Appendix 2

Determining Asset Protection Zones

A2.1 Introduction

This Appendix shows how APZs are determined for residential and rural-residential subdivision and new special fire protection purposes. This assessment will determine the minimum setbacks required for habitable buildings in residential purpose developments designated as bush fire prone.

A2.2 Terminology

The methodology requires consideration of the following matters, which contribute to bush fire behaviour and radiant heat models:

(i) **Asset Protection Zone** (setback) distances provide for:

- minimal separation for safe firefighting (access to fire front);
- reduced radiant heat;
- reduced influence of convection driven winds;
- reduced ember viability thereby limiting the impact of ember attack; and
- dispersal of smoke which would otherwise severely impact on residents affected by reduced mobility or health issues.

(ii) **Predominant Vegetation** is classified by structure or formation using the system adopted by Keith (2004) and by the general description using Table A2.1. Vegetation types give rise to resultant radiant heat (assumed under unmanaged conditions to represent an extreme scenario as the danger period is the lifetime of any proposed development) and fire behaviour characteristics. There are 12 vegetation formations (with sub-formations) identified in PBP.

(iii) **Effective Slopes** are classified within five slope classes, one being upslope and four being downslope, ranging from flat to 18 degrees in steps of five degrees. This recognises the reduced rate of spread (ROS) inherent to fire travelling downslope and the restrictions imposed on development by slopes greater than 18 degrees. The effective slope is that slope within the hazard which most significantly affects fire behaviour of the site having regard to the vegetation class found.

(iv) **Fire weather** assessment assumes a credible worst case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The 1:50 year fire weather scenario for most of the State was determined as FDI=80, however, a number of areas including the Greater Sydney, Greater Hunter, Illawarra, Far South Coast and Southern Ranges Fire Areas have higher FDIs which are set at 100. This is believed to occur with reasonable frequency in their respective fire areas. The relevant fire areas are set out in Table A2.3.

(v) **Fire intensity** (I) is determined following the formula adapted from Luke and McArthur (1978), I = HWr/36 where H is the heat yield for vegetation, W is fuel load (t/Ha) and r is ROS (km/hr). ROS is normally determined using McArthur Meter Mark V at the relevant FDI for forests and woodlands. Other models are used for heaths and scrubs (Catchpole, et al, 1998). Radiant heat is then derived from flame length and intensity models using the 'view factor' model (Douglas and Tan, 2005).

(vi) **Inner Protection Area (IPA) and Outer Protection Area (OPA)** for forest and woodland vegetation. The IPA is critical to providing a defendable space and managing heat intensities at the building surface. The OPA serves to reduce the potential length of flames by slowing the ROS, filtering embers and reducing the likelihood of crown fire. The IPA may be increased at the expense of OPAs.

For other vegetation types (such as heaths,

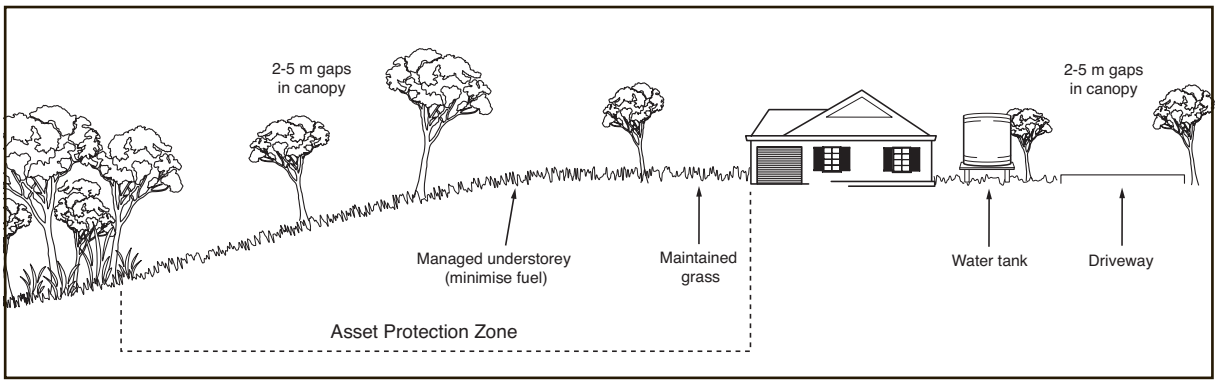

Figure A 2.1 Asset Protection Zone (setback) design

rainforests, arid shrublands and semi-arid woodlands), it is not feasible to distinguish between IPAs and OPAs and therefore all such APZs should be managed as IPAs.

An IPA should provide a tree canopy cover of less than 15% and should be located greater than 2 metres from any part of the roofline of a dwelling. Garden beds of flammable shrubs are not to be located under trees and should be no closer than 10 metres from an exposed window or door. Trees should have lower limbs removed up to a height of 2 metres above the ground.

An OPA should provide a tree canopy cover of less than 30% and should have understorey managed (mowed) to treat all shrubs and grasses on an annual basis in advance of the fire season (usually September).

A2.3 Procedure

The following procedure is to be adopted when assessing a development at a defined precinct level in order to determine whether the development is bush fire prone and if so, which setbacks will be appropriate:

(a) Determine vegetation formations, as follows:
  (i) identify all vegetation in all directions from the site for a distance of 140 metres:
  (ii) consult Table A2.1 to determine the predominant vegetation type; and
  (iii) select the predominant vegetation formation as described in Table A2.1.
(b) Determine the effective slope of the land under the Predominant Vegetation Class and the site (slope classes are detailed on page 56).
(c) Determine the appropriate fire (weather) area in Table A2.3 and note the relevant FDI.
(d) Consult Tables A2.4–2.7 and determine the appropriate setback for the assessed land use, vegetation group and slope range.

(a) Predominant Vegetation Class Formation

Determine the predominant vegetation communities using high resolution (within five metres) vegetation databases and/or field assessment by qualified persons over a distance of at least 140 metres in all directions from the proposed property boundary or building footprint on the development site. Where a mix of vegetation types exist the type providing the greater hazard is said to predominate. Vegetations descriptions are as per Keith D. 2004 in: "Ocean Shores to Desert Dunes" published by DEC (except heathlands which is provided two sub-formations rather than one based largely on vegetation height). Consideration is to be given to the understorey as this may contain the greater mass of fuels. Do not include vegetation that is to be cleared as part of the development.

For the purposes of this document, vegetation is classified (using the formations and sub-formations within Keith (2004) (see Table A2.1) into:

- forests (wet sclerophyll forests and dry sclerophyll forests);
- woodlands;
- forested wetlands;
- tall heaths;
- freshwater wetlands
- short heaths;
- alpine complex;
- semi-arid woodlands;
- arid shrublands;
- rainforests; and
- grasslands.

Plantations not being native timber plantation (usually pines) are also assessed as being a bush fire hazard with a fuel load of 20t/Ha.

Where fuel loads are to be assessed, PBP has adopted a reliable system of assessing fuel accumulation rates based on canopy cover, years since last fire and shrub layer cover (Forestry Commission of NSW, 1991). This has also been validated with published literature on fuel loads (eg. Good, 1994, Watson, 2005, Cheney and Sullivan,

PBP does not accept photo comparative assessment techniques as a basis of estimating fuel in forests for land use planning and construction purposes due to the significant variability in interpretation.

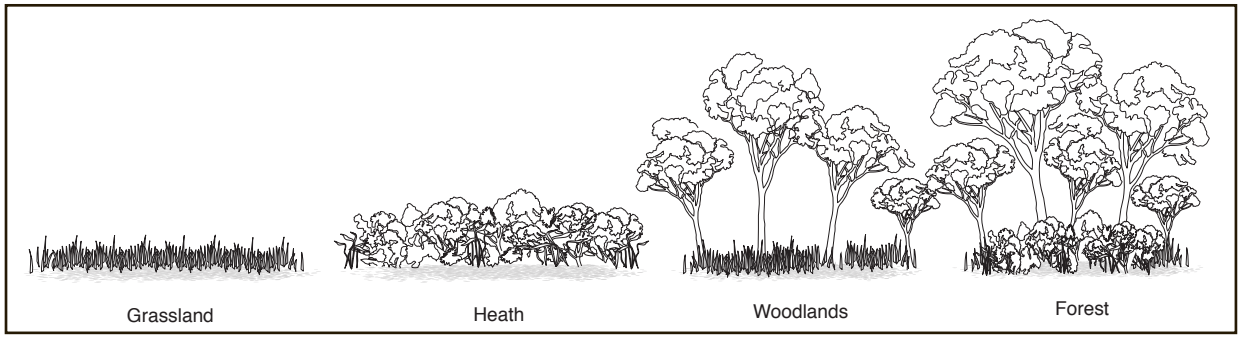

Figure A 2.2 Examples of Vegetation Types used in PBP

Riparian areas

Orchards (reduced vegetation)

Playgrounds (reduced vegetation)

Woodland remnant

Examples of non-vegetated and reduced vegetation areas.

1997, Department of Planning, 1984).
For the purposes of assessing available fuel, the forest fuel is assumed to have accumulated over a period of 20 years and is the loading given for dry sclerophyll forests.

Recent experiences from bush fires in Central Western NSW have demonstrated that a significant threat can exist for developments in grassland areas. Construction requirements are not specified in relation to grassland areas and these areas may not be mapped as being bush fire prone. Grass fires can threaten the sub floor spaces of a building and may generate significant embers. The RFS supports protection of the sub floor or the integration of 1.8 metre high protective (non combustible) fencing in conjunction with screened windows and a basic APZ of 10 metres for these situations. LEP provisions should address rural properties at threat from crop or grass fires including access, water and the above as a requirement.

Remnant vegetation is a parcel of vegetation with a size of less than 1 Ha or a shape that provides a potential fire run directly toward buildings not exceeding 50m. These remnants are considered a low hazard and APZ setbacks and building construction standards for these will be the same as for rainforests. The effective slope is to be determined over the length of the remnant.

Although small remnants, coastal wetlands and riparian areas vary significantly in structure and composition, these areas have been generally assessed as being bush fire hazards, with the exception of saline wetlands that are assessed as being a non-hazard. Riparian areas are those areas of vegetation which are no greater than 20 metres in width and are found on either bank of a river, creek or stream identified on a bush fire prone land map, and are treated the same as rainforests.

For the purposes of assessment, the following are not considered a hazard or as a predominant vegetation class/ formation and can be included within an asset protection zone:

(a) non-vegetated areas including roads, footpaths, cycleways, waterways, buildings, rocky outcrops and the like; and

(b) reduced vegetation including maintained lawns, golf course fairways, playgrounds or sports fields, vineyards, orchards, cultivated ornamental gardens and commercial nurseries.

Rainforests (Closed forest)

Dry sclerophyll forests (Open forest)

Central Western Grasslands

Semi-arid woodlands (Low woodlands)

Examples of Vegetation Formations of NSW

Table A2.1 Classification of Vegetation Formations (after Keith, 2004)

Keith (2004) Formations		
Formation class	**Formation (Sub formation) Description**	**F (r)/F(t)* (t/ha)**
Rainforests (Closed forest)	Closed and continuous tree canopy composed of relatively soft, horizontally-held leaves. Generally lacking in eucalypts. Understorey typically includes ferns and herbs. Vines often present in canopy or understorey. Occur mainly in areas that are reliably moist, mostly free of fire and have soils of moderate to high fertility. Typically coastal and escarpment locations.	8/10
Wet sclerophyll forests (Tall open forest)	High open tree canopy dominated by tall (typically >30m), straight-trunked eucalypt species. Luxuriant understorey composed of soft leaved shrubs, ferns and herbs. Many understorey plants are rainforest species. Found on moderately fertile soils in areas of high (>900mm) rainfall.	
	Shrubby sub formation Many soft-leaved shrubs and small trees in understorey. Eg. Typically sub-alpine and tableland locations.	25/30
	Grassy sub formation Fewer soft-leaved shrubs allowing a more substantial cover of grasses and herbs on the forest floor. Reflects drier habitat. Eg. Typically coastal and escarpment locations.	20/25
Grassy woodlands (Woodlands)	Dominated by an open to sparse layer of eucalypts (typically boxes and red gums) with the crowns rarely touching (ie <30% foliage cover). Typically 15-35m high (may be shorter at sub-alpine altitudes). Diverse ground cover of grasses and herbs. Long lived perennial tussock grasses form the structural matrix of the understorey. Shrubs are sparsely distributed. Found on fine textured soils of moderate to high fertility, principally on flat to undulating terrain. Rainfall 500-900mm Tablelands, western slopes, and low rainfall coastal lowlands.	10/15
Grasslands	Dominated by large perennial tussock grasses and the presence of broad-leaved herbs in the inter-tussock spaces. Lack of woody plants. Associated with fertile heavy clay soils on flat topography on in regions with low to moderate rainfall. Plants include grasses, daisies, legumes, geraniums, saltbushes and copperburrs.	6
Dry sclerophyll forests (Open forest)	Dominated by eucalypts 10-30m tall with crowns that touch or overlap (ie foliage cover of 20-50%). Prominent layer of hard-leaved shrubs. Infertile soils. Rainfall >500mm. Coast, tablelands and western slopes.	
	Shrub/grass sub formation Conspicuous presence of grasses in the understorey. Also have a significant shrub component, including a mixture of hard leaved and soft-leaved plants. Includes native timber plantations.	20/25
	Shrubby sub formation Understorey dominated by shrubs including waratahs, banksias, spider flowers, wattles, pea-flowers, gum trees, tea-trees, native fuschias, boronias and wax flowers. Sparse ground cover comprised mainly of hard-leaved sedges. Found on sandy infertile soils on exposed sites.	20/25
Heathlands (Shrublands)	Shrubby vegetation. Principal plant species include banksias, spider flowers, wattles, legumes, eucalypts, tea-trees, paper barks, sheoaks, grass trees, cord rushes and sedges. Grasses are scarce. Found on infertile soils and is dependant on fire. Not found in arid and semi arid locations.	

Table A2.1 Classification of Vegetation Formations (after Keith, 2004)

Formation class	Formation (Sub formation) Description	F (r)/F(t)* (t/ha)
Heathlands (Shrublands)	**Tall Heaths (Scrub)** Heathlands greater than 2 metres tall. Includes Hawkesbury Sandstone vegetation with scattered overstorey trees and predominantly healthy understorey and coastal heath. May include some mallee eucalypts in coastal locations.	25
	Short Heath (Open Shrub) Heathlands less than 2 meters in height. Often more open in canopy.	15
Alpine complex (Sedgelands)	Structural dominance by small-leaved shrubs, herbs and tussocky grasses. Seasonal dormancy and snow tolerance. A lack of trees.	17
Freshwater wetlands	Areas permanently or temporarily inundated either by standing or running water (swamps). Dominated by sedges, shrubs or herbs. Excludes wetlands dominated by trees and those with significant quantities of salt. Coast, tablelands, western slopes and plains.	15
Forested wetlands	Restricted to riverine corridors and floodplains subject to periodic inundation. Dominated by eucalypts, tea-trees and paperbarks or sheoaks. Distinguished by presence of hydrophytes, woody plants that can live in flooded environments eg. sedges, rushes, buttercups, knot weeds, lignum, ferns and grasses. Found generally low altitudes. Soils vary from peaty and semi-humic loam soils to mineral clays and sandy loams. Coast, tablelands, and inland.	15/20
Saline wetlands	Distinguished by an abundance of salt. Halophytes abundant. Eg mangrove swamps, salt marshes and seagrass meadows. Coast (tidal estuaries) and western plains (salt lakes).	-
Semi-arid woodlands (Low woodlands)	Widely spaced tree canopies, trees 5-20m tall. Dominance of sclerophyllous trees (box eucalypts, mallee eucalypts, sheoaks, wattles and cypress pines), drought resistant shrubs and ephemeral grasses and herbs. Rainfall 250-500mm/year. Western plains.	
	Grassy sub formation Occurs on floodplains. Understorey predominantly grassy, although chenopod shrubs may be common in some local areas. Can be distinguished from grassy woodlands by their more ephemeral ground cover and predominant trees and shrubs, all of which have inland distributions.	5/18
	Shrubby sub formation Occurs on more elevated areas or uplands. Shorter trees <15m and less cover of grasses than the grassy formation. Abundant drought resistant shrubs and variable grass cover. Eg. Mallee woodland	8
Arid shrublands	Dominated by drought-tolerant shrubs, including chenopods. Occur where the rainfall or local soil moisture is too low to support tree-dominated vegetation. Rainfall <500mm. Western plains.	
	Chenopod sub formation (Low shrublands) Dominated by low shrubs (mostly <1.5m tall) such as saltbushes, bluebushes and copperburrs. Ground cover of perrenial tussock grass (never hummock grass). Found on lime-rich calcareous or saline soils.	9
	Acacia sub formation (Tall shrublands) Shrubs usually taller than 2m, dominated by various acacia species and other large shrubs. May have abundant hummock grass (spinifex) ground cover. Found on silica rich soils. Eg. Mulga shrubland	9

** Fuel loads are expressed as fuels contributing to rates of spread [F(r)] and total fuel loads [F(t)] that contribute to intensity. Single figures denote same values for both based on bush fire behaviour models.*

(b) Effective Slope

Assess the slope over a distance of at least 100m from the existing property boundary (for subdivision) or building footprint (for SFPP) on the development site towards the various vegetation communities constituting the hazard. In assessing the slope, it may be found that there are a variety of slopes covering different distances. Determine the gradient within the hazard (vegetation) which will most significantly influence the fire behaviour of the site having regard to vegetation class found.

Slope assessment may be derived from topographic maps displaying 10 metre contour intervals. Where land is being surveyed by a land surveyor, assessments should be based on a minimum of five metre contours.

The slope is determined in terms of the following classes, relative to the location of the hazard:

(i) all upslope vegetation (considered 0º)
(ii) >0 to 5° downslope vegetation
(iii) >5 to 10° downslope vegetation
(iv) >10 to 15° downslope vegetation
(v) >15 to 18° downslope vegetation

APZ tables in this Appendix are provided for acceptable solutions with slopes of up to 18 degrees. Effective slopes to be assessed with hazards in excess of 18 degrees will require a detailed performance assessment

SLOPE COMPARISIONS

Ratio	Degrees	Percentage
1:1	45	100%
1:1.5	34	66%
1:2	26	50%
1:2.5	21	40%
1:3	18	33%
1:3.5	15	28%
1:4	14	25%
1: 4.5	12	22%
1:5	11	20%
1: 5.5	10	18%
1: 6	9	16%
1: 6.5	9	15%
1: 7	8	14%
1: 7.5	8	13%
1: 8	7	12%
1: 8.5	7	11%
1: 9	6	11%
1: 10	6	10%
1: 11	5	9%
1: 12	5	8%
1: 13	4	8%
1: 14	4	7%
1: 15	4	7%
1: 16	4	6%
1: 17	3	6%
1: 18	3	5.5%
1: 19	3	5%
1: 20	3	5%

Table A 2.2 Slope Comparisons

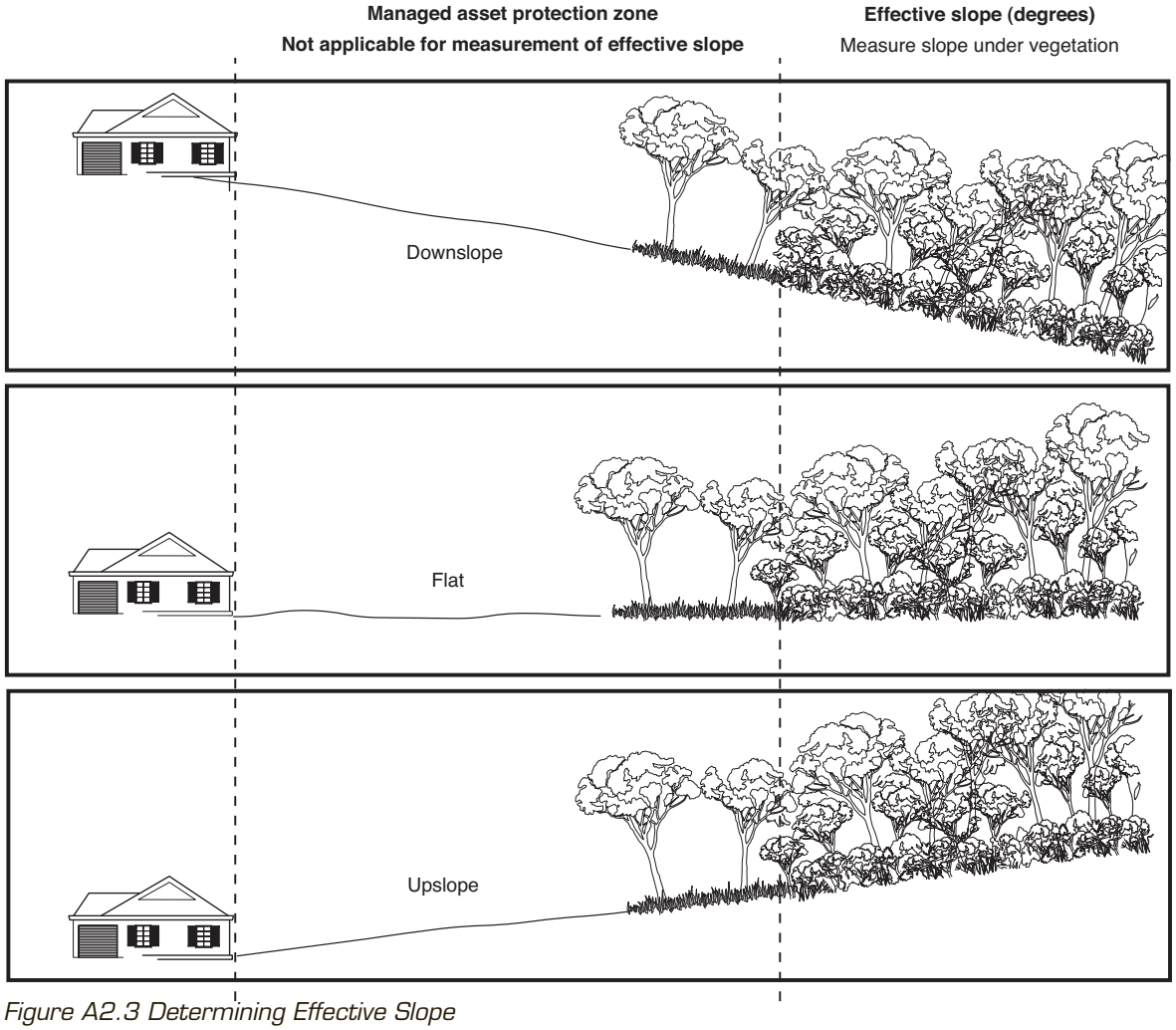

Figure A2.3 Determining Effective Slope

1. FAR NORTH COAST (80)
Ballina
Byron
Clarence Valley
Kyogle
Lismore
Richmond Valley
Tweed

2. NORTH COAST (80)
Bellingen
Coffs Harbour
Gloucester
Great Lakes
Greater Taree
Hastings
Kempsey
Nambucca

3. GREATER HUNTER (100)
Cessnock
Dungog
Lake Macquarie
Maitland
Muswellbrook
Newcastle
Port Stephens
Singleton
Upper Hunter

4. GREATER SYDNEY REGION (100)
All Sydney Metropolitan Councils
Plus Gosford, Blue Mountains,
Hawkesbury and Wyong

5. ILLAWARRA/SHOALHAVEN (100)
Kiama
Shellharbour
Shoalhaven
Wingecarribee
Wollondilly
Wollongong

6. FAR SOUTH COAST (100)
Bega Valley
Eurobodalla

7. MONARO ALPINE (80)
Bombala
Cooma Monaro
Snowy River

8. ACT (N/A)
Australian Capital Territory

9. SOUTHERN RANGES (100)
Palerang
Goulburn Mulwaree
Queanbeyan
Upper Lachlan
Yass Valley

10. CENTRAL RANGES (80)
Bathurst
Blayney
Cabonne
Cowra
Lithgow
Mid Western Regional
Oberon
Orange

11. NEW ENGLAND (80)
Armidale Dumaresq
Glen Innes Severn
Guyra
Tenterfield
Uralla
Walcha

12. NORTHERN SLOPES (80)
Gunnedah
Gwydir
Inverell
Liverpool Plains
Tamworth Regional

13. NORTH WESTERN (80)
Moree Plains
Narrabri
Walgett
Warrumbungle

14. UPPER CENTRAL WEST PLAINS (80)
Bogan
Coonamble
Gilgandra
Warren

15. LOWER CENTRAL WEST PLAINS (80)
Bland
Dubbo
Forbes
Lachlan
Narromine
Parkes
Temora
Weddin
Wellington

16. SOUTHERN SLOPES (80)
Boorowa
Cootamundra
Gundagai
Harden
Tumbarumba
Tumut
Young

17. EASTERN RIVERINA (80)
Albury
Coolamon
Greater Hume
Junee
Lockhart
Wagga Wagga

18. SOUTHERN RIVERINA (80)
Berrigan
Conargo
Corowa
Deniliquin
Jerilderie
Murray
Urana
Wakool

19. NORTHERN RIVERINA (80)
Carrathool
Griffith
Hay
Leeton
Murrumbidgee
Narrandera

20. SOUTH WESTERN (80)
Balranald
Wentworth

21. FAR WESTERN (80)
Bourke
Brewarrina
Broken Hill
Central Darling
Cobar
Unincorporated NSW

Table A2.3 NSW Fire Areas and associated council areas with appropiate FDI rating assumed as a 1:50 year event.

(c) Determining Appropriate Fire (Weather) Areas

For residential and rural residential subdivisions locate the site in terms of the local council area (see inside rear cover and Table A2.3) where the development is to be located and determine the appropriate fire areas and corresponding FDI rating. For SFPP's see (d) below.

(d) Determining Appropriate Asset Protection Zones (APZs)

Consult Tables A2.4 and A2.5 (for subdivisions) for each respective vegetation class and appropriate FDI rating. **These setbacks are based upon the need to conform to Level 3 (except grasslands) construction (AS 3959 – 1999) for a building of Class 1 or 2 under the BCA.**

Grasslands of 100 metres from any boundary (subdivision) or buildings (SFPPs) do not require construction requirements in conformity with AS 3959 – 1999 or this document but requires an APZ of 10 metres for slopes <18°.

If it is intended to construct to a lower bush fire protection standard (e.g. Level 1 or 2) or to no specific bush fire protection standards, Appendix 3 should be consulted for the appropriate setbacks for individual circumstances.

For SFPPs (e.g. SEPP – Seniors Living and Class 3 buildings), Table A2.6 is used. In interpreting the Tables refer to the accompanying notes to these Tables.

Location of APZs on slopes greater than 18 degrees is not supported for new developments on wooded vegetation, due to environmental constraints and difficulties in managing vegetation. In addition, vegetation could carry a canopy fire along these steep slopes where an understorey would otherwise normally be required to support a sustained crown fire.

APZs should be identified on plans for interface allotments by either a building line or building footprint. In some cases building envelopes are identified which include other building constraints. Unless otherwise specified, a building envelope will be taken as the building footprint.

Where the predominant vegetation is removed in establishing the required APZ, the site should be reassessed and the dimensions of the APZ may be adjusted in the light of the remaining predominant vegetation.

Allowable OPAs within an APZs are set out in Table A2.7 for forest vegetation.

Table A2.4 Minimum Specifications for Asset Protection Zones (m) for Residential and Rural Residential Subdivision Purposes (for Class 1 and 2 buildings) in FDI 100 Fire Areas (≤29kW/m²)

	Effective Slopes				
Vegetation Formation	**Upslope/Flat**	**>0°-5°**	**>5°-10°**	**>10°-15°**	**>15°-18°**
Rainforests	10	10	15	20	25
Forests	20	25	35	50	60
Woodland (Grassy)	10	15	20	25	30
Plantations (Pine)	20	25	30	45	50
Tall Heath (Scrub)	15	15	20	20	20
Short Heath (Open Scrub)	10	10	10	15	15
Freshwater Wetlands	10	10	10	15	15
Forested Wetlands	15	20	25	35	45

Table A2.5 Minimum Specifications for Asset Protection Zones (m) for Residential and Rural Residential Subdivision Purposes (for Class 1 and 2 buildings) in FDI 80 Fire Areas (≤29kW/m²)

	Effective Slopes				
Vegetation Formation	**Upslope/Flat**	**>0°-5°**	**>5°-10°**	**>10°-15°**	**>15°-18°**
Rainforests	10	10	15	15	20
Forests	20	20	30	40	45
Woodland	10	15	15	20	25
Plantations (Pine)	15	20	25	35	40
Tall Heath (Scrub)	15	15	20	20	20
Short Heath (Open Scrub)	10	10	10	15	15
Freshwater Wetlands	10	10	10	15	15
Forested Wetlands	15	20	20	30	35
Semi-Arid (Woodland)	10	10	10	10	15
Arid Shrubland	10	10	10	15	15

Table A2.6 Minimum Specifications for Asset Protection Zones (m) for Special Fire Protection Purposes in bush fire prone areas (≤10kW/m²)

	Effective Slopes				
Vegetation Formation	**Upslope/Flat**	**>0°-5°**	**>5°-10°**	**>10°-15°**	**>15°-18°**
Rainforests	30	40	50	60	65
Forests	60	70	85	100	100
Woodland (Grassy)	40	50	60	70	75
Plantations (Pine)	50	60	70	85	95
Tall Heath (Scrub)	45	50	55	60	65
Short Heath (Open Scrub)	35	35	40	45	45
Freshwater Wetlands	35	35	40	45	45
Forested Wetlands	50	60	75	90	95
Semi-Arid (Woodland)	30	35	40	45	50
Arid Shrubland	30	35	40	45	45
Alpine Resorts	(see page 31 and Table A3.5 on page 66)				

Table A2.7 Determining Allowable Outer Protection Areas (m) for forest vegetation within an APZ

	Effective Slopes				
	Upslope/Flat	**>0°-5°**	**>5°-10°**	**>10°-15°**	**>15°-18°**
Forests FDI 100 - subdivision	10	10	15	25	30
Forests FDI 80 - subdivision	10	5	15	20	20
Forests SFPP	20	20	25	30	25

Note: Vegetation Formations based on Keith D. (2004) - see pages 54 - 55

For Forest Vegetation Formations, APZs can incorporate IPAs and OPAs (see page 50). OPAs to the distances specified in Table A2.7 are allowable subject to meeting the perfomance requirements for the OPAs. The balance of the APZ is to be managed as an IPA.