



# EDGELEA ESTATE, LINDFIELD

## Bushfire Management Plan

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Defence Housing Australia

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# 1 Introduction and Background

This Bushfire Management Plan (BMP) was prepared for Defence Housing Australia (DHA) under contract by Eco Logical Australia Pty Ltd (ELA).

## 1.1 SCOPE AND OBJECTIVES

The BMP describes the objectives, strategies and activities for bushfire management within Edgelea Estate (formerly part of the University of Technology Sydney - Ku-ring-gai Campus), off Eton Road, Lindfield (hereafter referred to as the 'Site'). The BMP is prepared for the years 2012 to 2017, and it provides a framework for continued management beyond 2017.

The BMP addresses both the life and property protection and biodiversity conservation goals of fire management within the Site. The BMP also provides guidance on fire prevention and fire suppression.

Seven primary objectives of the BMP have been identified for the Site by ELA. These are set out below:

1. Meet DHA's legislative requirements in terms of its public risk liability.
2. Minimise unplanned bushfires.
3. Minimise the spread of bushfires in the Site.
4. Protect persons and property, in and adjacent to the Site.
5. Manage fire regimes and hazard reduction activities to avoid extinction of species, communities and populations.
6. Protect cultural assets from damage by fire and hazard reduction activities.

## 1.2 LIMITATIONS OF THE PLAN

The task of establishing appropriate mitigation measures in areas of existing development is often complicated. There are many obstacles to the upgrading of existing developments to achieve construction standards similar to those required for new buildings (AS 3959 Standards Australia 2009). Further, modifying vegetation to the extent required to create an appropriate Asset Protection Zone (APZ) can be limited by significant environmental constraints, such as steep lands with possible geotechnical problems, threatened species, endangered ecological communities and other environmental considerations.

In this instance, even though the Site is generally able to accommodate compliance with the legislative bushfire protection requirements, a risk based approach has been utilised for this BMP in order to further identify protection measures that can be applied through which risks from bushfire can be reduced to more manageable and tolerable levels.

### **1.3 RESIDUAL RISK**

Residual risk is defined as the bushfire risk that remains after the implementation of bushfire risk reduction measures. It is acknowledged that despite the bushfire protection measures, some bushfire risk to life and property will remain and bushfires will continue to threaten life and property to some extent. It is simply not possible, without major environmental and/or financial impact, to provide complete protection for life and property located in bushfire prone areas. However, as outlined in Section 3, the risk assessment process documented that risk in this instance is generally insignificant to moderate.

## 2 Description of the Site

### 2.1 LOCATION

The DHA-owned Edgelea Estate (the Site) is located in the suburb of Lindfield, within lands previously owned by the University of Technology Sydney (Figure 1). Access is limited due to the layout of the existing road network and can only be acquired from Eton Road within the north of the Site.

The area of DHA-owned land (the subject of this is BMP) covers approximately 15ha, including 5.6ha of vegetated areas retained specifically for the implementation of Asset Protection Zones (APZs).

The Site is surrounded predominantly by Lane Cove National Park (LCNP) to the west, south and east, with existing urban development to the north. The Site contains various existing buildings associated with the previous UTS educational uses, including the main campus building in the south, the gym and sports facilities in the central portion of the Site, and the child care centre in the north western portion of the Site. There is an existing road network currently linking these areas of the Site, as well as informal walking/management tracks along the perimeter of LCNP.

### 2.2 BIODIVERSITY

Two (2) native vegetation communities are recognised to occur in the Site (ERM 2011); Sydney Sandstone Ridge top Woodland (within the upper, developed areas of the Site) and Coastal Sandstone Gully Forest (within the remnant bushland areas of the Site).

None of the vegetation communities recorded within the Site are listed as endangered under either Schedule 1 of the *Threatened Species Conservation Act 1995* (TSC Act) or the *Environmental Protection and Biodiversity Act 1999* (EPBC Act) (ERM 2011).

One threatened plant, *Darwinia biflora*, and one threatened amphibian, the Red-crowned Toadlet, have been recorded within the Site. The powerful Owl has also been known to utilise the Site as a potential day-roosting area. Designated conservation areas have been established for the protection of the *Darwinia biflora*, whilst the primary habitat area for the Red-crowned Toadlet has been dedicated to form part of LCNP. The ongoing conservation of these threatened species within the Site is also subject to specific Threatened Specific Management Plans (ERM 2011).

### 2.3 CULTURAL HERITAGE

As no detailed cultural heritage surveys have been undertaken, undiscovered Aboriginal sites and/or artefacts may exist under the vegetation covering the Site. Aboriginal Heritage within the Site is largely undocumented and has the potential to be impacted

The Site contains the existing UTS Ku-ring-gai Campus buildings which are considered to have heritage value, due to both the building themselves (materials, designs and the like) and also due to the interactions between the buildings and the immediately surrounding remnant bushland areas.

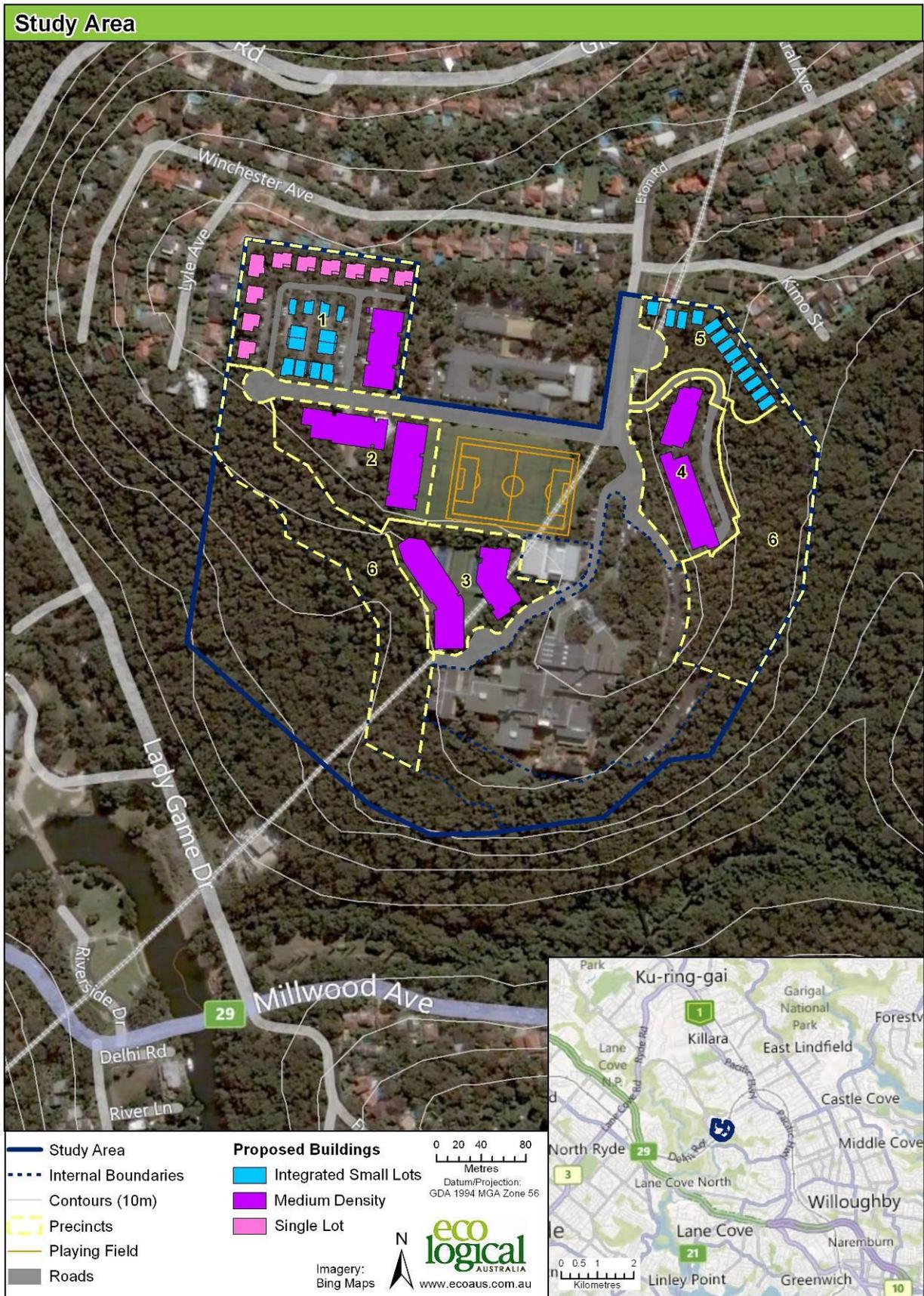


Figure 1: Study area location

## 2.4 RECREATIONAL USE AND FACILITIES

Recreational activities within the Site currently include community/university sports (using the open space areas), walking/running, dog walking, mountain biking, and other active and passive recreation from time to time. These activities are generally confined to the open space or established infrastructure areas of the Site, but are likely to also include the informal trails that exist along the perimeter of LCNP – within the proposed APZ areas.

The existing informal track network provides access from the residential areas in the north west around Winchester Avenue and Lyle Avenue through the Site to the existing UTS buildings and around to the east towards Kimo Street and Abingdon Road. The topography throughout the perimeter areas of the Site and within LCNP makes any access trails almost impassable in certain locations. Informal access can also be gained directly to LNCP from the Site. These tracks are in generally poor condition and appear to be infrequently used.

Since the formal approval of the concept plan for the Site, there is now a mixture of zonings that apply to the Site, including:

- R1 – Medium density residential use;
- R2 – Low density residential use;
- E3 – Environmental management;
- RF1 – Public Open Space; and
- B4 – Education precinct.

## 2.5 EXISTING BUSHFIRE ASSETS AND ADVANTAGES

### 2.5.1 Access Arrangements

The proposed access and egress arrangements for the Site are defined and constrained by the existing road design and layout. The concept approval sought to modify the roads with the intent of making them as compliant and safe as possible for the proposed development of the Site, whilst also having consideration for the utilisation of the same areas within the Site, i.e. minimising the formation of completely new roads. The access and egress for the proposed subdivision complies with the relevant provisions of PBP, with the exception of the length of the dead end roads. This non-compliance is a constraint upon the development due to the existing layout of road network which has been carried forward to the concept plan approval. Alternatively, the road layout is able to comply with the relevant Performance Criteria of PBP in this regard.

As can be seen within Figure 1, the subject Site itself is somewhat restricted in terms of potential access arrangements, as there is only one access route in and out of the subject land via Eton Road to the north and the roads within the Site are terminal. This is an unfortunate consequence of both past planning arrangements in combination with the nature of the surrounding topography which make the construction of alternative through roads, both within the Site and around it, either too difficult to construct or not situated in locations where they will provide any ease of traffic flows into and away from the subject Site.

Eton Road itself is greater than 8 metres in width and the entry point into the Site is also situated within 35 metres of Abingdon Road which does provide for a secondary egress route through the surrounding parts of Lindfield and towards the Pacific Highway in the north east. Both egress routes are well shielded by existing residential development from the potential impacts of bushfire.

The proposed internal road network will connect directly on to Eton Road with all the roads drawing evacuees away from the hazard through both the proposed residential development and surrounding existing residential areas, effectively providing a level of shielding as the egress takes place.

It should also be noted that due to the holistic and comprehensive approach taken in the implementation of a suite of bushfire protection measures across the site, including APZs greater than those required within PBP and the provision of extensive open space community lands (sports ovals) that are suitable as an evacuation assembly/staging area, a scenario is created within the site where the need for the complete evacuation of the site is greatly reduced. The subsequent flow-on effect of this is the potential easing traffic pressures on the existing road network both with the site and surrounding community.

### **2.5.2 Water Supplies**

In terms of water supplies, there are existing reticulated water network and associated hydrants situated along both Eton Road and within the Site shall be upgraded to ensure they are compliant and meet the potential demand that future residential development of the site will require.

In addition, there is also proposed to be a strategic distribution of static water storage area through at least three of the proposed development precincts within the site. The placement of the tank storage will be focused around the precincts that contain the medium-density residential development, and are likely to be incorporated into the structure and design of the building, such as basement/car parking areas. The water storage tanks will also have an appropriate access point from the sealed road network in the form of a 'dry-hydrant' arrangement to allow emergency services to pump directly from the tank with maximum efficiency and convenience.

At this stage it is proposed that each storage tank for each precinct shall have a minimum capacity of 20,000L, therefore providing the entire development precinct with an additional 60,000L water supply for use by emergency services when required. This will also assist in offsetting any inconsistencies in water pressures on the reticulated network under emergency conditions.

A possible design outcome being considered for the water tanks is the provision of the 20,000L static water storage through the building water reuse tanks. This approach provides for a more economical solution as it combines the two functions of reuse and water storage into the one unit and also ensures that the tanks would be strategically located adjacent to buildings around the site (as mentioned above) and would be part of a system that is being used regularly (limiting the potential for stale water or water removal occurring).

## 3 Bushfire Risk Analysis

This chapter describes the bushfire risks to the Site through an examination of the fire history, a field based analysis of the potential head fire intensity, and an analysis of assets at risk.

### 3.1 BUSHFIRE HISTORY

Fire history within the Site has not been recorded, however it is known from the fire history of Lane Cove National Park (LCNP) that significant fires occur at intervals of 6-12 years within the vicinity of the Site.

*“Significant fire seasons within the reserves occurred in 1976 (243 ha), 1987–88 (51 ha), January 1994 (383 ha, 13 houses destroyed), December 1994 (70 ha) and New Year’s Day 2002 (634 ha). There have been numerous other fire ignitions within the Lane Cover River valley, but these have rarely occurred in extreme conditions, and because of quick response times have remained small. Most bushfires in the reserves are believed to have been started by arson.” (NPWS 2006)*

Of the above fires, the January 1994 fires swept through and directly impacted the Site, burning approximately 95% of LCNP and the majority of vegetation contained within the Site in the process. These fires also saw a number of dwellings within both Winchester Avenue and Lyle Avenue, to the north west of the Site, destroyed due to the impacts of bushfire.

Fire incursions into the Site from other bushland areas, such as LCNP, are certainly possible and have been shown historically to occur.

### 3.2 POTENTIAL HEAD FIRE INTENSITY

Potential head fire intensity of a bushfire under extreme weather conditions has been mapped for the study area using a Head Fire Intensity Potential (HFIP) model (Figure 6). This model uses the following parameters to identify the potential bushfire intensity:

- Fuel (vegetation);
- Terrain (slope and aspect);
- Weather scenario and direction of travel;
- Forest Fire Danger Index (FFDI of 100).

It calculates potential head fire intensity using the McArthur (1962) fire intensity formulae. A model has been provided to display the potential head fire intensity under north to westerly winds. The HFIP model is valid until 2016 or until the next fire occurs (whichever is first) as subsequent fire history and fuel accumulation will alter the assessment.

It is important to note that the model of HFIP model does not provide an indication of ignition risk or the rate of spread of a bushfire. It is specifically noted that, although the grassland areas will not carry a fire of the same intensity as the forested areas, these areas potentially have the highest risk of ignition and rate of spread.

### 3.2.1 Vegetation Formation

Vegetation formations were assessed according to Keith (2004) (Figure 2 and Table 1). Within the Site, the vast majority of vegetation falls under the 'Forest' vegetation formation with the exception of a small area within the north western portion of the Site adjacent to an existing car park where there is a presence of weedy/urban (Open Scrub) vegetation.

The assessed vegetation formations are then assigned relevant estimated maximum fuel loadings based on an amalgamation of formation characteristics contained within both Keith (2004) and PBP (2006). These fuel load figures show the maximum fuel load that is likely to accumulate within a given vegetation formation should all fire and management activities be excluded for a specific period of time. The fuel loadings are displayed within Figure 3 below.

Outside the Site, the presence of high hazard areas is extensive due to the vegetation formations within LCNP, including areas of Forest, Forested Wetland, and to a lesser extent, Rainforest, Saline wetlands and weedy Open Scrub areas.

**Table 1: Vegetation Formations within the Site**

Vegetation Type	Vegetation Formation
Shrubby Dry Sclerophyll Forest (Open Forest)	Forest
Weeds / Urban	Open Scrub

### 3.2.2 Slope & Aspect

Slope was assessed across the Site using 10m contours (Figure 4). The slope variation and steep, complex topography is a significant feature of the Site and immediate surrounds. The areas of the Site proposed for future development or containing existing buildings are all situated on a relatively level of gently sloping plateau. However, the areas to the west, south and east all drop away with steep slopes and the presence of extensive rocky outcrop areas that cause small vertical drop offs in some places, and flat rock surfaces free of vegetation in other locations.

The slopes within the western portion of the Site, within the APZ precinct and further west into LCNP generally range from 5-10 degrees downslope from the Site. Whilst the eastern portion of the Site is generally steeper ranging from 10-15 degrees downslope from the Site. The steepest portion overall is directly to the south of the Site, beyond the existing UTS buildings, where the slopes are generally >20 degrees downslope.

Additionally, Figure 5 provides an overview of the aspects present within the subject Site. Aspect can be a significant factor, particularly when investigating potential fire behaviour, as certain aspects, such as the west and north west are likely to be subject hotter and drier prevailing winds which in turn increases the fuel availability in these areas and drive more extreme fire activity.

### 3.2.3 Conclusions

The gentle slopes throughout the developable areas of the study area reduce the effect of slope and aspect on the potential intensity so that, in these portions of the Site, the predominant determinant of intensity is fuel load, which results in relatively low intensity. However, once moving to the west, south or east from the proposed development precincts, presence of steep slopes is extensive as the Site drops away into the LCNP. The presence of steep east to south to west facing slopes means that very

little of the study area is shielded from the north westerly and westerly winds. The majority of the study area has the capacity to fuel uncontrollable bushfires (as shown in Figure 6).

The assessment indicates that the properties in the south west and western portion of the development precincts are exposed to the greatest potential bushfire threat. It should however be noted that potential fire intensity is different to bushfire risk, with the later being more appropriate for the development of mitigation strategies and is addressed in Section 3.4 below.

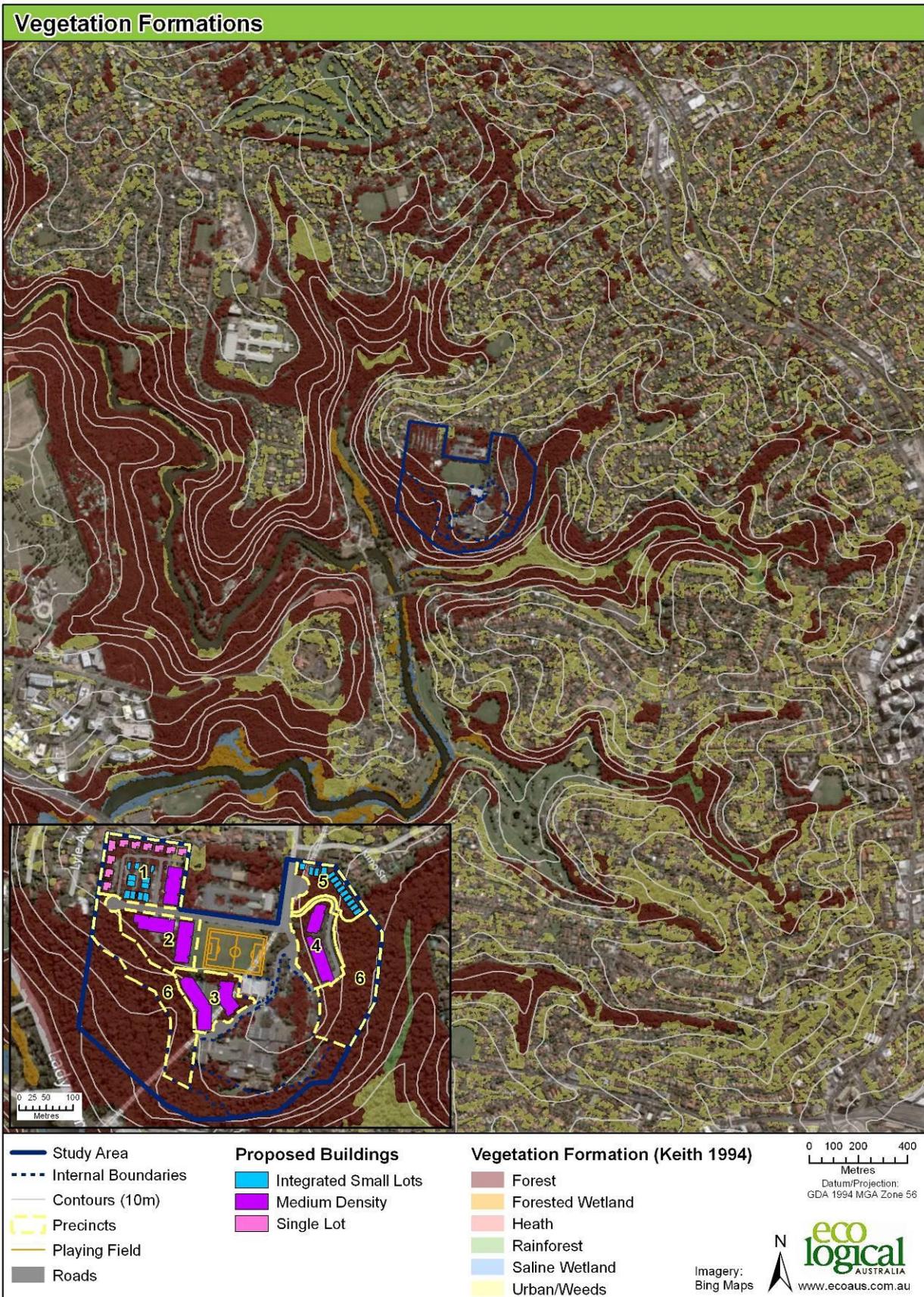


Figure 2: Vegetation Formations

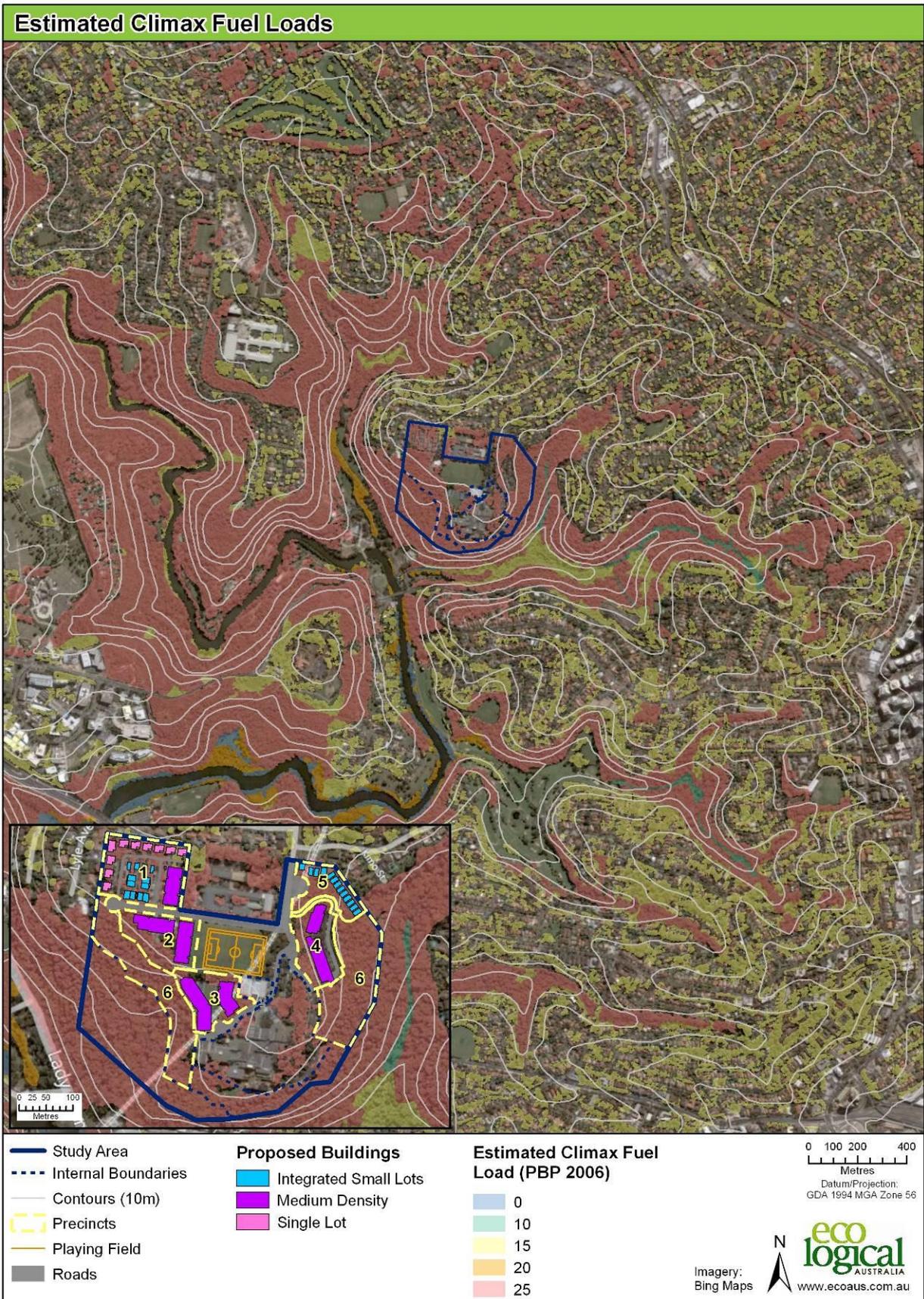


Figure 3: Vegetation Fuel Loads

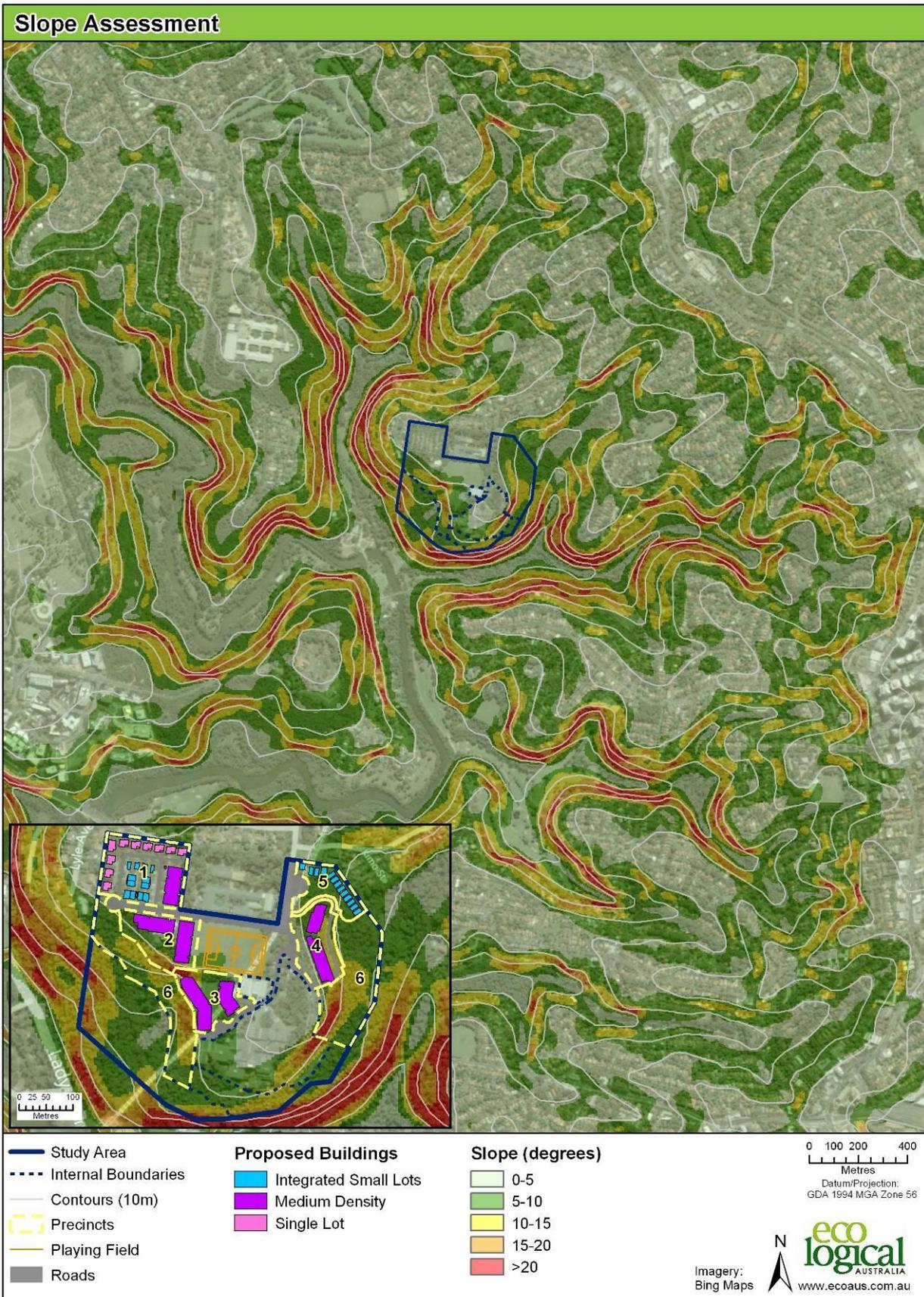


Figure 4: Slope Assessment

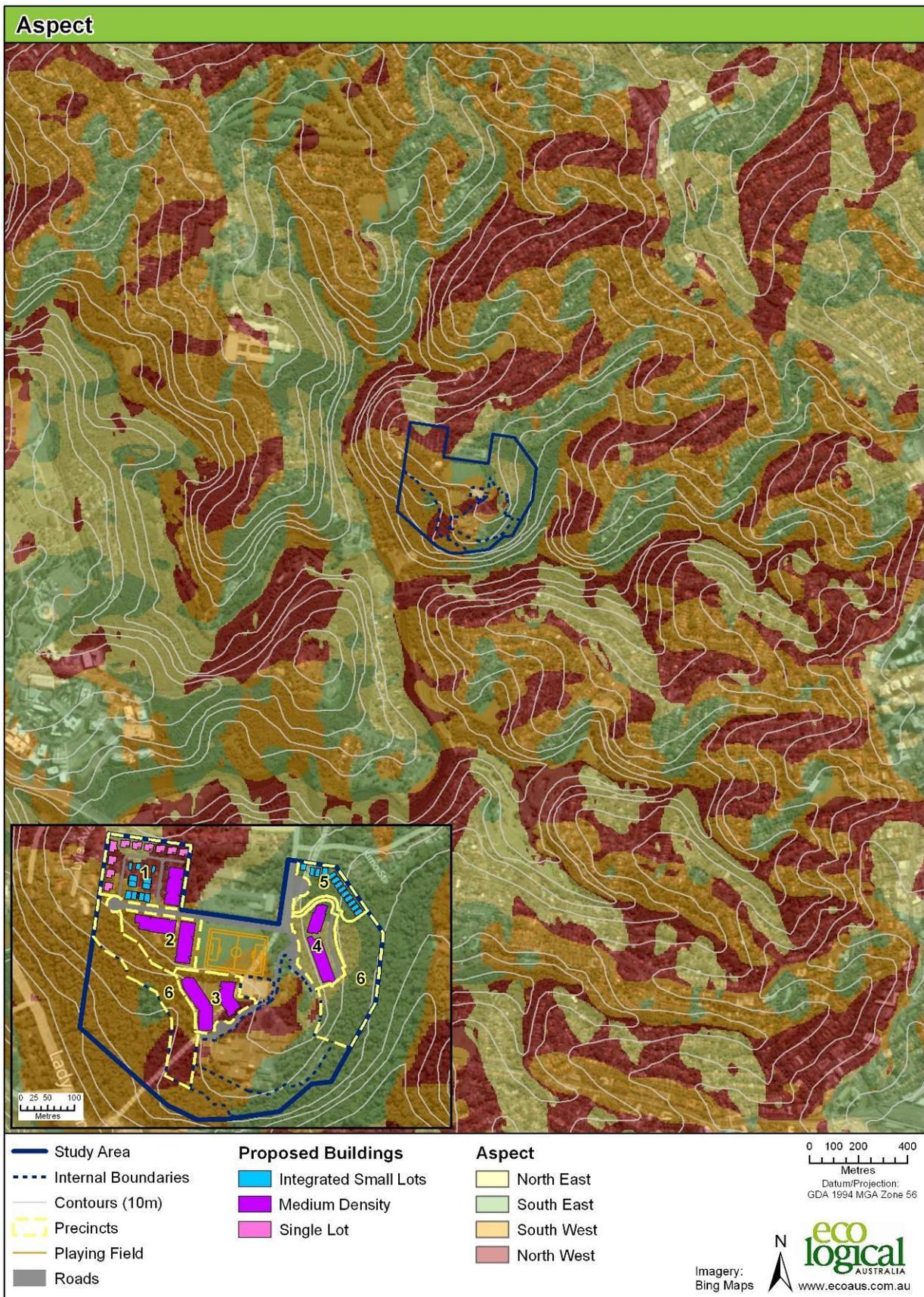


Figure 5: Aspect Assessment

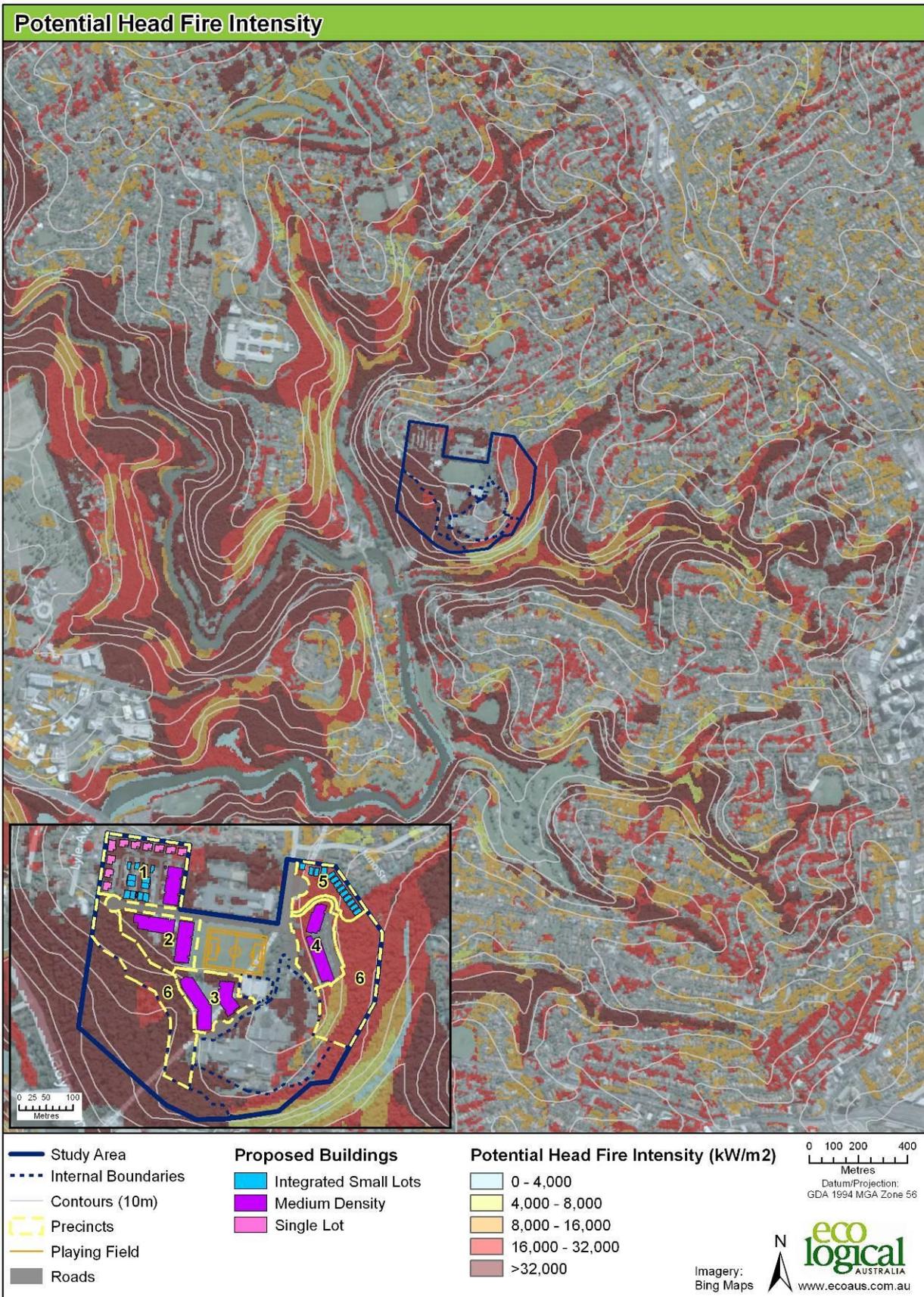


Figure 6: Potential Head Fire Intensity

### 3.3 ASSETS AT RISK

Bushfire, bushfire management, and bushfire suppression activities all have the potential to adversely impact built and environmental assets in and around the Site. Damage or destruction of these assets may have major economic, social, and environmental consequences.

#### 3.3.1 Built Assets

There are significant built assets within the Site itself in the form of the UTS Ku-ring-gai educational buildings, sports/recreational facilities and a child care centre. Further to this, there is future development proposed for the Site and existing residential development surrounds the Site. As such, built assets that are typical for this type of development e.g. dwellings, decks and sheds, often have little setback from the Site and are therefore more vulnerable to the impact of bushfire.

The dwellings adjoining the north western, northern and north eastern boundaries of the Site are at greatest risk from bushfire having little setback from the bushfire hazard, particularly to the east and west (Figure 5).

The most obvious threat to built assets is the impact from the elements of bushfire attack, being flame contact, wind, radiant heat, smoke and burning debris. Evidence indicates ember attack is responsible for most bushfire related house fires (NSWRFS 2001 p.41). However strong winds generated by severe bushfires may drive embers into vulnerable areas of a building, preheat and dry fuel ahead of a fire, lift roofing, damage windows, and extend flames along a more horizontal plane closer to building elements. Embers can cause spotting well in advance of a bushfire and provide piloted ignition to building elements. Radiant heat can impair fire fighting operations, the health of residents and the integrity of building elements. Flames restrict fire fighting operations, provide piloted ignition to building elements and threaten the health of residents and their capacity to evacuate the area (NSW RFS 2001 p.44). Smoke may affect the health of nearby residents, especially the elderly and those with or susceptible to respiratory disorders.

Effective bushfire protection planning should aim to prevent flame contact, reduce radiant heat to below the ignition thresholds for various elements of a building, to minimise the potential for embers to cause ignition, and reduce the effects of smoke on residents and fire-fighters.

#### 3.3.2 Natural Heritage

Natural heritage assets are also at risk from bushfire and bushfire management and this is discussed below.

Fire regimes are the primary determinant of effects of bushfire on natural heritage. A fire regime is determined by fire interval, fire intensity, season of burn and pattern of burning. Each of these four factors combines to determine the effect of an individual bushfire and a sequence of bushfires on the natural environment.

In March 2000, the Scientific Committee, established through the TSC Act, made a Final Determination to support a proposal to list "*High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition*" as a Key Threatening Process on Schedule 3 of the Act. The threat of high frequency fire occurs in all fire-prone habitats in New South Wales, although the likelihood of occurrences of high frequency fire is currently greatest in coastal and tablelands habitats and in urban areas.

One of the main threats to *Darwinia biflora* in the Sydney Basin Bioregion (Department of Environment and Conservation NSW 2004) is:

*Habitat degradation (from inappropriate fire regimes, slashing for easement maintenance, illegal track creation and weed invasion).*

Therefore, to conserve this species, fire management within the Site must aim to avoid the incidence of high frequency and high intensity fires and ensure that fire is predominantly within regimes that promote biodiversity and the conservation of threatened species and communities (refer to Section 5.2).

Bushfire, bushfire suppression and bushfire management activities also have the potential to exacerbate weed problems. Weed invasion is a threatening process to the *Darwinia biflora* in the Sydney Basin Bioregion and a general problem for many of Sydney's urban reserves. Particular problem species that threaten the biodiversity of the Site are, Asparagus Fern, Cobblers Pegs, Panic Veldt grass, Lantana, Large Leaved Privet, Small Leaved Privet, Mickey Mouse Plant, Buffalo Grass and Wandering Jew. These species will respond well to the exposed, nutrient rich, and competition free conditions following fire. Bushfire management activities may allow these and other weeds to penetrate new areas and increase the density of existing infestations. As such, appropriate management before and after fire is required to mitigate this risk. This is discussed later in Section 5.

Another potential threat from bushfire is damage resulting from fire suppression activities. This threat includes damage to vegetation and soil through the use of heavy vehicles and the creation of new tracks as fire control lines. New tracks have the potential to become vectors for problems associated with access such as weed and pest invasion, erosion and fire ignition.

### 3.3.3 Cultural heritage

There are no known Aboriginal heritage items in the Site. However, as the Site has yet to be comprehensively surveyed and as the dense vegetation may conceal artefacts, this plan has adopted a precautionary approach and contains measures and guiding principles to protect unknown aboriginal sites within the Site. These measures are detailed within Section 5.4 of this report.

In terms of non-aboriginal heritage, the Site contains the existing UTS Ku-ring-gai Campus buildings which are considered to have heritage value, due to both the building themselves (materials, designs and the like) and also due to the interactions between the buildings and the immediately surrounding remnant bushland areas. These buildings are unlikely to be impacted significantly by low-moderate intensity fires.

## 3.4 BUSHFIRE RISK ASSESSMENT

The findings of the risk analysis process have been summarised within Table 5. Further to this, the following tables (being 6 to 9) assess the specific risks that bushfire presents to life / people, property (including infrastructure and assets), environmental assets, and cultural assets. The methodology adopted is that given in AS/NZS ISO 31000:2009 whereby a risk classification scheme is developed through qualitative scales of likelihood and of consequence.

This assessment adopts a definition of likelihood based on likelihood of occurrence over the currency of the plan. Values have been allocated to the likelihood descriptors on a scale of 1 to 5 with 1 being rare and 5 being almost certain, as outlined in Table 2 below.

**Table 2: Likelihood Description**

Likelihood Descriptor	Description
Almost certain (5)	The event is expected to occur in most circumstances during the currency of the plan
Likely (4)	The event will probably occur in most circumstances during the currency of the plan
Possibly (3)	The event might occur at some time over the currency of the plan
Unlikely (2)	The event could occur at some time over the currency of the plan
Rare (1)	The event may occur only in exceptional circumstances

The scale of consequence is shown below. Values have been allocated to the consequence descriptors on a scale of 1 to 5 as outlined in Table 3 below

**Table 3: Consequence Description**

Consequence Descriptor	Description
Catastrophic (5)	Death, huge financial loss, irreversible widespread environmental damage
Major (4)	Extensive injury, major financial loss, irreversible local environmental damage
High (3)	Medical treatment, high financial loss, Long-term environmental damage
Medium (2)	First aid, medium financial loss, Short-term environmental damage
Low (1)	No injuries, low financial loss, minor environmental impact

Rating codes and the level of risk were then calculated by multiplying likelihood levels and consequence levels with the rating determined as per the scale outlined in Table 4 below.

**Table 4: Risk Rating**

Level of risk	Risk rating
0 - 4	Insignificant
5 - 9	Minor
10 - 14	Moderate
15 - 19	Major
20 - 25	Extreme

Table 5 below provides an analysis of the risk factors. The risk assessments presented in Tables , 7, 8, and 9 indicates that, over the currency of the plan, threats to life, property, heritage and environmental attributes of the Site are a moderate risk and will require appropriate risk management.

**Table 5: Analysis of risk factors**

Risk Factor	Analysis of the risk factor
1. The likelihood of human and natural fire ignitions, as influenced by time, space and demographics.	<p>Natural ignitions within the Site are unlikely.</p> <p>Human induced ignitions are known to be relatively more frequent at the urban / bushland interface; however the likelihood is lessened given that only the northern boundary of the Site is adjacent to residential development.</p>
2. The potential spread and severity of a bushfire, as determined by fuel, topography and weather conditions.	<p>The Site is relatively small and surrounded only to the north by urban development.</p> <p>The western, southern and eastern portions of the Site directly adjoin Lane Cove National Park</p> <p>The Site is exposed to strong north-westerly, westerly and south westerly winds.</p> <p>The slopes on average are steep.</p> <p>The vegetation formations are considered to provide higher hazard.</p>
3. The proximity of assets vulnerable to bushfire and likely bushfire paths.	<p>Residential dwellings and associated structures directly adjoin the Site. Although the majority of these assets have some set back from the Site boundary and most backyards are managed appropriately, in a fuel reduced state.</p>
4. The vulnerability of assets, or their capacity to cope with, and recover from bushfire.	<p>Dwellings may not have been constructed in accordance with <i>AS 3959 - Construction of Buildings in Bushfire Prone Areas</i>.</p> <p>Fire may impact vegetation communities and exacerbate weed and pest invasion.</p>

**Table 6: Bushfire Risk Assessment - Life**

<b>Vulnerability Criteria</b>	<b>Consequence (A)</b>	<b>Likelihood (B)</b>	<b>Level of risk (A x B)</b>	<b>Rating</b>
Populated area where the combination of threat and vulnerability expose a community to a significant likelihood of fatalities and major injuries.	5	2	10	Moderate
Less likely to be fatalities or major injuries due to the presence of attributes which afford some protection.	4	3	12	Moderate
Loss of life or major injury highly unlikely. Medical/hospital treatment may be required.	3	3	9	Minor
Minor injuries only - first aid treatment. No major injuries or fatalities likely.	2	3	6	Minor
No injuries or fatalities likely.	1	4	4	Insignificant

**Table 7: Bushfire Risk Assessment - Property (infrastructure, assets and private property)**

<b>Vulnerability Criteria</b>	<b>Consequence (A)</b>	<b>Likelihood (B)</b>	<b>Level of risk (A x B)</b>	<b>Rating</b>
Extensive and widespread loss of property. Major impact across a large part of the community and region. Long term external assistance required to recover.	4	3	12	Moderate
Localised damage to property. Short-term external assistance required to recover.	3	3	9	Minor
Short-term damage to individual assets. No external assistance required to recover.	2	3	6	Minor
Inconsequential or no damage to property. Little or no disruptions to the community.	1	4	4	Insignificant

**Table 8: Bushfire Risk Assessment - Environment**

<b>Vulnerability Criteria</b>	<b>Consequence (A)</b>	<b>Likelihood (B)</b>	<b>Level of risk (A x B)</b>	<b>Rating</b>
Local extinctions of native species.	4	1	4	Insignificant
Irreversible damage to the environment.	4	2	8	Minor
Long-term damage to the environment over a landscape scale.	3	3	9	Minor
Short-term, localised damage to the environment.	2	3	6	Minor
Minor impact on the environment.	1	5	5	Minor

**Table 9: Bushfire Risk Assessment - Cultural Sites**

<b>Vulnerability Criteria</b>	<b>Consequence (A)</b>	<b>Likelihood (B)</b>	<b>Level of risk (A x B)</b>	<b>Rating</b>
Loss and/or irreversible damage to sites or objects of national, state or regional significance.	5	1	5	Minor
Extensive damage to sites or objects of national, state, regional or local significance requiring major external assistance.	4	1	4	Insignificant
Short-term damage to individual objects. Short term external assistance required to repair.	3	2	6	Minor
Short-term, localised damage to a small number of sites, objects and the cultural landscape.	2	2	4	Insignificant
Minor impact on sites or items which are repairable with little to no external assistance.	1	3	3	Insignificant

## 4 Bushfire Risk Management

Bushfire risk management should aim to reduce both the likelihood and consequences of bushfires. Broad strategies to achieve this aim are summarised in Table 10 and detailed in the following subsections.

Implementation of these strategies provides an effective way of minimising the risk to natural assets within the Site and residential areas adjoining the Site. However as no development in a bushfire prone area can be guaranteed to be entirely safe from bushfires, providing an acceptable level of protection and a tolerable residual risk, is to some extent a compromise between the level of threat, inconvenience, dangers, ability or practicality of implementation and costs (financial and environmental) involved in providing the protection. To create this balance and minimise adverse impacts on the Site, a 'joint responsibility' for fire protection is seen as essential. This can be facilitated by proposed bushfire extension programs (Section 4.3) and other development controls discussed within this section.

**Table 10: Bushfire risk reduction strategies and actions**

Strategy	Actions
Avoid the risk	<ul style="list-style-type: none"> <li>▪ Building and development controls and prohibiting certain developments where appropriate.</li> </ul>
Reduce the hazard	<ul style="list-style-type: none"> <li>▪ Reduce the level of fuel available to burn in a bushfire.</li> <li>▪ Manual clearing of bushfire fuels and provision of asset protection zones.</li> </ul>
Reduce unplanned ignition	<ul style="list-style-type: none"> <li>▪ Local bushfire education and extension programs.</li> <li>▪ Communications regarding Total Fire Ban days and burn permits.</li> </ul>
Reduce vulnerability	<ul style="list-style-type: none"> <li>▪ Establishment and maintenance of Asset Protection Zones for the protection of built assets in and around the Site.</li> <li>▪ Development and implementation of cooperative and complimentary fire management strategies with neighbours and adjoining residences.</li> </ul>
Understand and accept residual risk	<ul style="list-style-type: none"> <li>▪ Manage with early detection and fire suppression operations.</li> <li>▪ Maintenance of existing access routes to facilitate suppression of fires.</li> </ul>

#### 4.1 FIRE MANAGEMENT UNITS

Management zones are based on the location of assets, topography, landuse and potential bushfire hazard (Section 3 above) and risk (Section 4 above). Management zones are separated into the following three categories based on the Bushfire Environmental Assessment Code (BEAC) (NSW RFS 2006):

- Asset Protection Zone (APZ);
- Strategic Fire Advantage Zone (SFAZ);
- Land Management Zone (LMZ).

Zones have been identified and mapped across the Site to provide a planning framework upon which the protection of life, property and the environment can be improved. These zones are shown in Figure 7 and described in Tables 11, 12 and 13 below.

**Table 11: Asset Protection Zones**

<b>Asset Protection Zone (APZ) Details</b>	
<b>Aim</b>	<ul style="list-style-type: none"> <li>• To provide a fuel free zone around the asset in question to protect from direct flame attack.</li> </ul>
<b>Specifications</b>	<ul style="list-style-type: none"> <li>• See Section 4.1.1 below – in accordance with the requirements of PBP 2006.</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>• Vegetation removal or thinning allowed in accordance with the direction of a Development Application (DA) approval;</li> <li>• Where no DA approval applies, then vegetation removal and thinning shall be subject to an Environmental Impact Assessment or other equivalent authorisation (i.e. Review of Environmental Factors);</li> <li>• Flagging tape (or an alternative method of demarcation) to be used to mark the limit of APZ clearing before any works are undertaken.</li> </ul>

Table 12: Strategic Fire Management Zones

Strategic Fire Advantage Zone (SFAZ) Details	
<b>Aim</b>	<ul style="list-style-type: none"> <li>To provide a fuel reduced zone around the primary assets and biodiversity conservation areas to reduce the rate of spread and intensity of fires.</li> </ul>
<b>Specifications</b>	<ul style="list-style-type: none"> <li>See section 4.1.2 below – aims to have consideration of the requirements of PBP 2006;</li> <li>Also considers the specific needs of areas across the site and allows for customised management to achieve synergy with ecological, landscape, heritage or other relevant outcomes applicable to the site;</li> <li>Fuel managed area – comparable to an Outer Protection Area (OPA) as defined within PBP 2006.</li> <li>Implementation of low-intensity hazard reduction burns may be utilised in some SFAZ areas – where there is no direct exposure to existing buildings.</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>Ongoing manual removal of fuels to a level applicable for the specific outcomes that particular SFAZ area;</li> <li>Suppress all fires;</li> <li>Long term weed suppression;</li> <li>Hazard reduction burn (where appropriate) at the minimum allowable interval.</li> </ul>

Table 13: Land Management Zones

Land Management Zone (LMZ) Details	
<b>Aim</b>	<ul style="list-style-type: none"> <li>To manage land primarily for conservation.</li> </ul>
<b>Specifications</b>	<ul style="list-style-type: none"> <li>Area managed primarily for environmental purposes;</li> <li>Conservation of <i>Darwinia biflora</i> threatened species.</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>Majority of nominated LMZ areas to be dedicated to Ku-ring-gai Council for ongoing management as appropriate;</li> <li>Long term weed suppression (minimum annual weed removal);</li> <li>Consider the implementation of ecological burns.</li> </ul>



Figure 7: Management Zones

#### 4.1.1 Asset Protection Zones (Zone 1)

The threat from flame contact and radiant heat to property, assets and thereby persons in and adjacent to the Site can be significantly reduced by the establishment and maintenance of Asset Protection Zones at the locations displayed within Figure 7. Asset Protection Zone (APZ) dimensions have been determined with consideration of;

- UTS Kuring-gai – Statement of Commitments;
- Planning for Bush Fire Protection (NSW RFS 2006);
- Bush Fire Environmental Assessment Code (NSW RFS 2006);
- A field based assessment of pre-existing conditions (*i.e.* existing fire breaks, open space, management trails);
- The existing residential setback, and
- Adjusted to suit the bushfire threat and risk to the assets.

##### 4.1.1.1 Vegetation / Fuel Management Prescription within Asset Protection Zones

The following guidelines are intended for APZ maintenance within the Site. However, the guidelines provide principles that should also be encouraged on adjoining UTS-owned lands or private property.

It is important to note that where there are any conflicts perceived between the landscape outcomes for the site and the bushfire management requirements, particularly within the APZ, then the requirements of the APZ have been designed in order to achieve compliance with the Rural Fire Service document '*Planning for Bush Fire Protection*' (2006), as this was a key requirement within the UTS Kuring-gai – Statement of Commitments.

- Existing larger trees (at least 200 mm in diameter measured at chest height) can remain within the APZ provided that;
  - No part of their canopy occurs within 2 m of any building (this also applies to significant habitat trees where necessary);
  - Canopies are discontinuous, *i.e.*, canopies are separated by at least 2 m;
  - They are smoothed barked species or, if rough barked, are maintained free of hanging bark and other ladder fuels; and
  - Low branches holding fine fuel (*i.e.* leaves and twigs of <6mm in diameter) are pruned to 2 m from the ground.
- Trees are to be hand-removed leaving stumps cut at ground level and where accessible, stumps are to be reduced down to just below soil level. Stumps of all species that have the capability of re-sprouting are to be treated with an appropriate herbicide immediately after the cut is made;
- Smaller trees (*i.e.* less than 200 mm in diameter), shrubs, fallen trees and tree-limbs and stumps may be removed or if retained they shall be continuously suppressed;

- All shrubs and tree saplings may be removed off-site or mulched in situ, however mulch remaining onsite shall be given sufficient time to decompose prior to the commencement of the fire season. All native grasses within the Site are to remain in-situ wherever possible; and
- A minimal ground fuel is to be maintained to include either mown grass or bare ground or native vegetation with a fine fuel loading of approximately 3-4 tonnes per hectare (i.e. material of <6 mm in diameter).

#### 4.1.1.2 Additional APZ Considerations (response to Statement of Commitments)

- The Concept Plan approval has allowed for the creation of designated APZ areas along the bushland interface areas within the subject site. These are in the process of being formally subdivided into stand-alone lots for the purposes of vegetation management and asset protection. This BMP (see above) establishes a clear maintenance regime in accordance with the requirements of PBP, which is also consistent, or even an improved bushfire protection outcome, relative to the APZs prescribed in the *Barry Eadie Consulting* report.
- The intent of the strategies within this BMP and the subsequent APZ implementation works is to minimise the potential impacts and required removal of significant trees (habitat or otherwise) within the defined APZ areas and other areas of the site. These trees will be identified prior to any vegetation removal within the APZ. However, the retention all trees within the APZ is likely to be an unrealistic expectation in the context of achieving an APZ fuel management outcome in accordance with the RFS legislative document PBP 2006. Significant trees will only be removed where this is required in order to achieve an appropriate level of fuel reduction and separation in a given location.
- Additionally, the intent of the strategies within this BMP and the subsequent APZ implementation works are to minimise the complete removal of vegetation within the defined APZs – including understorey vegetation (ground and elevated fuels). However, it is important to note that in order to achieve an appropriate standard of APZ fuel reduction (as required by the legislative document PBP 2006) there is a limitation on the amount of ground covers and shrubs that can be retained throughout the APZ. As such, retaining the ground covers and shrubs to 50cm across the entire APZ is not a realistic outcome from a bushfire management perspective.

The key performance criteria in this regard is for there to be no continuous fuel path created, either vertically or horizontally, in terms of the placement of retained individual or clumped trees, shrubs and ground covers. This means that some ground covers can be retained, but not in areas where shrubs and trees are also retained, etc. The intent is to create separation of fuels in order to limit potential fire movement and growth through the landscape. This is unable to be compromised without undermining the overall level effectiveness of the bushfire mitigation strategies, particularly the APZs. Ideally, an overall fuel load retention of approximately 3-4 tonnes per hectare is the objective within the APZ areas.

- The presence of rock within the APZ provides a natural mitigation feature that is 'fuel free' and as such it is intended that it be retained.
- The intent of the strategies within this BMP and the subsequent APZ implementation works is to recognise the presence and potential impacts upon Threatened Species – in particular *Darwinia biflora*. Where these specimens are found to be present within the APZ and are not already protected within a Land Management Zone (LMZ) or defined conservation area, they will be

identified and appropriate protection strategies implemented, such as effective conversion of that particular location and the immediate surrounds to an LMZ for conservation of the *Darwinia biflora*, prior to the removal of surrounding vegetation (being undertaken as part of the APZ management works).

In relation to *Darwinia biflora* specimens that are discovered within the development footprint itself, there may be the opportunity, where appropriate, to transfer these to an existing LMZ or another suitable position within the defined APZ area, in order to ensure a greater level of conservation value is applied to the threatened species identified within the site.

#### 4.1.2 Strategic Fire Advantage Zone (Zone 2A)

The threat from flame contact and radiant heat to property, assets and thereby persons in and adjacent to the Site can be significantly reduced by the establishment and maintenance of Strategic Fire Advantage Zones (SFAZ) at the locations displayed within Figure 7. The areas designated as SFAZ have been determined with consideration of;

- UTS Kuring-gai - Statement of Commitments;
- Planning for Bush Fire Protection (NSW RFS 2006);
- Bush Fire Environmental Assessment Code (NSW RFS 2006);
- A field based assessment of pre-existing conditions (*i.e.* existing landscaping, remnant bushland areas, pathways and trails);
- The defensible space available to existing buildings; and
- The bushfire threat and risk to the assets.

##### 4.1.2.1 Vegetation / Fuel Management Prescription within Strategic Fire Advantage Zones

The following guidelines are intended for SFAZ maintenance within the Site. However, the guidelines provide principles that should also be encouraged on adjoining UTS-owned land or private property.

- Existing larger trees (at least 200 mm in diameter measured at chest height) can remain within the SFAZ provided that;
  - No part of their canopy occurs within 2 m of any building (this also applies to significant habitat trees where necessary);
- Approximately 30-50% of smaller trees (*i.e.* less than 200 mm in diameter), shrubs, fallen trees and tree-limbs and stumps are to be removed and continuously suppressed;
- Approximately 30-50% of shrubs and tree saplings are to be removed off-site or mulched in situ, however mulch remaining onsite shall be given sufficient time to decompose prior to the commencement of the fire season. All native grasses within the Site are to remain in-situ wherever possible; and
- A reduced ground fuel is to be maintained to include a slashed or manually managed understorey of approximately 8 tonnes per hectare of fine fuel (*i.e.* material of <6 mm in diameter).

#### 4.1.3 Strategic Fire Advantage Zone – Heavy Landscaped (Zone 2B)

The threat from flame contact and radiant heat to property, assets and thereby persons in and adjacent to the Site can be significantly reduced by the establishment and maintenance of Strategic Fire Advantage Zones (SFAZ) at the locations displayed within Figure 7.

The management of Zone 2B has been modified in relation to the remaining SFAZ areas in recognition of the prescribed heavy landscaping that is required in these portions of the site. The intent is that the landscaping outcomes are still achieved while not undermining overall fire safety to the site.

The areas designated as SFAZ have been determined with consideration of:

- UTS Kuring-gai – Statement of Commitments;
- Planning for Bush Fire Protection (NSW RFS 2006);
- Bush Fire Environmental Assessment Code (NSW RFS 2006);
- A field based assessment of pre-existing conditions (*i.e.* existing landscaping, remnant bushland areas, pathways and trails);
- The defensible space available to existing buildings; and
- The bushfire threat and risk to the assets.

##### 4.1.3.1 Vegetation / Fuel Management Prescription within Strategic Fire Advantage Zones

The following guidelines are intended for SFAZ maintenance within the Site. However, the guidelines provide principles that should also be encouraged on adjoining private property.

- The implementation of heavy landscaping is conducted in accordance with the Landscape Management Plan – in particular the Heavy Landscaping Layout diagram and supporting details;
- The heavy landscaping areas shall be managed in such a way so as to ensure the defined layout remains consistent with the details above. In particular that there is not permitted to be a significant continuity of fuels – either vertically or horizontally - within the heavy landscaped areas;
- Existing larger trees (at least 200 mm in diameter measured at chest height) can remain within the SFAZ provided that;
  - No part of their canopy occurs within 2 m of any building (this also applies to significant habitat trees where necessary);
- Where possible, a reduced ground fuel is to be maintained to include a slashed or manually managed understorey of approximately 8-10 tonnes per hectare of fine fuel (*i.e.* material of <6 mm in diameter). This should be done in a manner to ensure there is no conflict with requirements of the Landscape Management Plan.

#### 4.1.4 Strategic Fire Advantage Zone – UTS-owned Property (Zone 2C)

The threat from flame contact and radiant heat to property, assets and thereby persons in and adjacent to the Site can be significantly reduced by the establishment and maintenance of Strategic Fire Advantage Zones (SFAZ) at the locations displayed within Figure 7.

Defence Housing Australia does not currently have ownership or management responsibility over lands that have been defined within this zone. However, the BMP has sought to establish an appropriate management regime for the purposes of providing guidance for the benefit of UTS Kuring-gai management during their continued tenure, and also, to establish a framework that is able to be efficiently adopted when a change of ownership occurs.

In these particular locations, the management considerations are, at least in part, similar to those within the heavy landscaped portions of the site, with the additional considerations of the heritage value of the UTS-building/vegetation interaction, and most importantly, the proximity of these vegetated areas to the existing educational buildings/assets that are still being utilised – as opposed to some of the SFAZ (heavy landscaping) areas which are slightly more isolated.

It is also important to note that the Heritage Assessment & Conservation Strategy (as prepared by Graham Brooks & Associates Pty Ltd, 2007) states that *‘...the bushfire asset protection zones will be required to maintain as much of the bushland character as possible, within the constraints for controlling fuel loads under the tree canopies...’* In this instance, clear preference is provided to the implementation of compliant and appropriate bushfire protection measures across the site, despite the inherent heritage value.

The areas designated as SFAZ have been determined with consideration of;

- UTS Kuring-gai – Statement of Commitments;
- Planning for Bush Fire Protection (NSW RFS 2006);
- Bush Fire Environmental Assessment Code (NSW RFS 2006);
- Heritage Assessment & Conservation Strategy (Graham Brooks and Associates Pty Ltd, 2007);
- A field based assessment of pre-existing conditions (*i.e.* existing landscaping, remnant bushland areas, pathways and trails);
- The defendable space available to existing buildings; and
- The bushfire threat and risk to the assets.

##### 4.1.4.1 Vegetation / Fuel Management Prescription within Strategic Fire Advantage Zones

The following guidelines are intended for SFAZ maintenance within the Site. However, the guidelines provide principles that should also be encouraged on adjoining private property.

- The implementation and maintenance of landscaping is conducted in accordance with the key outcomes of both the Landscape Management Plan and Heritage Assessment & Conservation Strategy – in particular in relation to the interaction between significant existing vegetation and the existing UTS buildings;

- These more heavily landscaping areas shall be managed in such a way so as to ensure that key values in terms of landscaping or heritage are not undermined, whilst also adhering to the overarching bushfire mitigation objective that there is not permitted to be any significant continuity of fuels – either vertically or horizontally;
- Existing larger trees (at least 200 mm in diameter measured at chest height) can remain within the SFAZ provided that;
  - No part of their canopy occurs within 2 m of any building (this also applies to significant habitat trees where necessary);
- Where possible, a reduced ground fuel is to be maintained to include a slashed or manually managed understorey of approximately 8-10 tonnes per hectare of fine fuel (i.e. material of <6 mm in diameter). This should be done in a manner to ensure there is no conflict with requirements of the Landscape Management Plan or Heritage Assessment & Conservation Strategy.

#### 4.1.5 Land Management Zones (Zone 3)

The preservation of ecological and other environmental outcomes within the context of bushfire management is achievable through the implementation of and maintenance of Land Management Zones (LMZ) at the locations displayed within Figure 7.

Furthermore, there may be opportunities to extend the overall size of the LMZ, should this be required in order to adequately mitigate the effects of the various fire management regimes (i.e. erosion, runoff, fuel management) upon the environmental assets intended for conservation – in particular, the LMZ situated within the western APZ portion of the site.

The areas designated as LMZ have been determined with consideration of;

- UTS Kuring-gai – Statement of Commitments;
- Bush Fire Environmental Assessment Code (NSW RFS 2006);
- The ecological assets contained within the site and their appropriate regimes for their management – in particular the presence of *Darwinia biflora*;
- A field based assessment of pre-existing conditions (i.e. existing landscaping, remnant bushland areas, pathways and trails); and
- The bushfire threat and risk to the other assets.

##### 4.1.5.1 Vegetation / Fuel Management Prescription within Land Management Zones

The following guidelines are intended for LMZ maintenance within the Site. However, the guidelines provide principles that should also be encouraged on adjoining private property.

- Existing larger trees (at least 200 mm in diameter measured at chest height) can remain within the LMZ;
- Existing smaller trees (i.e. less than 200 mm in diameter), shrubs, fallen trees and tree-limbs and stumps can remain within the LMZ where they are considered to contribute to the ecological health of the environmental assets contained within. Where accumulated fuels or weeds are not considered important for retention, they shall be manually removed;
- Existing shrubs and tree saplings can remain within the LMZ where they are considered to contribute to the ecological health of the environmental assets contained within. All native grasses are to remain in-situ wherever possible. Where accumulated fuels or weeds are not considered important for retention, they shall be manually removed; and
- All vegetation management or weed removal occurring within these areas shall be conducted manually or with an appropriate low-intensity hazard reduction burn. All management shall be in accordance with the relevant fire regimes specified for the ecological assets – with particular consideration and preference to the requirements for *Darwinia biflora*.

## 4.2 ACCESS

During a bushfire it is likely that the emergency services will access the Site via the primary access/egress point to the Site on Eton Road. Access is available via sealed roads to various portions of the Site, however, these roads are currently terminal and do not provide any through road access. The steep topography around the perimeter of the Site prohibits vehicle access currently and also prohibits the construction of any formal access trail or similar suitable for a vehicle. Some informal walking/management tracks exist, however these are in poor condition in some areas due to infrequent use. Access on foot is possible around most of the boundary of the Site with LCNP and this will be further enhanced by the implementation of the proposed APZ in the western and eastern portions of the Site.

The current access arrangements are proposed to be upgraded to comply (where practicable) with the requirements of *Planning for Bush Fire Protection* (NSW RFS 2006) – with the exception of the dead-end roads - whilst still operating within the constraints of the concept approval. This BMP does not recommend the establishment of any additional access provisions at this point in time.

The intent of measures within PBP for public roads is ‘to provide safe operational access to structures and water supplies for emergency services, while residents are seeking to evacuate from an area’. This is considered to be achieved despite the constraints of the existing road layout. This assessment is further supported by a statement from Andrew Johnson (consulting traffic engineer for the project) which includes the following assertions: *“The road widths will allow exit movements to occur without impeding the ability to have fire trucks enter the site. There are no signalised intersections in the immediate vicinity that would impede egress.”*

It should also be noted that due to the holistic and comprehensive approach taken in the implementation of a suite of bushfire protection measures across the site, including APZs greater than those required within PBP and the provision of extensive open space community lands (sports ovals) that are suitable as an evacuation assembly/staging area, a scenario is created within the site where the need for the complete evacuation of the site is greatly reduced. The subsequent flow-on effect of this is the potential easing traffic pressures on the existing road network both with the site and surrounding community.

### 4.2.1 Additional Access / Fire Trail Considerations (response to Statement of Commitments)

The implementation of an upgraded fire trail through the western portion of the site has been explored and options exhausted, without any perceived value in undertaking the significant upgrade works required for the existing trail. Due to the nature of the topography throughout the perimeter areas of the site, it has been deemed prohibitive in terms of cost and in particular, potential environmental impacts, to comply with the abovementioned commitment.

It is important to note that the existing fire trail is not currently an operational fire trail with any strategic connections to local networks, nor does it provide any significant fire management advantages through its retention. The trail's current condition and location means that it is suitable for pedestrian access only and is effectively a ‘management trail’ that enables some of the portions of the site that are situated within more rugged landscape to be accessible. It is considered that there is definite merit in maintaining, and even improving, the trail for this purpose.

The trail location will be largely situated within the proposed APZ areas, meaning it will provide strategic benefit for management of the hazardous vegetation within the site. However, from an operational perspective, the presence of a fire trail in this location is unlikely to be utilised in the event of significant

fire activity in the vicinity. Under such circumstances, fire fighting appliances would most likely be undertaking defensive property protection activities and therefore be positioned in and around the buildings accordingly. Alternatively, there may be opportunities to undertake low-intensity hazard reduction activities or back-burning operations from the fire trail – utilising the trail as access and as a fire break. However, the presence of the proposed APZ in combination with the management trail would also achieve these outcomes satisfactorily – and with reduced overall environmental impact.

#### **4.3 EDUCATION AND EXTENSION PROGRAMS**

The establishment of APZs, SFAZs and LMZs as proposed in this BMP provides a significant improvement in the protection of community assets within and adjoining the Site. Despite these works, assets within adjoining lands cannot be totally protected without complimentary bushfire protection activities. Education/extension programs by the proposed Community Association – in consultation with Ku-ring-gai Municipal Council, NSW Fire and Rescue and the NSW Rural Fire Service - should be conducted to facilitate this process.

The objective of extension programs is to effectively share the fire management responsibility amongst the neighbouring residents and local community by providing information, raising awareness and improving their fire management capabilities. Readiness and awareness of the community is vital to ensure the safety of people and the preparation of their dwellings and assets. To achieve this objective, it is recommended that the Community Association (with the support and assistance of Ku-ring-gai Council) implement the following initiatives:

- All bushfire management works undertaken within the Site should be advertised to neighbours and to relevant stakeholder groups;
- Support community groups who have an interest in the Site. Community based groups offer an effective means to raise awareness of fire related issues and encourage public cooperation and participation in fuel management practices;
- In conjunction with local fire brigades, undertake advertising and other community-awareness campaigns aimed at reducing the frequency of bushfires, increasing asset protection, and providing safe bushfire response behaviour;
- Use signs within the Site, leaflets, displays and other available interpretative media to disseminate fire related messages.

It is also recommended that the Community Association (with the support and assistance of Ku-ring-gai Council) produces its own interpretative media (leaflets, displays, signs) that focuses on encouraging private/personal ownership of fire management whilst also promoting appreciation of the community's natural and cultural resources provided by this Site. In the interim, once established, the Community Association should liaise with NSW Fire and Rescue to investigate opportunities and programs that are currently available (e.g. FireWise).

## 4.4 FUTURE DEVELOPMENT AND MANAGEMENT OF THE SITE

### 4.4.1 Compliance with PBP 2006 (Response to Statement of Commitments)

All future development of the site, including the proposed subdivision of land, will be undertaken in accordance with the relevant planning legislation and requirements. In this instance, the subject site is mapped as bushfire-prone on Ku-ring-gai Municipal Council mapping, and as such will require compliance with the NSW Rural Fire Service document '*Planning for Bush Fire Protection*' (2006). The aim of the Bushfire Management Plan is to enable this outcome to be achieved whilst also having regard for the various environmental and landscape outcomes as prescribed within the SOC.

### 4.4.2 Building Construction (Response to Statement of Commitments)

The construction future buildings in accordance with the standard specified by council are no longer relevant for several reasons. Primarily, the reference to 'Level 3' is an indication that the requirement is based on the implementation of construction standards for all buildings within the site in accordance with AS3959-1999 - *Construction of buildings in bush fire prone areas*. This Australian Standard is now obsolete and has been replaced by AS3959-2009 of the same name. The new document has a different methodology and construction level outcomes and as such the buildings within the site should be assessed in accordance with the new standard.

Secondly, this is a national standard that is referenced as a deemed-to-satisfy outcome within the Building Code of Australia (BCA), and any certification of newly constructed buildings would be required to occur in accordance with the current BCA, which references AS3959-2009, as opposed to the previous edition.

Finally, based on the new methodologies and construction requirements of the AS3959-2009, it is considered inappropriate to define construction standards across the entire subject site for proposed buildings that have yet to gain Development Application (DA) approval. Particularly in light of the suite of bushfire protection measures proposed within the site, including extensive APZs, it is far more appropriate that the construction requirements for each proposed building be assessed on their merits during the DA process, including consultation with both KMC and the RFS.

### 4.4.3 Evacuation and Emergency Management (Response to Statement of Commitments)

An evacuation management plan is currently in place for the educational uses within the site. However, as the site is further developed for residential and other recreational uses, an updated and relevant evacuation and emergency management plan will be prepared and will provide effective strategies for both residential occupants once the development is complete, but also for workers and visitors to the site during the construction phase. The evacuation and emergency management plan will eventually be implemented and managed by the Community Association.

## 5 Protection of Environment and Cultural Sites

The BMP has identified operational guidelines, to reduce impacts on the environment which are to be followed when carrying out the activities identified in the BMP. These operational guidelines are detailed in the following subsections.

### 5.1 FUEL / VEGETATION REDUCTION OPERATIONS

During the establishment and maintenance of APZs within the Site, the following tree and vegetation clearing and management operations should be followed to protect soils, landscape features, and conservation values:

- Scrub cutters and hand tools are the most satisfactory equipment for hazard reduction operations. Only this type of minimum impact equipment should be used;
- Threatened flora species under the TSC Act or EPBC Act must not be removed or damaged (Section 5.2). In order to minimise the risk of damage to these species or communities, surrounding vegetation is to be removed by hand only;
- The use of bulldozers or other track type machinery should not be permitted;
- Cut vegetative material (with the exception of noxious and environmental weeds) and ground fuel, leaves, bark, twigs, grass tussocks *etc.* may be mulched and spread to help prevent weed invasion and soil erosion;
- Removal by hand is permissible on all slopes while mowing will not be undertaken on slopes greater than 15°.

### 5.2 THREATENED SPECIES MANAGEMENT

Identified threats to *Darwinia biflora* include “*Habitat loss, particularly as a result of clearing for urban and industrial development, and habitat degradation (from inappropriate fire regimes, slashing for easement maintenance, illegal track creation and weed invasion) Department of Environment and Conservation NSW 2004*”). This plan mitigates the impact on this community through proposing weed control works after fire management activities and wildfire (Section 5.3) and not proposing the creation of access tracks.

*Darwinia biflora* is also adversely impacted by frequent bushfire hazard reduction activities including prescribed burning and mechanical vegetation clearance. To ensure protection of this species the following should therefore be applied:

- Fire management within the Site must avoid the incidence of high frequency and high intensity fires;
- Future prescribed burns should only be undertaken in accordance with the recommended fire intervals for that vegetation type (Table 14 below).

**Table 14: Recommended Fire Intervals for Vegetation Communities within the Site (NPWS 2004)**

Vegetation Type (Keith 2004)	Community Name (Total Earth Care 2009)	A decline in biodiversity is predicted if (NPWS 2004):		Additional Recommendations
		Minimum interval	Maximum interval	
Shrubby Dry Sclerophyll Forest (Open Forest)	Sydney Sandstone Ridgetop Woodland	more than one fire occurs every 7 years	no fire for more than 30 years	Maintain interval closer to the maximum where possible.
Shrubby Dry Sclerophyll Forest (Open Forest)	Coastal Sandstone Gully Forest	more than one fire occurs every 7 years	no fire for more than 30 years	Maintain interval closer to the maximum where possible.

### 5.3 WEED MANAGEMENT

Where fuel/vegetation reduction and access construction and maintenance works occur, all vehicles and machinery likely to disturb the soil should be cleaned prior to, during and after these activities to reduce the spread of weeds.

As bushfires may exacerbate weed infestations, it is recommended that weed control occurs within 6 months of any bushfire. Table 15 outlines safeguards to reduce the spread of weeds during fire management activities.

**Table 15: Safeguards when carrying out fire management activities in sites containing exotic plant species**

Potential impact	Possible safeguards (or ameliorative measures) to mitigate the impact
Exotic seeds introduced on machinery and boots during fire management activities	<ul style="list-style-type: none"> <li>▪ Wash down all vehicles and machinery likely to disturb the soil prior to, during and after prescribed burning or trail maintenance activities.</li> <li>▪ Vehicles and machinery regularly used in wildfire suppression should be thoroughly cleaned on a regular basis.</li> <li>▪ Carry out weed management following the fire management activities.</li> </ul>
Weed distribution and abundance increased as a result of fire management activities	<ul style="list-style-type: none"> <li>▪ Carry out weed control following the fire management activities.</li> <li>▪ Avoid movement through weed infested areas.</li> <li>▪ Wash down all vehicles and machinery that are likely to disturb the soil during prescribed burning or trail maintenance activities.</li> </ul>
Environmental conditions that favour the expansion of exotic species are created by fire regimes	<ul style="list-style-type: none"> <li>▪ Minimise size of burn areas by slashing or other (non-fire) fuel reduction.</li> <li>▪ Delay burning if burning at the proposed time will exceed fire interval threshold.</li> <li>▪ whenever possible, avoid scorching the overstorey canopy during prescribed</li> </ul>

	burning.
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#### 5.4 PROTECTION OF HISTORIAL SITES

To reduce the potential impact on unknown Aboriginal sites, the following operational guidelines should apply during fire suppression operations, APZ works, and access trail construction and maintenance works:

- In the event of fire management activities disturbing or damaging an unknown site, the NSW Office of Environment and Heritage (OEH) and the NSW Heritage Office must be informed;
- In the event of an unrecorded site being found during fire suppression operations, action should be taken to avoid damage to the site and it must be reported to the incident controller;
- All post-fire reports are to consider the effects of the fire on Aboriginal sites and where necessary recommend ameliorative action;
- Where known, sites are to be protected with appropriate protection structures (e.g. strong temporary fences and bold signage) during vegetation removal and fire trail maintenance operations; and
- As vegetation cover is reduced and the possibility of finding sites is increased, post-bushfire inspections and surveys may be considered relevant.

## 6 Work Schedule

Tables 17 and 18 summarise the works required to achieve the bushfire management objectives of the plan. This should be read in conjunction with Figure 7. The fire management activities identified here are to be implemented in accordance with any additional requirements of any environmental impact statement and the environmental protection safeguards detailed in Section 5.

Actions are given priority using the rating system in Table 16 below. This system is based on an effort/impact ratio where preventative actions that occur regardless of the BMP and/or are inexpensive to implement are given a higher priority rating and actions that require a considerable injection of funds without immediate impacts are rated much lower.

**Table 16: Action Priority Rating System**

Priority	Meaning	Reason
Very high (1)	Critical action	Actions prevent the occurrence of fires and/or prevent the creation of additional risk.
High (2)	Must be done	Actions aim to protect significant tangible assets from bushfire (e.g. buildings, relics, and threatened species).
Medium (3)	Should be done	Actions that facilitate the suppression of bushfires.
Low (4)	To be undertaken when other actions are complete	Actions aim to extend bushfire management to adjoining lands to increase protection of neighbouring properties.

Table 17: Summary of fire management actions – Zone 1 – Asset Protection Zones (Figure 7)

Zone Ref.	ID	Actions	Priority	2010	2011	2012	2014	2015-2020
Entire Management Unit		Use suppression and fuel reduction methods that reduce the potential impact on the natural and cultural environment of the Site (Section 5).	2	✓	✓	✓	✓	✓
		Investigate complaints regarding fuel loads within the Site.	3	✓	✓	✓	✓	✓
1.1	Establish a 50-60m Asset Protection Zone (APZ) in the west and south west of the Site – currently vegetated	<p>Establish a minimum 50 m APZ (within the designated community lands) to the specifications provided in section 4.1.1. Requires the expansion of current slashing widths. Trees are to remain however treatment of canopy to restrict overhang and create canopy spacing may be required.</p> <p>Annually monitor fuel loads within the 50-60m APZ prior to the bushfire season and at least once mid-way through the bushfire season. Implement works as needed to ensure the APZ is at a standard consistent with section 4.1.1.</p>	2	✓	✓	✓	✓	✓
1.2	Establish a 50-100m Asset Protection Zone (APZ) in the east of the Site – currently vegetated	<p>Establish a minimum 50 m APZ (within the designated community lands) to the specifications provided in section 4.1.1. Requires the expansion of current slashing widths. Trees are to remain however treatment of canopy to restrict overhang and create canopy spacing may be required.</p> <p>Annually monitor fuel loads within the 50-100m APZ prior to the bushfire season and at least once mid-way through the bushfire season. Implement works as needed to ensure the APZ is at a standard consistent with section 4.1.1.</p>	2	✓	✓	✓	✓	✓

Table 18: Summary of fire management actions – Zone 2A, 2B &amp; 2C – Strategic Fire Advantage Zones (Figure 7)

Zone Ref.	ID	Actions	Priority	2010	2011	2012	2014	2015-2020
Entire Management Unit		Extensive weed removal and long term control.	2	✓	✓	✓	✓	✓
		Removal of dead fuel and some understorey vegetation with the goal of reducing fuel loads without impacting the health of the vegetation. Management should still be predominantly consistent with 4.1.1, but with less intensity to the fuel removal. Fuel loads can accumulate to approximately 8-10 t/ha.	2	✓	✓	✓	✓	✓

Table 19: Summary of fire management actions – Zone 3 – Land Management Zones (Figure 7)

Zone Ref.	ID	Actions	Priority	2010	2011	2012	2014	2015-2020
Entire Management Unit		Extensive weed removal and long term control.	2	✓	✓	✓	✓	✓
		Removal of dead fuel and some understorey vegetation where this is considered to be detrimental to the health of the conserved threaten species – particularly <i>Darwinia biflora</i> . Fuel management to be done either manually or through the use of low-intensity ecological/hazard reduction burning provided it falls within the appropriate fire regime thresholds for the abovementioned species.	2	✓	✓	✓	✓	✓

## 7 Monitoring, Review & Evaluation

All strategies and plans must have mechanisms that show that progress is being made in dealing with the problem or it is successfully completing the prescribed actions. It is also necessary to determine the effectiveness of the plan and efficiency of individual actions.

### 7.1 MONITORING AND EVALUATION

Monitoring should occur at both the management level and a biodiversity level. Monitoring at the biodiversity level, however, usually involves analysis of environmental stress and response of indicator species (e.g. threatened species), biotic composition, life history studies, and distress syndromes (e.g. the effect of fire or lack of fire). This level of monitoring is not considered necessary due to the lack of baseline data and the amount of resources it usually takes to undertake this work. Monitoring for management purposes should therefore be carried out to ensure that the actions listed in Tables 17 to 20 are being carried out and the objectives are being achieved.

Monitoring and evaluation against the actions and timeframes outlined in the Work Schedule (Section 6) are effective way to monitor the implementation of the plan.

### 7.2 REVIEW OF THE PLAN

A complete evaluation, review and updating of the plan should occur after five years. The review should;

- consider whether the plan has achieved the objectives set out in Section 1.1;
- reassess the strategies and environmental safeguards in light of current research and management best practice; and
- Reassess the strategies taking into account of legislative changes, financial constraints, social philosophies, improvements in bushfire protection and suppression, and changes in vegetation.

Annual reviews of the plan may be done when preparing annual works programs. Small changes to the actions and strategies may occur within the plan without formally discussing the changes with the NSW Fire and Rescue. Matters that require a more significant variation should be discussed with the NSW Fire and Rescue and any affected stakeholders.

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