inner Protection Area will be dependent on species selection and spatial arrangement.

Note: eg. 10 % means that for every 100 square metres (eg. 10 metres x 10 metres) only 10 % of that area may have a shrub component. The remainder would be free of shrubs see Figure 1. A 10 % landscaped shrub layer would add a further 1.5 tonnes of fuel to the overall hazard weight. To maintain the aggregate below 3 t/ha the ground fuels must be mown grass, or similar.

Figure 1 – Example of Spatial Arrangement in a Inner Protection Area



If a shrub layer is present the following table shows the additional fuel weights that should be added to the calculated surface fuels.

Shrub cover	Fuel Weight
10-30 %	2.5 tonnes / ha
35-50 %	5.0 tonnes / ha
55-75%	7.5 tonnes / ha

PRESENCE OF TREES WITHIN AN INNER PROTECTION AREA

A tree may occur within an Inner Protection Area if the canopy does not form a link with shrubs. The reason is to lessen any chance for 'vegetation linking' and the capability for fire to extend into the canopy.

It is a basic premise in fire behaviour understanding that fire cannot occur in the canopy unless surface fuels such as grasses or shrubs are burning. This merging creates opportunity for fire to link with the canopy and therefore increase fire intensity by some significant amount.

Trees that have a canopy beginning near the ground (such as Forest Oaks *Allocasuarina*) form a continuous link with the tree canopy and shrubs. A forest canopy cannot therefore burn without fuel to feed that fire. In a 'tall open forest' where the trees are generally above 20 metres in height the canopy is separated from the land surface by some distance. In an 'open woodland' the low canopy height (usually < 5 metres) merges with the shrubland layer.

Knowing the relationship between the shrub layer and the tree canopy allows fire managers to design safer areas in the asset protection zones. It is for this reason that vegetation such as Forest Oaks are usually excluded from an Inner Protection Area.

Similarly in 'open forests' the height of the forest is sufficiently removed from the shrub layer. As a general rule trees are allowed within an Inner Protection Area where the density of those trees is commensurate with Table 2 below and located on slopes up to 20% with a Westerly aspect.

In respect of trees that can be located in an Inner Protection Area Table 2 provides guidelines.

Table 2 – Tree Density in Inner Protection Area

Distance from dwelling wall	Trees permitted on the exposed side of a dwelling	Trees permitted on the non exposed side of a dwelling
within 5 metres	No trees	No trees
between 5-10 metres	One tree per 100 m ²	2 trees per 100 m ²
Between 10-20 metres	<10 tree per 400 m ² .	<10 trees per 400 m ²

There are variations to Table 2.

- Trees vary in height and tree crown width /depth. Some trees have canopies that extend close to the ground (eg < 5 metres from the ground) whilst other trees have canopies that are high off the ground (> 15 metres off the ground). In some cases these tall trees do not have canopies that are affected by undergrowth / tall shrubs that could cause fire to burn into the canopy. Therefore if trees are isolated they do not form a significant risk.
- Similarly smooth barked trees are less of a hazard than heavily barked trees. The latter can cause fire to run up into the canopy and if there is sufficient wind the resulting fire can be of high intensity.
- Similar to the above, the number of trees per 100 m² depends on an individual assessment being undertaken to determine the 'type / size of tree', and its resultant potential impact upon a dwelling.
- The exposed side of a dwelling is the side that is directly affected by a moving fire particularly when fanned by wind. The non-exposed side of a dwelling is the side where fire is unlikely to come from either from a lack of wind, slope or other factors such as a lack of hazardous fuel.

3.0 OUTER PROTECTION AREA (O.P.A)

Rationale: This zone is designed to stop the development of 'intense' fires and the transmission of 'severe' radiated heat.

Physical Appearance: This area assumes all trees will remain but with a modified shrub / grass and litter layer. In some sparse vegetation communities the shrub layer may not require modification.

Fire Fighting Advantage: Reduced fire intensity. It achieves this by denying fire a significant proportion of the fuel to feed upon. Fuels containing small (or fine) leaves such as *Forest Oaks* (or similar) are targeted for removal due to the capacity to burn quickly and therefore feed fire up into adjacent trees.

Measurability: Practitioners measure fuel load in *tonnes per hectare*. It is assessed by way of measuring the load in a given small quadrat eg. 300mm by 300mm and equating that to a hectare.

Performance Standard: A safe load is between 4-6 T/Ha.

Note: An experienced / qualified bush fire protection practitioner should undertake an individual assessment of a site to determine the requirements within an Asset Protection Zone.

Photographic Montage Depicting Outer Protection Area

PHOTO – 1



Site Description: This area has a low tree and shrub density but a high presence of native grasses. Almost no litter layer present.

Fire Behaviour: The lack of shrubs means that fire behaviour will be less but the presence of the sloping lands and the heavy presence of grass means that fire can burn quickly up the slope with flame heights between 1200-1800mm.

Maintenance: Maintain the grass height. Shrubs can grow to what is pictured in Photo 1.

Fuel Weight: 2-3 T/Ha

PHOTO – 2



Site Description: This area has increased shrub density and the beginnings of those shrubs linking with the tree canopy. Litter layer is present, but less than 3 T/Ha. The shrub layer is approx' 3 T/Ha.

Fire Behaviour: The increase in shrubs means that fire behaviour will be high. Flame heights would be expected to be between 2000mm – 6000mm (depending on fuel loadings and Fire Danger Index).

Maintenance: Maintain the grass height and current density of shrubs.

Fuel Weight: 6 T/Ha.

PHOTO – 3



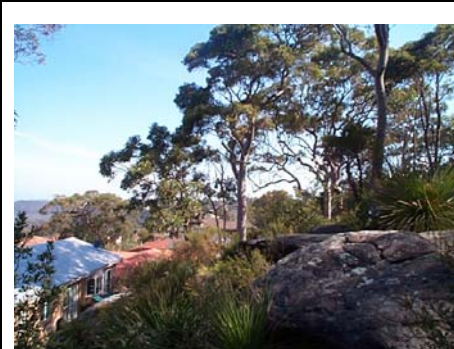
Site Description: This area has a low tree and shrub density but a high presence of native grasses.

Fire Behaviour: The heavy presence of native grass means that fire can burn quickly through the outer protection area with flame heights of between 1200-3m.

Maintenance: Remove and maintain grass layer/leaf litter by slashing/hand removal.

Fuel Weight: 6-8 tonnes/hectare

PHOTO – 4



Site Description: Outer Protection Area above dwelling showing large rock outcrops, low shrub and tree density.

Fire Behaviour: Fires impacting this area would burn down slope to the dwelling. Flame heights in the order of 1-2 metres.

Maintenance: Management of this area by slashing/hand removal/burning to maintain fuel loading to < 8 tonnes/hectare.

Fuel Weight: < 6 tonnes/hectare
Nil on rock ledges.

APPENDIX 2

SUMMARY OF AUSTRALIAN STANDARD AS3959 (1999 – AMENDED)

CONSTRUCTION OF BUILDINGS IN BUSHFIRE PRONE AREAS

AUSTRALIAN STANDARD AS3959 (1999 – AMENDED)

CONSTRUCTION OF BUILDINGS IN BUSHFIRE-PRONE AREAS

Levels of Construction:

Three levels of construction are given which correspond to the category of bushfire attack determined for the site of the building:

Level 1 Construction – For the category of **medium** bushfire attack.

Level 2 Construction – For the category of **high** bushfire attack.

Level 3 Construction – For the category of **extreme** bushfire attack.

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
FLOORING SYSTEMS	<p>The requirements for a floor in a Level 1 construction shall be one, or a combination, of the following:</p> <ul style="list-style-type: none"> (a) A concrete slab-on-the-ground. (b) A suspended floor, which may be one, or a combination of the following, supported by posts, columns, stumps, piers, or poles complying with Clause 3.4 or walls complying with Clause 3.5: <ul style="list-style-type: none"> (i) A concrete floor. (ii) A framed floor where the underside of any one bearer at any point is greater than 600mm above the finished ground level. (c) A suspended timber floor, framed with timber or metal, where the underside of any one bearer, at any point, is not greater than 600mm above the finished ground level and which has – <ul style="list-style-type: none"> (i) The subfloor space unenclosed and any timber flooring, bearers and joists of fire-retardant-treated timber; or (ii) The subfloor space fully enclosed, either by a wall that complies with Clause 3.5.1(a), or by the use of non-combustible sheet material which extends for at least 400mm above the finished ground level. <p>Where non-combustible fibre-reinforced cement sheets are used to enclose the subfloor space, the material shall have a minimum thickness of 6mm and all material shall meet the bottom of the cladding material to ensure there are no gaps on the exterior face of the building.</p>	<p>The requirements for a floor in a Level 2 construction shall be as for Level 1 construction (see Clause 3.3.1)</p> <p>NOTE: The protection of subfloor openings against the entry of burning debris by way of introducing non-combustible material, such as fibre-reinforced cement sheeting to effectively enclose the subfloor space, may conflict with the requirements for termite protection and should therefore, take into consideration of the provisions of AS 3660.1.</p>	<p>The requirements for a floor in a Level 3 construction shall be as for Level 2 construction (see Clause 3.3.2)</p> <p>Except that in the case of a framed floor, where any bearer or joist is greater than 600mm above finished ground level and the floor is not enclosed as described in Clause 3.3.1 (c)(ii), the bearer, joists and flooring shall be of fire-retardant-treated timber or sheeted underneath with non-combustible material.</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
SUPPORTING POSTS, COLUMNS, STUMPS, PIERS AND POLES	<p>The requirements for supporting posts, columns, stumps, piers and poles in a Level 1 construction shall be one, or a combination, of the following:</p> <ul style="list-style-type: none"> (a) Non-combustible. (b) Fire-retardant-treated timber for a minimum of 400 mm above the finished ground level. (c) Timber mounted on galvanized metal shoes with a clearance of not less than 75 mm above the adjacent finished ground level or paving level (see Figure 3.2). <p>The above do not apply where the subfloor space is totally enclosed as described in Clause 3.3.1(c) (ii).</p>	<p>The requirements for supporting posts, columns, stumps, piers and poles in a Level 2 construction shall be as for Level 1 construction (see Clause 3.4.1)</p>	<p>Except in enclosed subfloor spaces, the requirements for supporting posts, columns, stumps, piers and poles in a Level 3 construction shall be as for Level 2 construction (see Clause 3.4.2) except that all timber shall be fire-retardant-treated to full height.</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
EXTERNAL WALLS	<p>The requirements for external walls in a Level 1 construction shall be as follows:</p> <p>(a) External walls shall be one, or a combination, of the following:</p> <ul style="list-style-type: none"> i) A wall having an external leaf of masonry, concrete, pise, rammed earth or stabilized earth. ii) A framed wall that incorporates either – <ul style="list-style-type: none"> A) breather-type sarking complying with AS.NZS 4200.1 and with a flammability index of not more than 5 (see AS 1530.2) installed immediately behind the external cladding; or B) an insulation material conforming to the appropriate Australian Standard for that material. <p>NOTE: No restrictions apply to the cladding material.</p> <p>(iii) A wall of timber logs that have the butting faces of adjacent logs, gauge-planed, and the space between the logs sealed in a manner that prevents the entry of burning debris and which allows for building movement.</p> <p>(b) Where the external leaf or cladding is of a combustible sheet material and is less than 400 mm above finished ground level, the cladding shall be protected for not less than 400 mm above the adjacent finished ground level (see Figure 3.3)</p> <ul style="list-style-type: none"> (i) by covering it with a suitable non-combustible material, or fire-retardant-treated timber suitably sealed to the existing cladding so as to prevent the entry of burning debris (see Figures 3.3 (a) and 3.3(b)); (ii) by substituting with a suitable non-combustible sheet material, or fire-retardant-treated timber (see Figure 3.3 (c)); or (iii) where the external cladding is timber, by using fire-retardant-treated timber. 	<p>The requirements for walls in a Level 2 construction shall be as for Level 1 construction (see Clause 3.5.1), except that PVC cladding is not permitted and all external timber wall cladding shall be of fire-retardant-treated timber.</p>	<p>The requirements for external walls in a Level 3 construction shall be as for Level 2 construction (see Clause 3.5.2).</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
WINDOWS	<p>All openable windows, including louvres, in a Level 1 construction shall be screened with corrosion-resistant steel, bronze or aluminium mesh with a maximum aperture size of 1.8 mm in such a way that the entire opening remains screened when the window is open.</p>	<p>The requirements for all windows, including louvres, in a Level 2 construction shall be as for Level 1 construction (see Clause 3.6.1) except that aluminium mesh shall not be used.</p> <p>In addition to the above, the following applies:</p> <p>(a) Where timber is used, it shall be fire-retardant-treated timber except where protected by non-combustible shutters.</p> <p>(b) Where leadlight windows are used, they shall be protected by shutters constructed of a non-combustible material or of toughened glass.</p>	<p>The requirement for windows in a Level construction shall be as for Level 2 construction (see Clause 3.6.2) except that where the windows are not protected by non-combustible shutters, they shall be glazed with toughened glass.</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
EXTERNAL DOORS	<p>External doors in a level 1 construction are to be fitted with –</p> <ul style="list-style-type: none"> (a) weather strips or draught excluders to prevent the penetration or build-up of burning debris beneath the door; and (b) tight fitting door screens fitted with corrosion-resistant steel, bronze or aluminium mesh with a maximum aperture size of 1.8 mm. 	<p>The requirements for external doors in a Level 2 construction shall be as for Level 1 construction except that aluminium shall not be used for the mesh (see Clause 3.7.1).</p> <p>If leadlight glazing panels are incorporated in the doors, they shall be protected by shutters constructed of a non-combustible material or of toughened glass.</p>	<p>The requirements for external doors in a Level 3 construction shall be as for Level 2 construction (see Clause 3.7.2) except that –</p> <ul style="list-style-type: none"> (a) timber doors shall be fire-retardant-treated or shall have a non-combustible covering on the exterior surface; or (b) doors shall be protected by shutters of non-combustible material; or (c) doors shall be solid-core having a thickness not less than 35 mm.
VENTS AND WEEPHOLES	<p>Vents and weepholes in a Level 1 construction shall be protected with spark guards made from corrosion-resistant-steel, bronze or aluminium mesh with a maximum aperture size of 1.8 mm (see Figure 3.4).</p>	<p>The requirements for Level 2 construction vents and weepholes shall be as for Level 1 construction (see Clause 3.8.1), except that aluminium mesh shall not be used.</p>	<p>The requirements for vents and weepholes in a Level 3 construction shall be as for Level 2 construction (see Clause 3.8.2)</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
ROOFS	<p>The following general requirements shall apply to all types of roofing systems in a Level 1 construction:</p> <ul style="list-style-type: none"> (a) Timber shakes or shingles shall not be used for the roof covering. (b) The roof/wall junction shall be sealed either by the use of fascias and eaves linings, or by sealing the gaps between the rafters with a suitable non-combustible material. (c) Sarking shall have a flammability index of not more than 5 (see AS1530.2). <p>Tiled roofs Tiled roofs shall be fully sarked (see Clause 3.9.1.1(c)). The sarking shall be located directly below the tiling barrens and shall cover the entire roof area including the ridge</p> <p>Sheeted roofs The requirements for sheeted roofs in a Level 1 construction are as follows:</p> <ul style="list-style-type: none"> (a) Only metal or fibre-cement sheet shall be used. (b) All gaps under the corrugations or ribs of the roofing material where it meets the fascia or wall line shall be sealed or protected- <ul style="list-style-type: none"> (i) by fully sarking the roof; or (ii) by providing corrosion-resistant steel or bronze mesh, with a maximum aperture size of 1.8 mm, profiled metal sheet, neoprene seal, compressed mineral wool or similar material. 	<p>The requirements for a roof in a Level 2 construction shall be as for Level 1 construction (see Clause 3.9.1), except that all roof sheeting shall be non-combustible and sarked, and rooflight glazing shall be of wired glass. Thermoplastic material or toughened glass shall not be used as the glazing for rooflights. The case of the evaporative cooler shall be manufactured from a non-combustible material.</p>	<p>The requirements for roof covering in a Level 3 construction shall be as for Level 2 construction (see Clause 3.9.2) except that no fibre-reinforced cement or aluminium sheet shall be used.</p>

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
ROOFS (Cont.)	<p>NOTES:</p> <ol style="list-style-type: none"> 1) The method of protection in Item (b)(ii) can only be achieved on a roof without valleys and having the deck fixed directly to, but not structurally supported by, the fascia. 2) It is generally recognized that where compressed mineral wool is used for sealing against bushfire attack or for other purposes, adequate ventilation should be provided to stop condensation on the mineral fibre causing corrosion in the roof sheeting or supporting structure. (c) Rib caps and ridge capping shall be sealed in accordance with Clause 3.9.1.3 (b) (see Figure 3.5(a)), or preformed rib caps or ridge capping shall be used (see Figures 3.5(b) and (c)). <p>Rooflights The requirements for rooflights in a Level 1 construction are as follows:</p> <ol style="list-style-type: none"> (a) All penetrations of the roof space for the installation of rooflights and associated shafts shall be sealed with a non-combustible sleeve or lining. <p>Thermoplastic sheet in a metal frame may be used for a rooflight, but the diffuser installed at ceiling level shall be of wired or toughened glass in a metal frame</p> <p>NOTE: AS 1288 and AS 4285 sets out specific requirements for glazing and skylights.</p> <ol style="list-style-type: none"> (b) Vented rooflights shall be provided with corrosion-resistant steel or bronze mesh having a maximum aperture size of 1.8 mm. 		

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
ROOFS (Cont.)	<p>Roof ventilators All components of roof ventilators, including the rotary type, in a Level 1 construction shall be constructed of non-combustible material and shall be sealed against the entry of sparks and embers with corrosion-resistant steel or bronze mesh having a maximum aperture size of 1.8 mm.</p> <p>Roof-mounted evaporative cooling units Roof-mounted evaporative cooling units shall only be used if the openings to the cooling unit are encased in corrosion-resistant steel or bronze mesh with a maximum aperture size of 1.8 mm.</p>		
EAVES	All eaves in a Level 1 construction shall be enclosed, and the fascia or the gaps between the rafters shall be sealed (see Clause 3.9.1.1)	The requirements for eaves in a Level 2 construction shall be as for Level 1 construction (see Clause 3.10.1), except that all timber eaves lining and joining strips shall be of fire-retardant-treated timber.	The requirements for eaves in a Level 3 construction shall be as for Level 2 construction (see Clause 3.10.2) except that aluminium shall not be used.
FASCIAS	There are no requirements for fascias in a Level 1 construction.	All materials used for fascias in a Level 2 construction shall be either non-combustible or of fire-retardant-treated timber.	The requirements for fascias in a Level 3 construction shall be as for Level 2 construction (see Clause 3.11.2) except that no fibre-reinforced cement or aluminium sheet shall be used.

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
GUTTERS AND DOWNPIPES	Any materials or devices used to stop leaves collecting in the gutters of a Level 1 construction shall have a flammability index of not greater than 5 when tested in accordance with AS 1530.2.	The requirements for gutters and downpipes in a Level 2 construction shall be as for Level 1 construction (see Clause 3.14.1).	The requirements for gutters and downpipes in a Level 3 construction shall be as for Level 2 construction (see Clause 3.12.2).
VERANDAS AND DECKS	<p>Verandas, decks, and the like, forming part of a building required to be Level 1 construction shall comply with one, or a combination, of the following:</p> <p>(a) <i>Slab</i> - A reinforced concrete suspended slab floor, supported by posts or columns complying with Clause 3.4 or walls complying with Clause 3.5, or a slab-on-the-ground floor complying with Clause 3.3.</p> <p>(b) <i>Sheeted or tongued and grooved solid flooring</i> – The requirements for flooring are as follows:</p> <p>(i) Compliance with the flooring requirements shall be in accordance with Clause 3.3</p> <p>(ii) Where the clearance between the finished ground level and the underside of the floor is not greater than 400 mm above finished ground level, all joints in the flooring shall be covered (above the floor level) or shall be sealed.</p> <p>(c) <i>Spaced decking</i> – The requirements for spaced decking are as follows:</p> <p>(i) The decking timbers shall be fixed with a clearance of not less than 5 mm between adjacent timbers.</p>	The requirements for verandas and decks in a Level 2 construction shall be as for Level 1 construction (see Clause 3.11.1) except that if spaced decking is used, fire-retardant-treated timber shall be used for the decking material.	The requirements for verandas and decks in a Level 3 construction shall be as for Level 2 construction (see Clause 3.13.2) except that all materials shall be non-combustible or where timber is used, it shall be fire-retardant-treated (including any balustrades).

ITEM	LEVEL 1	LEVEL 2	LEVEL 3
VERANDAS AND DECKS (Cont.)	<p>(ii) The external perimeter beneath the decking shall not be enclosed nor shall access to the space beneath the decking be impeded.</p> <p>NOTE: This requirement is designed to ensure that access to extinguish fires and remove burning material is maintained.</p> <p>(iii) Any supports for the decking shall be treated as set out in Clause 3.4.</p> <p>(iv) Decking timbers shall not be allowed to connect with the remainder of the building unless measures are used to prevent the spread of fire into the building.</p>		
SERVICE PIPES (WATER AND GAS)	All exposed piping, for water and gas supplies, in a Level 1 construction shall be metal. Pipes of other materials shall be buried to a depth of at least 300 mm below the finished ground level.	The requirements for service pipes in a Level 2 construction shall be as for Level 1 construction (see Clause 3.12.1).	The requirements for service pipes in a Level 3 construction shall be as for Level 2 construction (see Clause 3.14.2).