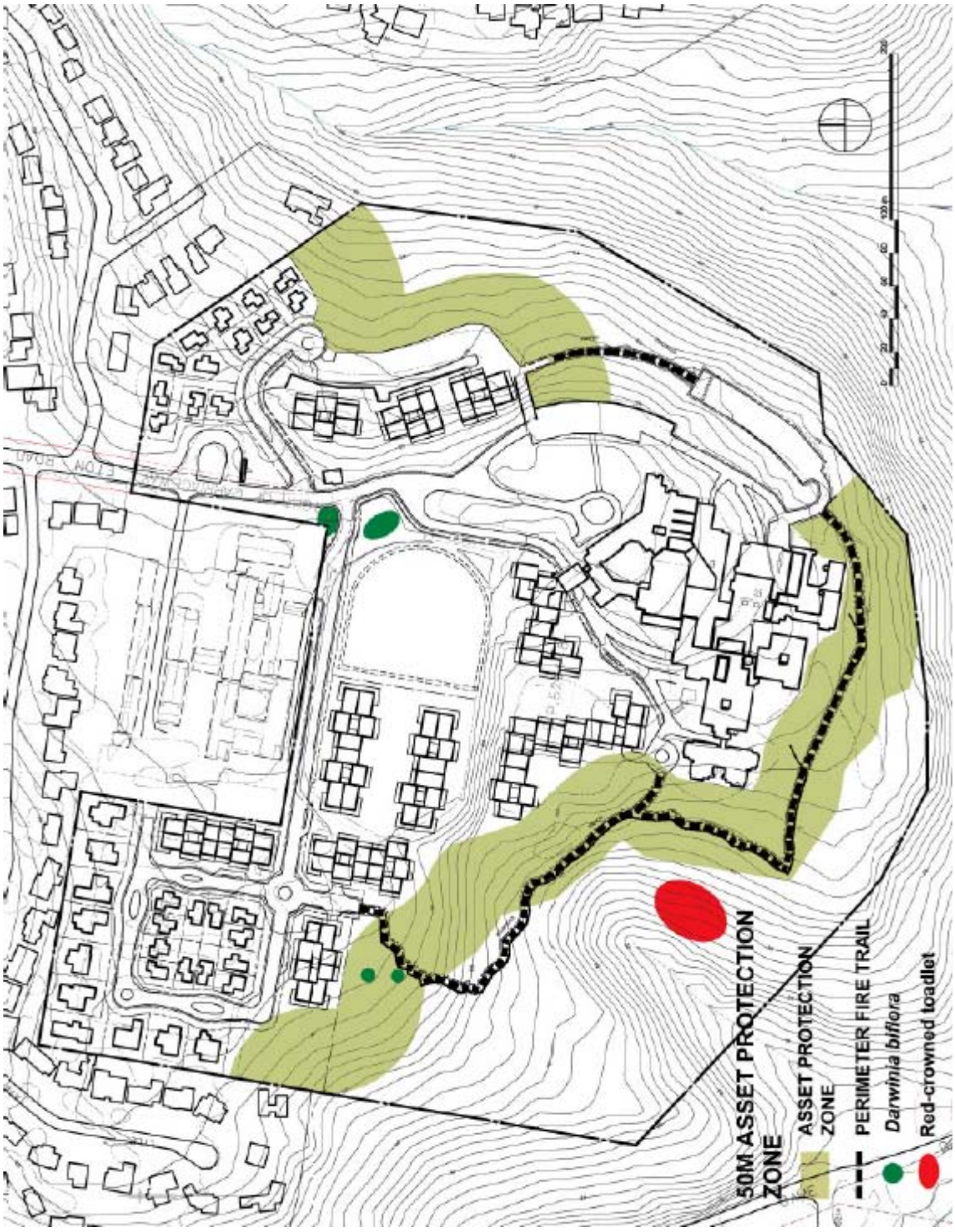
8 REFERENCES

NSW Rural Fire Service, Planning NSW, 2006, *'Planning for Bushfire Protection'*

AS 3959-1999: *Construction of Buildings in Bush Fire Prone Areas*.

Ku-ring-gai Council Local Government Area Bushfire Prone Land Maps

APPENDIX A – CONCEPT PLAN


50M ASSET PROTECTION ZONE
ASSET PROTECTION ZONE
PERIMETER FIRE TRAIL
Darwinia biflora
Red-crowned toadlet

APPENDIX B – VEGETATION ASSESSMENT

Figure A2.2, *Planning for Bushfire Protection* - Examples of Vegetation Types

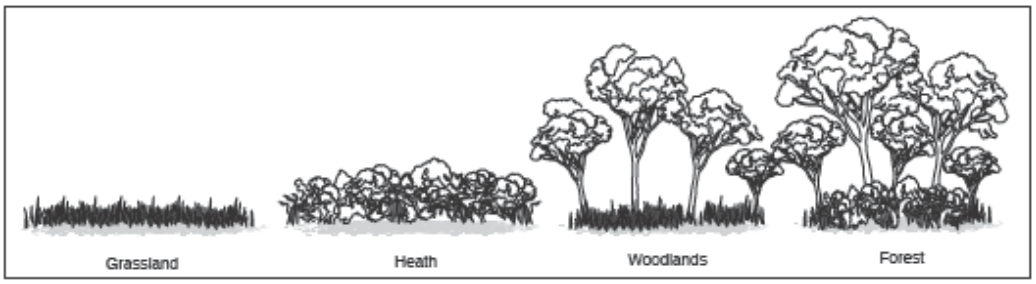


Figure A 2.2 Examples of Vegetation Types used in PBP

Table A2.1, *Planning for Bushfire Protection* - Classification of Vegetation Formations

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.*

APPENDIX C – BUSHFIRE PROTECTION ASSESSMENT (ASSET PROTECTION ZONES)

Tables A2.4 - A2.6, *Planning for Bushfire Protection* - Minimum Specifications for Asset Protection Zones (APZ) for **Residential and Rural Residential Subdivision Purposes and Special Fire Protection Purposes** in bushfire-prone areas:

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, *Planning for Bushfire Protection* - Allowable Outer Protection Areas (OPA) for forest vegetation within an APZ:

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

APPENDIX D – BUSHFIRE ATTACK ASSESSMENT (TABLE A3.1 AND A3.3)

Table A3.1, *Planning for Bushfire Protection* – Categories of Bushfire Attack

PBP Category	Description	AS 3959 Construction Level
Low	Minimal attack from radiant heat and flame due to the distance of the site from the vegetation, although some attack by burning debris is possible. There is insufficient threat to warrant specific construction requirements.	Low - no construction requirements
Medium	Attack by burning debris is significant with radiant heat (not greater than 12.5 kW/m²). Radiant heat is unlikely to threaten building elements (eg unscreened glass). Specific construction requirements for ember protection and accumulation of debris are warranted.	Medium - Level 1
High	Attack by burning debris is significant with radiant heat levels (not greater than 19 kW/m²) threatening some building elements (screened glass). Specific construction requirements for embers and radiant heat are warranted.	High - Level 2
Extreme	Attack by burning debris is significant and radiant heat levels (not greater than 29 kW/m²) threaten building integrity. Specific construction requirements for ember and higher radiant heat are warranted. Some flame contact is possible.	Extreme - Level 3
Flame Zone	Radiant heat levels and flame contact likely to significantly threaten building integrity and result in significant risk to residents who are unlikely to be adequately protected.	Outside Scope

Note: Attack from burning debris increases as the category of bush fire attack becomes more severe.

Table A3.2 Categories of bush fire attack and appropriate construction levels

Table A3.3, *Planning for Bushfire Protection* – Determination of Category of Bushfire Attack for a Site

Table A3.3 DETERMINATION OF CATEGORY OF BUSH FIRE ATTACK FDI 100 (Greater Sydney, Greater Hunter, Illawarra/Shoalhaven, Southern Ranges, South Coast Fire (Weather) Areas) (see table A 2.3).

Vegetation Formation (class)	Categories of Bush Fire Attack (AS 3959-1999)				
	Flame Zone	Level 3 (Extreme)	Level 2 (High)	Level 1 (Medium)	No requirement
	Distance (m) of the site from the predominant vegetation class				
All upslopes and flat land (0 degrees)					
Forests (wet and dry sclerophyll)	<20	20-<29	29-<40	40 - 100	>100
Woodlands	<11	11-<16	16-<23	23 - 100	>100
Tall heath	<13	13-<19	19-<27	27 - 100	>100
Short heath	<9	9-<13	13-<19	19 - 50	>50
Forested wetlands	<16	16-<23	23-<32	32 - 50	>100
Freshwater wetlands	<9	9-<13	13-<19	19 - 50	>50
Rainforest	<9	9-<13	13-<19	19 - 50	>50
Downslope > 0 to 5 degrees					
Forests (wet and dry sclerophyll)	<25	25-<36	36-<49	49 - 100	>100
Woodlands	<14	14-<20	20-<29	29 - 100	>100
Tall heath	<15	15-<22	22-<31	31 - 100	>100
Short heath	<10	10-<15	15-<22	22 - 50	>50
Forested wetlands	<20	20-<29	29-<40	40 - 100	>100
Freshwater wetlands	<10	10-<15	15-<22	22 - 50	>50
Rainforest	<10	10-<16	16-<24	24 - 50	>50
Downslope > 5 to 10 degrees					
Forests (wet and dry sclerophyll)	<34	34-<45	45-<59	59 - 100	>100
Woodlands	<18	18-<26	26-<37	37 - 100	>100
Tall heath	<17	17-<24	24-<35	35 - 100	>100
Short heath	<10	10-<17	17-<25	25 - 50	>50
Forested wetlands	<25	25-<36	36-<49	49 - 100	>100
Freshwater wetlands	<10	10-<17	17-<25	25 - 50	>50
Rainforest	<14	14-<21	21-<31	31 - 50	>50
Downslope > 10 to 15 degrees					
Forests (wet and dry sclerophyll)	<47	47-<55	55-<71	71 - 100	>100
Woodlands	<24	24-<33	33-<46	46 - 100	>100
Tall heath	<19	19-<28	28-<39	39 - 100	>100
Short heath	<13	13-<19	19-<28	28 - 50	>50
Forested wetlands	<35	35-<45	45-<60	60 - 100	>100
Freshwater wetlands	<13	13-<19	19-<28	28 - 50	>50
Rainforest	<19	19-<28	28-<39	39 - 60	>60
Downslope > 15 to 18 degrees					
Forests (wet and dry sclerophyll)	<57	57-<62	62-<80	80 - 100	>100
Woodlands	<29	29-<38	38-<52	52 - 100	>100
Tall heath	<20	20-<30	30-<41	41 - 100	>100
Short heath	<14	14-<21	21-<30	30 - 50	>50
Forested wetlands	<43	43-<51	51-<67	67 - 100	>100
Freshwater wetlands	<14	14-<21	21-<30	30 - 50	>50
Rainforest	<23	23-<32	32-<44	44 - 70	>70

APPENDIX E – COMPONENTS OF AN ASSET PROTECTION ZONE

Section 4.2.2, *Planning for Bushfire Protection (2001)* which provides a more succinct description of the components of Asset Protection Zones.

OUTER PROTECTION AREA

Location

The OPA is located adjacent to the hazard. Originally the OPA would have been part of the bushfire hazard but has become an area where the fuel loadings are reduced.

Purpose

The reduction of fuel in this area substantially decreases the intensity of an approaching fire and restricting the pathways to crown fuels; reducing the level of direct flame, radiant heat and ember attack on the IPA.

Depth

The depth of the OPA is largely dependent on the type of land use and vulnerability of the dwelling or persons affected.

Fuel Loadings

Within the OPA, any trees and shrubs should be maintained in such a manner that the vegetation is not continuous.

Fine fuel loadings within the OPA should be kept to a level where the fire intensity expected will not impact on adjacent developments. In the absence of any policy to the contrary, 8 tonnes per hectare of fuel is commonly used.

In grasslands, fuel height should be maintained below 10 cm.

INNER PROTECTION AREA

Location

The Inner Protection Area extends from the edge of the Outer Protection Area to the development.

Purpose

The IPA ensures that the presence of fuels, which could become involved in a fire, are minimised close to a development. Therefore the impact of direct flame contact and radiant heat on the development is minimised.

Depth

The depth of the IPA is dependent upon the slope of the land. The greater the slope, the greater the intensity of any approaching fire and hence the greater the depth required for the IPA.

Fuel Loadings

It is more practical to determine the specifications of the IPA in terms of performance than in terms of a minimum fuel loading.

The performance of the IPA must be such that:

(a) there is minimal fine fuel at ground level which could be set alight by a bushfire; and

(b) any vegetation in the IPA does not provide a path for the transfer of fire to the development – that is, the fuels are discontinuous.

The presence of a few shrubs or trees in the IPA is acceptable provided that they:

(a) do not touch or overhang the building;

(b) are well spread out and do not form a continuous canopy;

(c) are not species that retain dead material or deposit excessive quantities of ground fuel in a short period or in a danger period; and

(d) are located far enough away from the house so that they will not ignite the house by direct flame contact or radiant heat emissions.

Woodpiles, wooden sheds, combustible material storage areas, large areas/quantities or garden mulch, stacked flammable building materials etc should not be permitted in the IPA.