



# Ingleside Chase Reserve

## Bushfire Management Plan

Prepared by



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# 1 INTRODUCTION AND BACKGROUND

This Bushfire Management Plan (the Plan) was prepared for Pittwater Council under contract by Eco Logical Australia Pty Ltd (ELA). The Plan has been prepared as an update to a previous plan 'Warriewood Ingleside Escarpment Bushfire Management Plan 2005' prepared for the Reserve (for Pittwater Council) by Brian Parry and Associates.

## 1.1 SCOPE AND OBJECTIVES

The Plan describes the objectives, strategies and activities for bushfire management within Ingleside Chase Reserve (hereafter referred to as the Reserve) for the years 2012 to 2017 (the next 5 years). Further, it provides the framework for continued management beyond 2017.

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

Seven primary objectives of the Plan have been identified for the Reserve. These are set out below:

1. Protect persons and property, in and adjacent to the Reserve.
2. Meet Council's legislative requirements in terms of its public risk liability.
3. Minimise unplanned (human caused) bushfires.
4. Minimise the spread of bushfires in the Reserve.
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. Further, the application of such APZs are often divergent from the aims and objectives around biodiversity conservation for such a Reserve.

A limitation of this plan is that bushfire planning guidelines are unable to be strictly applied given existing constraints both on and off the Reserve. A risk based approach was therefore taken for this plan with the identification of provisions that can be applied by which risks from bushfire can be reduced to realistically appropriate 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 minor. Given this, and that it is considered good practice, education and extension programs for the neighbouring community are discussed later in the report.

## 2 DESCRIPTION OF THE RESERVE

### 2.1 LOCATION

Since the release of the 'Warriewood Ingleside Escarpment Bushfire Management Plan 2005', recent negotiations with the State Government and the Uniting Church have allowed for the incorporation of a further 27 ha of remnant bushland, including the former Heydon Estate, into the Council Owned Ingleside Chase Reserve (the Reserve). With the incorporation of these lands, the Reserve now covers approximately 70 ha of undisturbed natural vegetation and provides a vegetated link from Narrabeen Lagoon, through the Warriewood Wetlands and Irawong Reserve to Ku-ring-gai and Garigal National Parks. The Reserve and the surrounding areas are depicted in Figure 1.

The Reserve is bounded to the east by new residential development of the Warriewood Valley, to the south by the residential area of Elanora Heights, to the west by rural allotments and remnant native vegetation and to the north by Mona Vale Road. Areas to the east of the Reserve are being progressively developed into residential estates in line with the Warriewood Valley Urban Land Release Planning Strategy. Rural areas to the west of the Reserve are part of a longer term strategy for the development of the area.

The northern section of Ingleside Chase Reserve contains the upper catchment of both Narrabeen and Fern Creeks. The upper tributaries of Mullet Creek flow into and combine in the southern half of the Reserve before entering the Warriewood Wetlands to the east.

### 2.2 BIODIVERSITY

#### 2.2.1 Vegetation Communities

Seven (7) native vegetation communities are recognised to occur in the Reserve (Eco Logical Australia 2010): Hawkesbury Sandstone Woodland, Hawkesbury Sandstone Low Open Woodland, Ingleside Escarpment Wet Sclerophyll Forest, Sandstone Heath, Sandstone Gully Forest, Coachwood Warm Temperate Rainforest and Swamp Sclerophyll Forest as shown in Figure 2.

Only one of the vegetation communities in the Reserve corresponds to an Endangered Ecological Community (EECs) listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act), namely Swamp Sclerophyll Forest. Threats to Swamp Sclerophyll Forest include (DECCW 2010a): 'frequent burning which reduces the diversity of woody plant species'.

#### 2.2.1 Flora

Only two threatened flora species have been recorded within the immediate vicinity (i.e. 1 km) of Ingleside Chase Reserve, namely *Tetradlea glandulosa* (Glandular Pink-bell) and *Grevillea caleyi* (Caley's Grevillea). While suitable habitat for Glandular Pink-bell occurs within the confines of the Reserve, no potential habitat for Caley's Grevillea was identified (ELA 2010). Considering the size and condition of the Reserve, there is potential for other as yet unrecorded threatened species to occur (Eco Logical Australia 2010).

One species on the Rare or Threatened Plants (ROTAP) list, nine species which are considered threatened in northern Sydney (Smith and Smith 2000) and eight species considered locally rare and being of significance in the Pittwater LGA were identified at Ingleside Chase Reserve.

#### 2.2.2 Fauna

A list of significant fauna recorded or expected to occur in Ingleside Chase Reserve is provided in Table 1 (Eco Logical Australia 2010). This list is based on the table provided in the *Warriewood/Ingleside*

*Escarpment (North) Plan of Management* (Gondwana Consulting 2005), with updates from the NPWS Atlas (DECCW 2010c) and DEWHA Protected Matters Search (DEWHA 2010). A total of twelve mammals, six bats, two frogs, and twelve birds have been recorded or are expected to occur or utilise habitats within the Ingleside Chase Reserve.

Threats to these species include inappropriate fire regimes impacting habitat and prey availability.

**Table 1: Significant fauna recorded or expected to occur in Ingleside Chase Reserve**

SPECIES	COMMON NAME	LOCALLY SIGNIFICANT	REGIONALLY SIGNIFICANT	THREATENED IN NSW	THREATENED NATIONALLY
<b>Mammals</b>					
<i>Acrobates pygmaeus</i>	Feathertail Glider		X		
<i>Cercartetus nanus</i>	Eastern Pygmy-possum			V	
<i>Dasyurus maculatus</i>	Spotted-tail Quoll			V	V
<i>Dasyurus viverrinus</i>	Eastern Quoll			E	
<i>Isodon obesulus</i>	Southern Brown Bandicoot			E	E
<i>Perameles nasuta</i>	Long-nosed Bandicoot	X	X		
<i>Petaurus breviceps</i>	Sugar Glider	X			
<i>Petaurus norfolcensis</i>	Squirrel Glider			V	
<i>Petaurus norfolcensis</i>	Squirrel Glider (Endangered Population)			E	
<i>Phascolarctos cinereus</i>	Koala			V	
<i>Phascolarctos cinereus</i>	Koala (Endangered Population)			E	
<i>Wallabia bicolor</i>	Swamp Wallaby	X			
<b>Bats</b>					
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle			V	
<i>Miniopterus schreibersii</i>	Common Bent-wing Bat			V	
<i>Mormopterus norfolkensis</i>	Eastern Freetail Bat			V	
<i>Nyctinomus australis</i>	White-striped Freetail Bat	X			



SPECIES	COMMON NAME	LOCALLY SIGNIFICANT	REGIONALLY SIGNIFICANT	THREATENED IN NSW	THREATENED NATIONALLY
<i>Pteropus poliocephalus</i>	Grey-headed Flying Fox			V	V
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat			V	
<b>Reptiles</b>					
<i>Demansia psammophis</i>	Yellow-faced Whip Snake	X			
<i>Morelia spilota</i> ssp. <i>spilota</i>	Diamond Python	X			
<i>Phyllurus platurus</i>	Southern Leaf-tailed Gecko	X	X		
<i>Varanus rosenbergi</i>	Heath Monitor	X		V	
<b>Frogs</b>					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog			V	V
<i>Pseudophryne australis</i>	Red-crowned Toadlet			V	
<b>Birds</b>					
<i>Accipiter fasciatus</i>	Brown Goshawk	X			
<i>Calyptorhynchus lathami</i>	Glossy-black Cockatoo			V	
<i>Centropus phasianinus</i>	Pheasant Coucal		X		
<i>Glossopsitta pusilla</i>	Little Lorikeet			V	
<i>Lathamus discolor</i>	Swift Parrot			E	E
<i>Lopholaimus antarcticus</i>	Topknot Pigeon		X		
<i>Ninox connivens</i>	Barking Owl			V	
<i>Ninox strenua</i>	Powerful Owl			V	
<i>Ptilinopus magnificus</i>	Wompoo Fruit-dove			V	
<i>Ptilinopus superbus</i>	Superb Fruit-dove			V	
<i>Tyto novae-hollandiae</i>	Masked Owl			V	

SPECIES	COMMON NAME	LOCALLY SIGNIFICANT	REGIONALLY SIGNIFICANT	THREATENED IN NSW	THREATENED NATIONALLY
<i>Xanthomyza phrygia</i>	Regent Honey Eater			E	E, Migratory

Legend:

V = Vulnerable, E = Endangered

### 2.3 CULTURAL HERITAGE

Ridgelines, such as at Ingleside and the spur down to the coast that provides the current route of Mona Vale Road, originally served as important movement corridors for Aboriginal People (Gondwana Consulting 2005).

An abundance of Aboriginal heritage exists on the escarpment and surrounding land including many rock carvings depicting people and animals, information relating to hunting and water sources. In addition there are paintings in rock overhangs and other signs of the importance of the area to Aboriginal people.

Aboriginal Heritage within the Reserve is largely undocumented and has the potential to be impacted.

### 2.4 RECREATIONAL USE AND FACILITIES

Recreational activities at Ingleside Chase Reserve currently include walking/running, dog walking, mountain biking, and bird watching. Both mountain biking and dog walking are currently prohibited activities in the Reserve. Council is considering allowing mountain biking subject to approval of a plan for a sustainable bike path and having no environmental impact. These activities are generally confined to the more utilised walking trails through the Reserve, however there are many informal tracks crisscrossing the Reserve.

The existing informal track network provides access from the rural areas of Ingleside through the Reserve to both Mater Maria Catholic College and further south through Irrawong Reserve, the Warriewood Wetlands and ultimately to Warriewood Shopping Centre. There is no formal access to the northern section of the Reserve.

### 2.5 EXISTING BUSHFIRE ASSETS AND ADVANTAGES

The Reserve can be accessed by vehicles from Mona Vale Road to the north, Wesley Street to the south and Ingleside Road to the west however, access within/through the Reserve itself is only possible by foot.

Water supply hydrants are available along the surrounding public roads and water fill points for both fixed wing and helicopters is available in the local area. Hydrants have not been installed within the Reserve and no other supply of water for fire fighting exists within the Reserve.



Figure 1: Regional Location of the Reserve



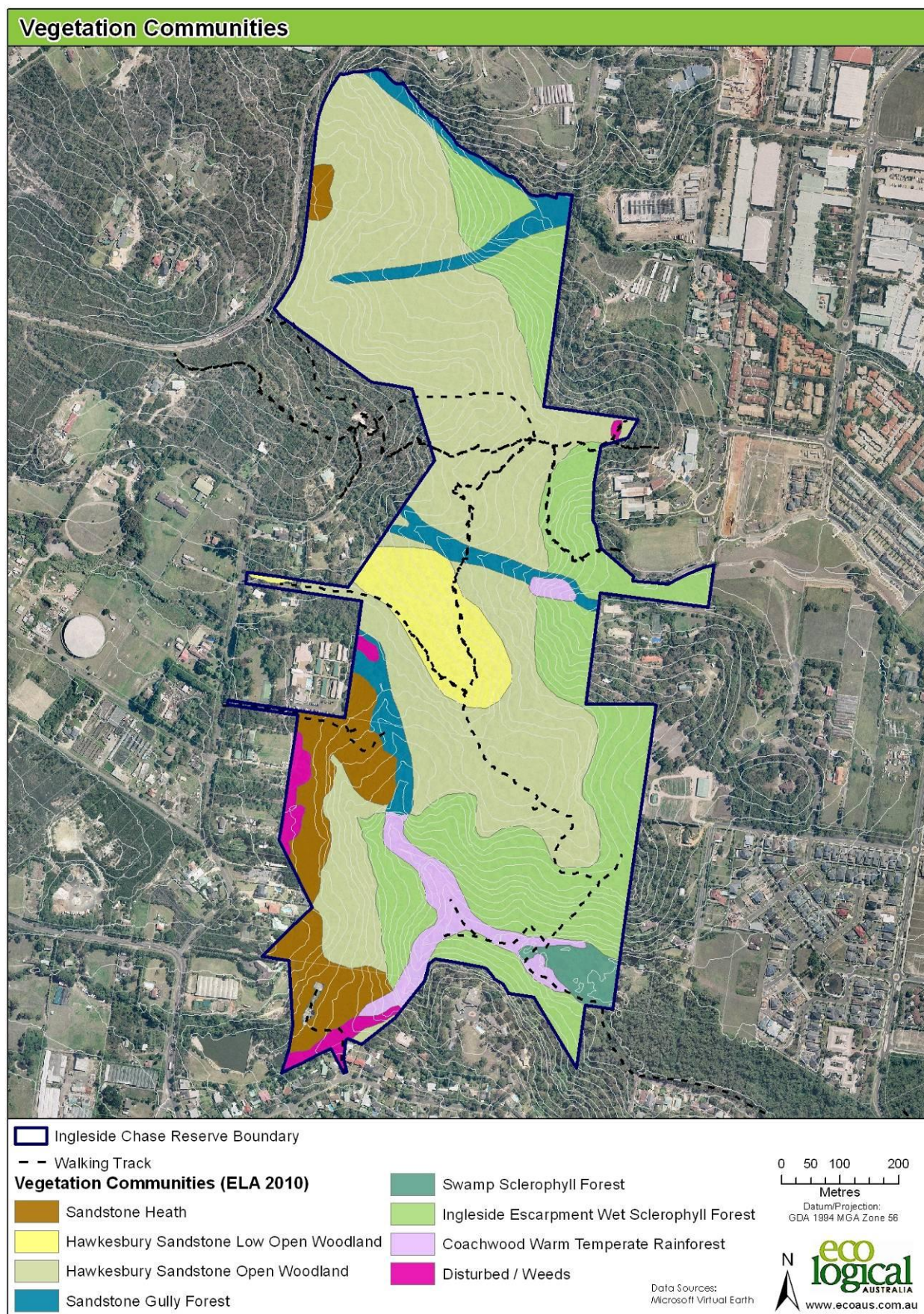


Figure 2: Vegetation Communities (ELA 2010)



## 3 BUSHFIRE RISK ANALYSIS

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

### 3.1 BUSHFIRE HISTORY

The entire Ingleside Chase Reserve was burnt by wildfire in 1994, which has resulted in a relatively even age class of vegetation across the Reserve. It is likely that a number of sheltered gullies, particularly those dominated by Coachwood Warm Temperate Rainforest would have escaped the fire due to a number of factors including aspect and moisture. Two hazard reduction burns have been undertaken within the confines of the Reserve by the RFS since 1994. One of these burns was along the boundary of the Uniting Church Conference Centre in the south of the Reserve in 2004. In 2005, a hazard reduction burn was undertaken in the central portion of the Reserve at Ingleside Park. One small wild fire covering only half a hectare occurred in 2003 in the centre of the Reserve. Bushfire history is shown in Figure 3.

### 3.2 BUSHFIRE HAZARD

#### 3.2.1 Terrain

The steep and variable terrain within and adjoining the Reserve will have a major effect on fire behaviour. This will include the rate and direction of fire spread, fire intensity, spotting distances along with other attributes of fire behaviour. The steepness of a slope, direction of fire spread on the slope, aspect of the slope and changes in slope direction not only strongly affect wildfire behaviour, but also the selection and risk of fire suppression and mitigation strategies.

Slope was assessed across the Reserve using 1m contours (Figure 4). Ingleside Chase Reserve is situated on the Ingleside escarpment which rises steeply from the floor of the Warriewood Valley to a height of over 120m AHD at Ingleside. Ingleside Chase Reserve is relatively steep with average slopes of 40°, however slopes range from less than 10° to over 60° in some areas. The topography of the Reserve is characterised by a series of relatively flat sandstone benches, steep slopes and sandstone cliffs. Cutting through the landscape are a series of steep gullies associated with the northern and southern arms of Mullet Creek in the south and Narrabeen Creek in the north. The predominant aspect is to the east.

#### 3.2.2 Vegetation and Fuel

Generally the fire hazard and the intensity of the fire will increase the more flammable and dense the fuel. Vegetation formations across the site fall into the categories of 'Dry sclerophyll forests', 'Wet sclerophyll forests', 'Forested Wetland', 'Rainforest' and 'Tall Heath' (PBP 2006, from Keith 2004). One linear patch, which is generally <50m in width was classified as 'Low hazard vegetation' (10t/ha) (PBP 2006) in recognition of the lower fire intensities expected from this smaller patch and fuel characteristics of the vegetation in this area.

Likely climax fuel loads have been estimated across the Reserve based on a brief field based assessment and vegetation community mapping (Figure 6).

### 3.2.3 Potential Fire Intensity

Potential intensity of a bushfire under extreme weather conditions has been mapped for the Reserve using a Head Fire Intensity (HFI) model (Figure 7). This model uses the following parameters to identify the potential bushfire intensity:

- terrain (slope and aspect);
- fuel (vegetation);
- likely weather scenario and direction of travel (from the North through to South West direction);
- Forest Fire Danger Index (FFDI of 100)

The HFI model calculates potential fire intensity using the McArthur (1962) fire intensity formulae. A model has been provided to display the potential fire intensity under north through to south-westerly winds.

The model of potential fire intensity shows that the greatest intensity is possible on the steeper forested western facing slopes which are limited within the Reserve as the dominant aspect is easterly. Generally, the steep eastern facing slopes are shielded from the north to south-westerly winds and fires on these slopes are potentially of much lower intensity.

It is important to note that the model of potential fire intensity does not provide an indication of ignition risk or the rate of spread of a bushfire.



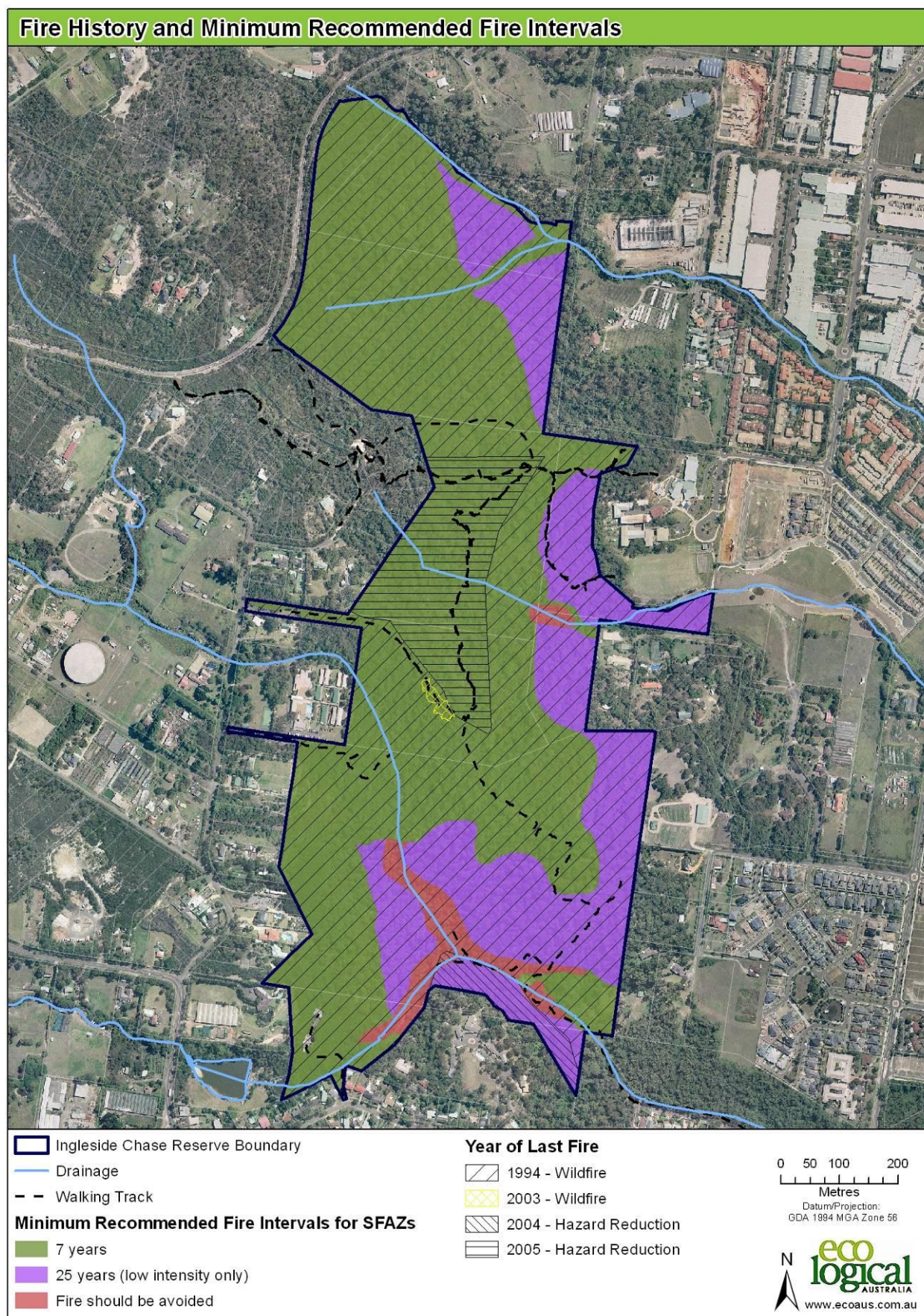


Figure 3: Fire History and minimum burn intervals



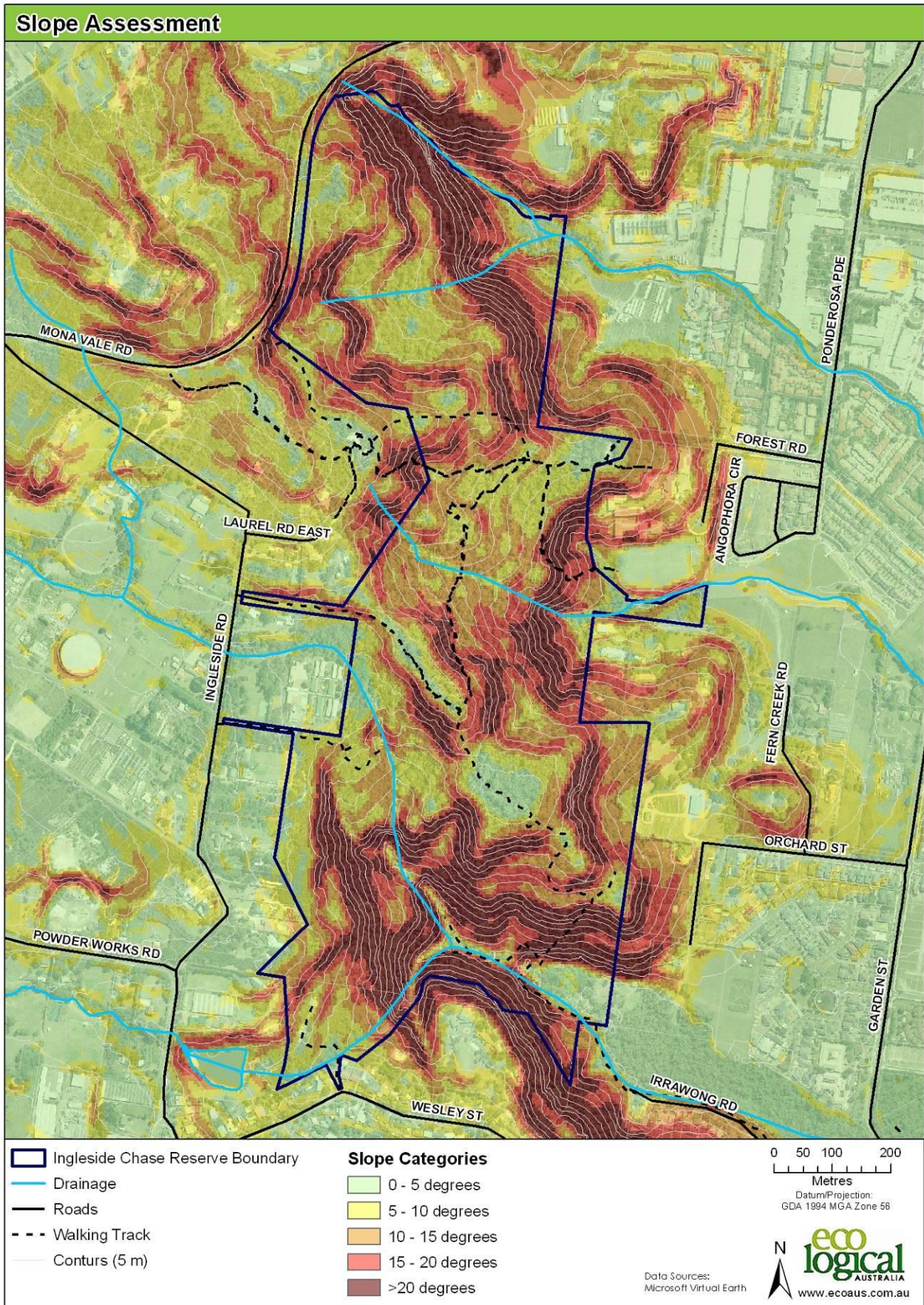


Figure 4: Slope Assessment



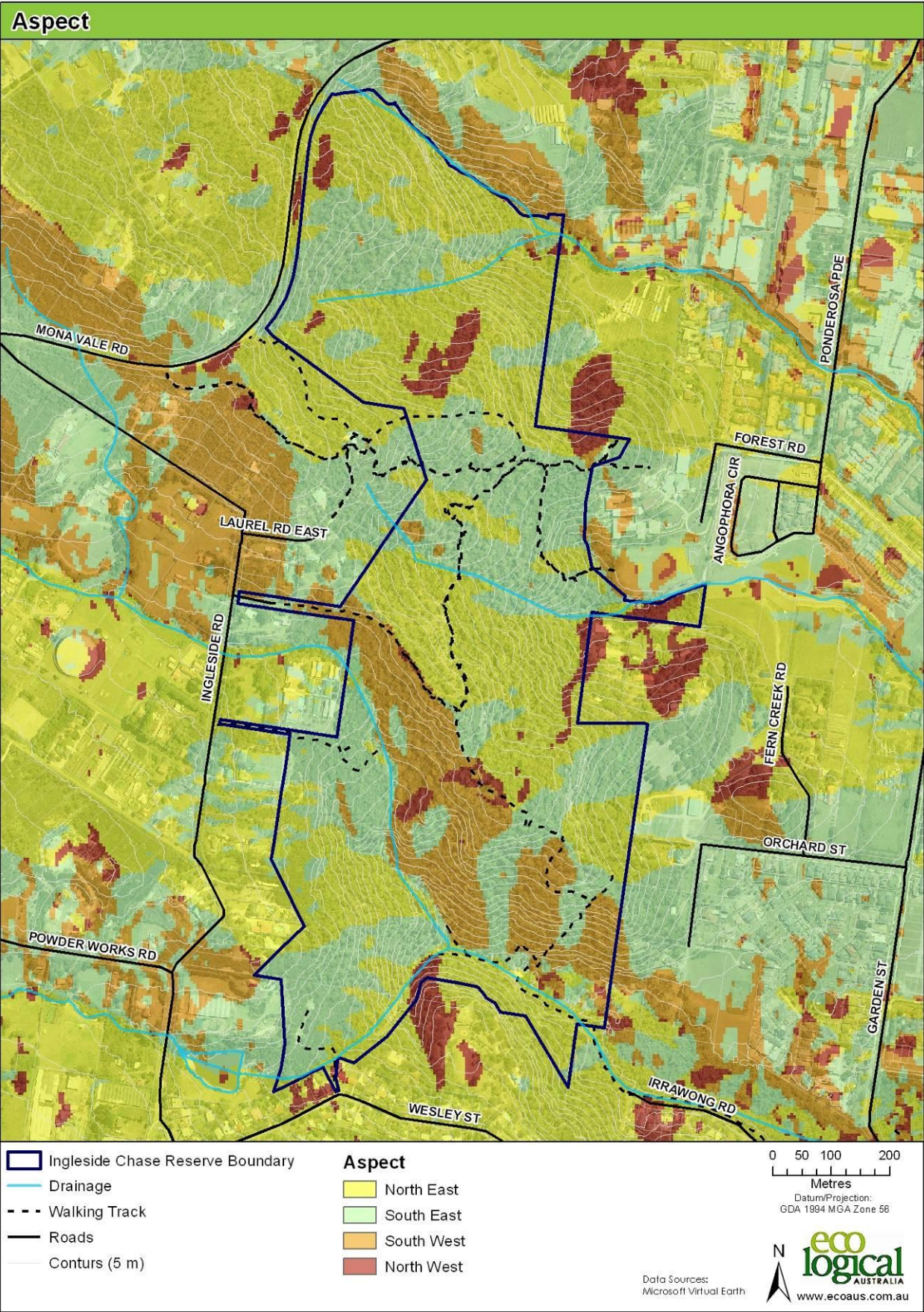


Figure 5: Aspect Assessment



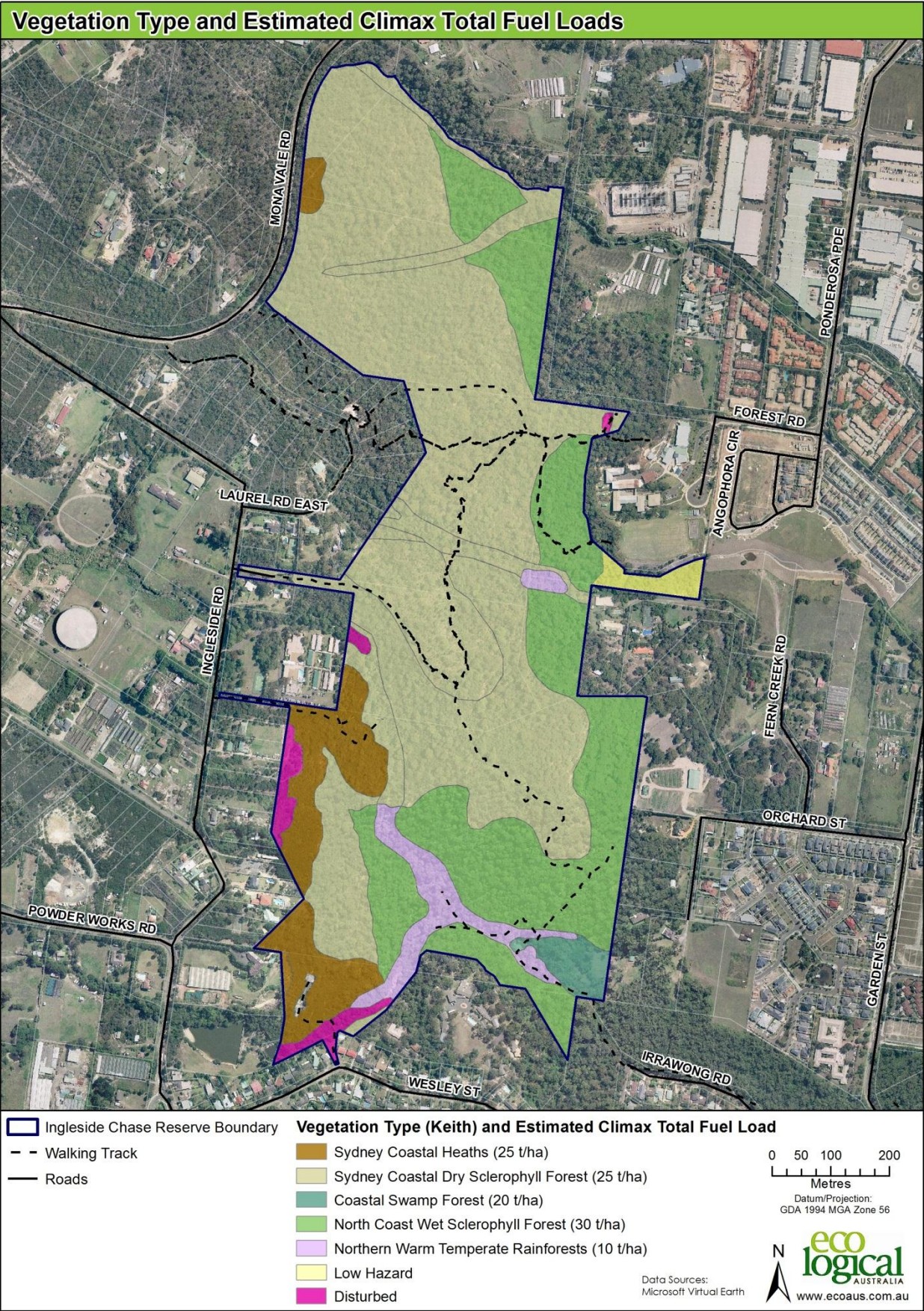


Figure 6: Bushfire Vegetation Formations



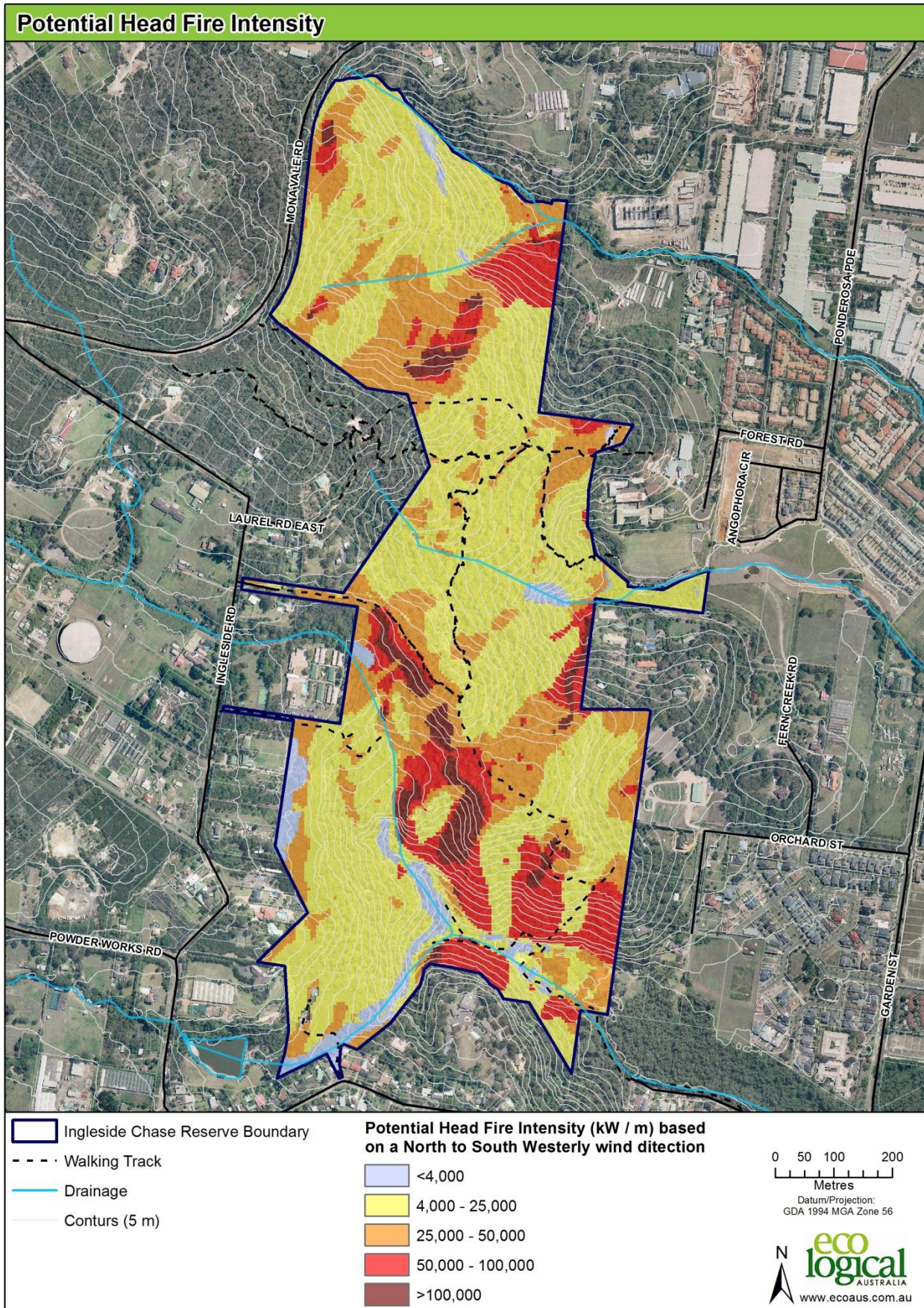


Figure 7: Potential Head Fire Intensity



### 3.3 ASSETS AT RISK

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

#### 3.3.1 Built Assets

There are no assets requiring specific bushfire protection located within the Reserve.

Residential and community development surrounds the Reserve, and as such, built assets that are typical for these types of development e.g. dwellings, halls, classrooms, decks and sheds adjoin the Reserve. Some of these structures have little setback from the Reserve and are therefore more vulnerable to the impact of bushfire.

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 firefighting operations, the health of residents and the integrity of building elements. Flames restrict firefighting 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 firefighters.

Unfortunately there are some situations where adjoining structural assets have been constructed in the past and are in close proximity to the Reserve and have not been built to withstand the expected level of bushfire attack. These will require some specific mitigation measures.

Of particular concern is a dwelling on Ingleside Road that adjoins the south west boundary of the Reserve, Mater Maria College in the east, the Uniting Church Conference Centre in the south and the Sydney Conference and Training Centre in the west as they are at greatest risk from bushfire having little setback from the bushfire hazard. The bushfire risk management actions in Section 4 aim to mitigate the risk to these vulnerable assets.

#### 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 combine 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 *Threatened Species Conservation (TSC Act) Act 1999*, 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 Swamp Sclerophyll Forest is frequent burning which reduces the diversity of woody plant species. Therefore, to conserve this community, fire management within the Reserve 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 Swamp Sclerophyll Forest and a general problem for many of Sydney's urban Reserves. Particular problem species that threaten the biodiversity of the Reserve 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 vegetation clearing, 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. A community engagement strategy would be beneficial to educate residents encroaching into the Reserve under the pretence of bushfire hazard reduction, as this can lead to illegal clearing.

### 3.3.3 Cultural heritage

There are numerous Aboriginal heritage items within the Reserve. This plan has adopted a precautionary approach and contains measures and guiding principles to protect aboriginal sites within the Reserve. These measures are detailed within Section 5.4 of this report.

There are no known significant non-Aboriginal cultural heritage sites at risk from bushfire within or adjacent to the Reserve.

## 3.4 BUSHFIRE RISK ASSESSMENT

Based on the analysis provided throughout this chapter and summarised in Table 5, Table 6 to Table 9 assess the risks for bushfire to people, property (infrastructure, assets, private property), environmental assets, and cultural assets. The methodology adopted is that given in AS4360 (SAI Global 2004) 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. The scale of likelihood is shown below and is based on AS4360. Values have been allocated to the likelihood descriptors on a scale of 1 to 5 with 1 being extremely rare (extremely unlikely) and 5 being almost certain, as outlined in Table 2 below.

**Table 2: Likelihood Description**

<b>Likelihood Descriptor</b>	<b>Description</b>
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**

<b>Consequence Descriptor</b>	<b>Description</b>
Huge (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**

<b>Level of risk</b>	<b>Risk rating</b>
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.

**Table 5: Analysis of risk factors**

<b>Risk Factor</b>	<b>Analysis of the risk factor</b>
1. The likelihood of human and natural fire ignitions, as influenced by time, space and demographics.	Natural ignitions originating within the Reserve are unlikely. Historically the Reserve has been ignited from wildfires approaching from the west under extreme fire weather conditions. Human induced ignitions are known to be relatively more frequent at the urban / bushland interface, and are possible within the Reserve.
2. The potential spread and severity of a bushfire, as determined by fuel, topography and weather conditions.	The majority of surrounding built assets are situated upslope from the hazard. The Reserve is mostly shielded from strong north-westerly winds. The easterly aspect of the Reserve has contributed to the growth of more mesic vegetation communities. The slopes on average are steep. The vegetation formations are considered to provide high fuel loads.
3. The proximity of assets vulnerable to bushfire and likely bushfire paths.	Residential dwellings and other built structures directly adjoin the Reserve. Although the majority of these assets have some set back from the Reserve boundary and most backyards are managed appropriately, in a fuel reduced state. Further, there is a low density of vulnerable assets in the east and south of the reserve (expected fire path).  The Endangered Ecological Community <i>Swamp Sclerophyll Forest</i> covers part of the Reserve. Inappropriate fire regimes may threaten this community.
4. The vulnerability of assets, or their capacity to cope with, and recover from bushfire.	Dwellings may not have been constructed in accordance with <i>AS 3959 - Construction of Buildings in Bushfire Prone Areas</i> .  Fire may impact threatened communities and exacerbate weed and pest invasion.

The risk assessments presented in Table 6, Table 7, Table 8 and Table 9 indicate that, over the currency of the plan, threats to life, property, heritage and environmental attributes of the Reserve are a minor risk and will require appropriate risk management.

**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	1	5	Minor
Less likely to be fatalities or major injuries due to the presence of attributes which afford some protection.	4	2	8	Minor

Vulnerability Criteria	Consequence (A)	Likelihood (B)	Level of risk (A x B)	Rating
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	4	8	Minor
No injuries or fatalities likely.	1	5	5	Minor

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

Vulnerability Criteria	Consequence (A)	Likelihood (B)	Level of risk (A x B)	Rating
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	1	4	Insignificant
Localised damage to property. Short-term external assistance required to recover.	3	2	6	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**

Vulnerability Criteria	Consequence (A)	Likelihood (B)	Level of risk (A x B)	Rating
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	4	8	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 Reserve and residential areas adjoining the Reserve. 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 Reserve, a 'joint responsibility' for fire protection is seen as essential between Council, the Rural Fire Service and local residents. This can be facilitated by proposed bushfire extension programs (Section 4.6) and development controls.

**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 Reserve.</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) and the Warringah Pittwater Bushfire Risk Management Plan (WPBFMC 2010):

- Asset Protection Zone (APZ)
- Strategic Fire Advantage Zone (SFMZ)
- Land Management Zone (LMAZ)

Zones have been identified and mapped across the Reserve to provide a planning framework upon which the protection of life, property and the environment can be improved. These zones are shown in Figure 3 and described in Sections 4.2, 4.3 and 4.4 below.



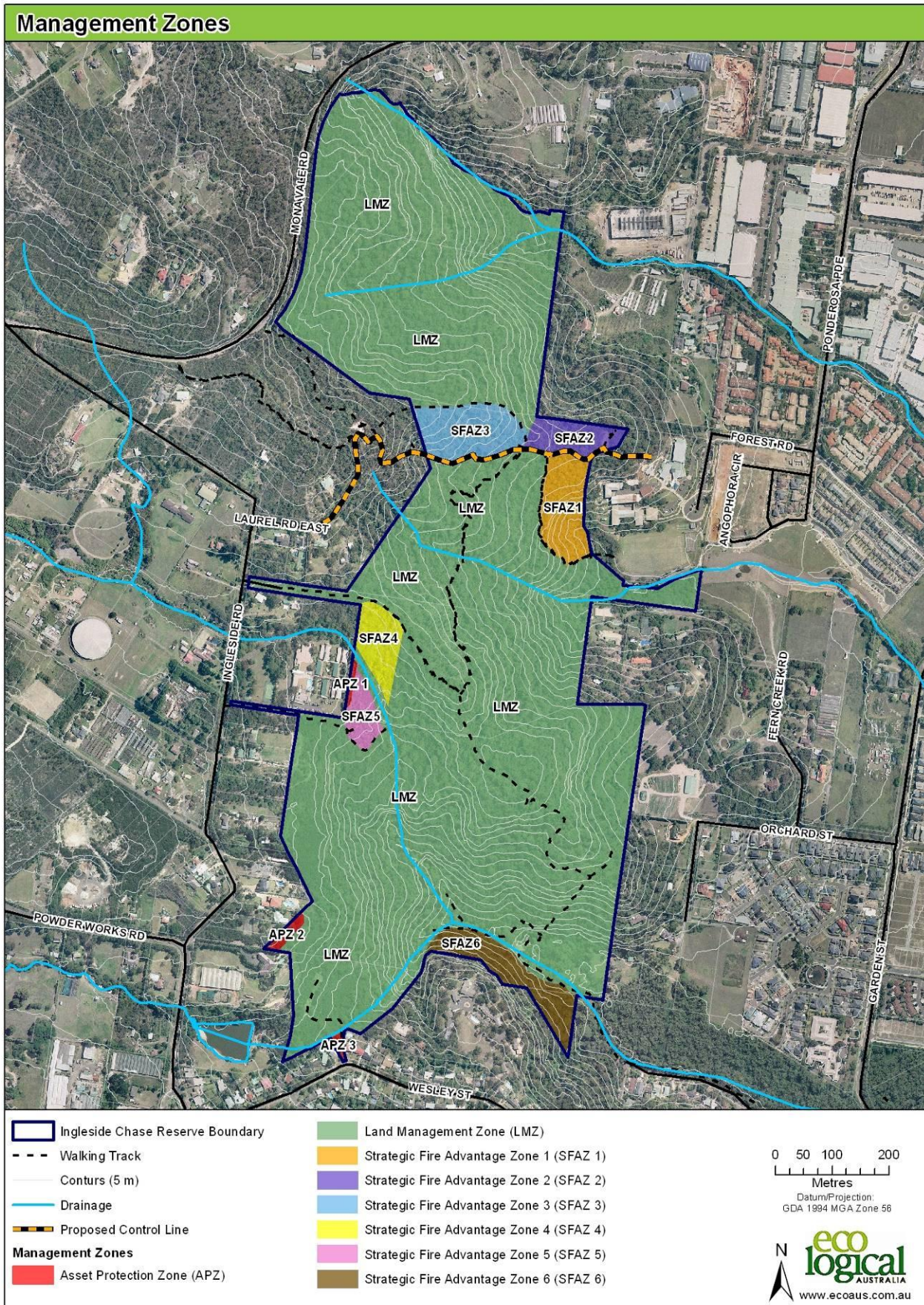


Figure 8: Management Zones



## 4.2 ASSET PROTECTION ZONES

An Asset Protection Zone (APZ) is a buffer area between a bushfire hazard and an asset which minimises the impact of fire on that asset. The APZ should be maintained so that bushfire fuels are minimised. Table 11 below describes the intended aim, specifications and management of APZs within the Reserve.

**Table 11: Asset Protection Zone**

Asset Protection Zone Details	
<b>Aim</b>	<ul style="list-style-type: none"> <li>To minimise bush fire impacts on assets 'at risk'</li> <li>To provide a fuel reduced zone around the asset in question to protect from direct flame attack.</li> <li>To enable the safe use of Direct Attack suppression strategies within the zone.</li> </ul>
<b>Specifications</b>	<ul style="list-style-type: none"> <li>Fuel reduced area through sensitive manual techniques (see Section 4.2.1 below).</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>No vegetation removal or thinning allowed without Environmental Impact Assessment and authorisation.</li> <li>Flagging tape (or an alternative method of demarcation) to be used to mark the limit of APZ before any works are undertaken.</li> <li>Only Council approved contractors to undertake APZ management works on the Reserve.</li> </ul>

The threat from flame contact and radiant heat to property, assets and thereby persons in and adjacent to the Reserve can be significantly reduced by the continued maintenance of APZs at the three (on-Reserve) locations displayed within Figure 8. These already cleared APZs include:

- A 20m APZ around an existing dwelling on Ingleside Road;
- A 20m APZ around the Sydney Conference and Training Centre; and
- An already cleared APZ between two properties at the Reserve entrance off Wesley Street.

APZ dimensions have been determined with consideration of:

- the Bush Fire Environmental Assessment Code (NSW RFS 2006),
- a field based assessment of bushfire hazard affecting neighbours of the Reserve,
- the existing setback, and
- adjusted to suit the bushfire threat and risk to the assets.

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

The following guidelines are intended for APZ maintenance within the Reserve. 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 APZ provided that;
- No part of their crown occurs within 5 m of any building (significant habitat trees can remain 2 m out from the building line);
- 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;
- 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 'ground' to just below soil level. Stumps of all species that have the capability of resprouting 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 are to be removed and continuously suppressed;
- All shrubs and tree saplings are to be removed off-site or mulched, but all native grasses within the Reserve are to remain in-situ wherever possible; and
- A minimal ground fuel is to be maintained to include either mown grass or rock of less than 4 tonnes per hectare of fine fuel (i.e. material of <6 mm in diameter).

#### 4.3 STRATEGIC FIRE ADVANTAGE ZONES

Table 12 below describes the intended aim, specifications and management of the SFAZs within the Reserve.

**Table 12: Strategic Fire Management Zones**

Strategic Fire Advantage Zone Details	
<b>Aim</b>	<ul style="list-style-type: none"> <li>• To provide a strategic fuel reduced zone around the key 'at risk' areas.</li> <li>• To provide strategic areas of fire protection advantage which will reduce the speed and intensity of bush fires, and reduce the potential for spot fire development.</li> <li>• To aid containment of wildfires to existing management boundaries.</li> </ul>

	<ul style="list-style-type: none"> <li>To improve the likelihood and safe use of Parallel Attack suppression strategies within the zone and/or Indirect Attack (back burning) in high to very high fire weather conditions within the zone.</li> </ul>
<b>Specifications</b>	<ul style="list-style-type: none"> <li>Fuel managed area through implement of hazard reduction burns.</li> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>Suppress all fires.</li> <li>Long term weed suppression.</li> <li>Hazard reduction burns at intervals of 5-10 years.</li> </ul>

#### 4.3.1 Proposed Burn Plan

The fuel loads within designated SFAZs will be managed through low intensity hazard reduction burns to be undertaken in collaboration with the RFS. A proposed burn plan has been developed based on an assessment of the recommended fire intervals for SFAZs (Table 15), fire history (Figure 3) and the previous interval between burns (Figure 9). The proposed burn plan is shown in Table 13 below.

**Table 13: Proposed SFAZ Burn Plan**

Proposed Burn Year	SFAZ Number	Comments
2012	1	This burn should be contained between the Mata Maria College in the east, the proposed control line in the north and the walking track in the south and west.
2013	3	This burn should be contained between the proposed control line in the south and the informal bike track in the north. If possible the burn should extend off-Reserve into the property to the west (through collaboration with the land owner).
2014	2	This burn should extend approximately 100m to the north of the proposed control line. If possible the burn should extend off-Reserve into the property to the east (through collaboration with the land owner).
2015	5	This burn should be contained between the Sydney Conference and Training Centre, the walking track to the south and the creekline to the north east. Care should be taken to not extend the burn into the riparian zone.
2016	6	This burn should extend to the north from the Uniting Church Conference Centre. Care should be taken not to burn into the rainforest vegetation at the base of the gully.
2017	4	This burn should be contained between the walking track to the north and the creekline to the south. A hand tool control line will need to be constructed along the western boundary of the burn to contain it's eastern extent. Care should be taken to not extend the burn into the riparian zone.

SFAZs 2 and 3 have been strategically located to provide fuel reduced strips that will work in conjunction with a proposed control line running east-west through the Reserve (Figure 8). The remaining SFAZs have been located in proximity to specific 'at risk' assets.

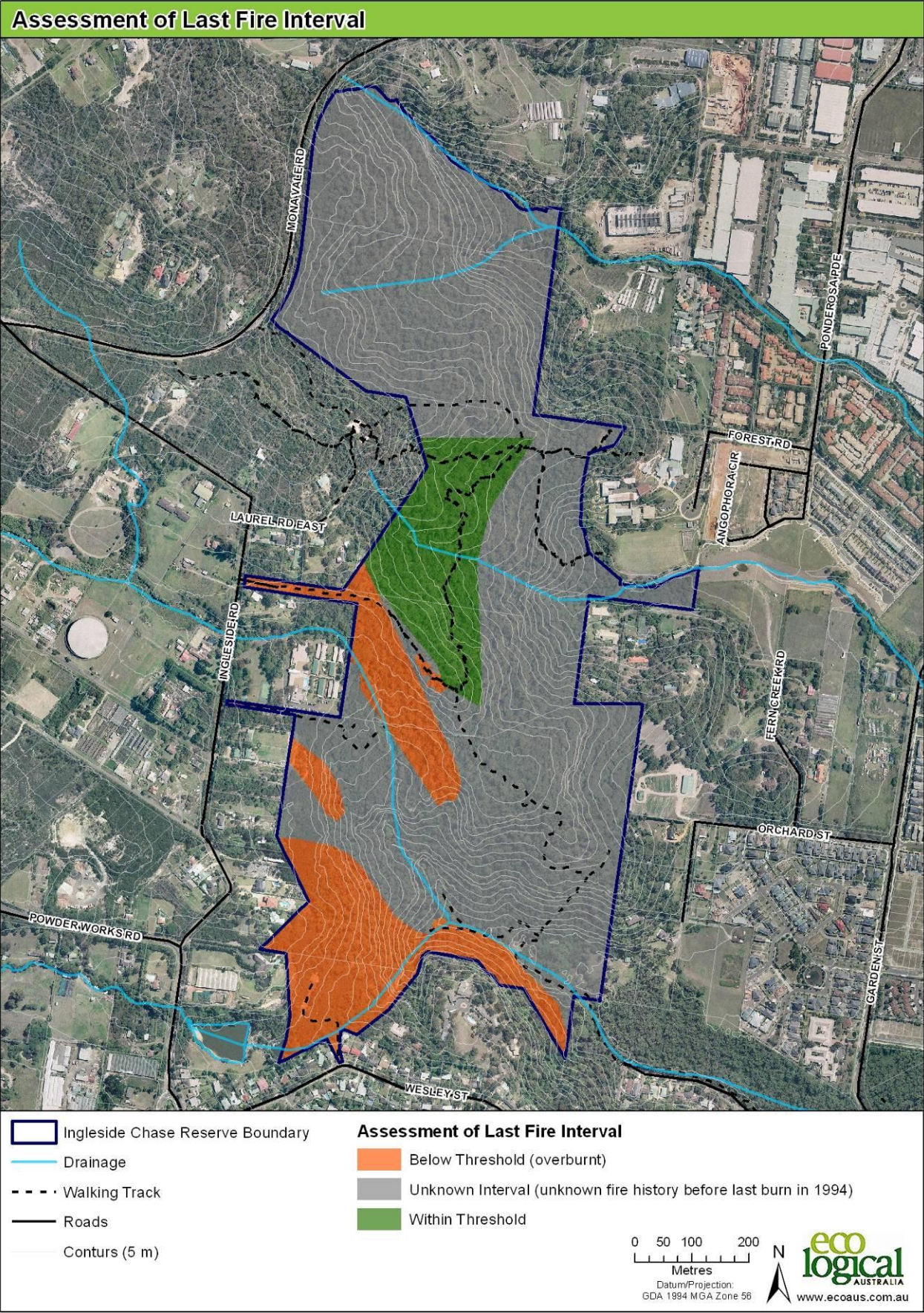
Wherever possible, fire regimes within the SFAZs are within the accepted biodiversity thresholds for each vegetation community as shown in Table 15. Notable exceptions are SFAZ 1 and SFAZ 6 which are within Wet Sclerophyll Forest where a burn interval of 5-10 years is well below the recommended burn interval for this community of 25 years. The proposal to manage as SFAZ these two areas of Wet Sclerophyll Forest at intervals below the guideline for biodiversity conservation allows larger parts of the Reserve to be burned less frequently and will strategically locate the best life and property protection strategies to where they will be effective under the widest range of fire attack scenarios. From a regional perspective, the impacts of low intensity fire at a frequency below the lower threshold guidelines restricted to a small area of the Wet Sclerophyll Forest are not considered significant. A long term change to the composition of the understorey species within the Wet Sclerophyll Forest is likely to occur, however no change to the overstorey species composition is likely to result.

We note that the burn strategy we have recommended is not consistent with the RFS Warringah Pittwater Bushfire Risk Management Plan (2010), where the entire Reserve was assigned as SFAZ, thus giving potential justification to burn the entire Reserve regularly. The following justifies the zoning proposed:

- Maximised life and property protection and conservation of biodiversity cannot be achieved by widespread regular burning. The Reserve is not large enough and does not have sufficient and appropriate control lines to establish the fine grain mosaic burn pattern that is required to effectively reduce risk to neighbours at the same time as keeping fire intervals within biodiversity thresholds; and
- As the above strategy is not feasible, the next best strategy to maximize the conservation of biodiversity within the Reserve is to restrict some impacts from fire management works to small areas so that the remainder of the Reserve is not under pressure to be regularly burned and older fire age classes can be maintained and higher value and fire sensitive communities can be better protected.

Based on our assessments and given the above, we believe that the approach recommended is appropriate for the Reserve and adequate to mitigate the identified risks whilst minimising biodiversity impacts (and thus being consistent with the Plan of Management (ELA 2010) for the majority of the Reserve).







**Figure 9: Fire interval before last burn****4.4 LAND MANAGEMENT ZONES**

Table 14 below describes the intended aim, specifications and management of LMZs within the Reserve.

**Table 14: Land Management Zones**

Land Management Zones	
<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> </ul>
<b>Management</b>	<ul style="list-style-type: none"> <li>Management in line with Ingleside Chase Reserve Plan of Management (ELA 2010).</li> <li>Prescribed fire to be implemented for the purposes of ecological burns above minimum recommended fire interval.</li> </ul>

No specific burns have been proposed within the LMZ for the life of this plan as all communities are below the maximum threshold and recent burns (and proposed burns within the SFAZs) have created a satisfactory mosaic of age classes. The following guidelines for the management of biodiversity should be considered:

- The fire regime for each vegetation community should be maintained within biodiversity thresholds (shown in Table 15), as far as is possible.
- In areas that have not experienced fire for a period that exceeds the biodiversity thresholds (in the future), use of fire will be considered. Any burn is to involve only a portion of the vegetation community to ensure that a mosaic of different age groups is created. Mosaic burning is an approach that involves using patches of small, low-intensity fires to control fuel levels in the vegetation understorey, over varying intervals of time. This achieves a variety of life stages for flora and fauna habitat. The mosaic approach to burning also allows for fauna in the area to take refuge and escape fire. It is recognised that this may mean that some vegetation communities may extend beyond their biodiversity thresholds temporarily.
- If fire frequency becomes high in the future, and the biodiversity thresholds are likely to have been exceeded, fire will be excluded.
- Some activities involved in the control of wildfire may have an adverse effect on biodiversity. Examples include use of heavy machinery to construct control lines, or use of fire retardant chemicals. This potential damage should be avoided wherever possible, using guidelines provided in the BEAC and in Section 5 below.
- In riparian areas, mechanical work must be excluded from all vegetation adjacent to a water body as defined in the BEAC.

- Prescribed burning is not permitted in vegetation adjacent to a water body (i.e. the riparian buffer zone) within 5 m, and should be excluded from rainforest vegetation.

#### 4.5 ACCESS

During a bushfire it is likely that the RFS will access the Reserve from the existing access points on Ingleside Road to the west, Wesley Street to the south or through private property surrounding the Reserve. Access is currently limited within the Reserve. The steep topography prohibits vehicle access. Some formal walking tracks and an informal bike track provide access on foot and there are numerous informal walking/bike tracks. It is however noted that utilisation of this foot access is likely to be limited to preventative actions such for as the application of prescribed fire or mopping up low intensity wildfire rather than use during high intensity wildfire events.

A control line has been proposed running east to west across the Reserve and this should be marked and maintained as a priority. This Plan does not recommend the establishment of any additional access tracks or trails.

#### 4.6 EDUCATION AND EXTENSION PROGRAMS

The establishment and maintenance of APZs and SFAZs as proposed in this Plan provides a significant improvement in the protection of community assets adjoining the Reserve. Despite these works, assets within adjoining lands cannot be totally protected without complimentary bushfire protection activities off-Reserve. It is recommended that education/extension programs by Pittwater Council and the RFS 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 Pittwater Council implement the following initiatives:

- All bushfire management works undertaken within the Reserve should be advertised to neighbours and to relevant stakeholder groups.
- Support community groups who have an interest in the Reserve. 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 RFS, 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 Reserve, leaflets, displays and other available interpretative media to disseminate fire related messages.

Council should liaise with RFS to investigate opportunities currently available to encouraging private/personal ownership of fire management whilst also promoting appreciation of the community's natural and cultural resources provided by this Reserve (e.g. FireWise).

## 5 PROTECTION OF ENVIRONMENT AND CULTURAL SITES

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

### 5.1 FUEL / VEGETATION REDUCTION OPERATIONS

During the establishment and maintenance of APZs within the Reserve, 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 or endangered ecological communities 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 Swamp Sclerophyll Forest include: Frequent burning which reduces the diversity of woody plant species; Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; and Removal of dead wood and dead trees (NSW Scientific Committee 2011). This plan mitigates the impact on this community through proposing weed control works after fire management activities and wildfire (Section 5.3), not recommending frequent burns and not proposing the creation of access tracks.

To ensure protection of this vegetation community the following should therefore be applied:

- Fire management within the Reserve must avoid the incidence of high frequency and high intensity fires within this community.
- Future prescribed burns should only be undertaken in accordance with the recommended fire intervals for that vegetation type (Table 15 below).

**Table 15: Recommended Fire Intervals for Vegetation within the Reserve (WPBFMC 2010)**

<b>Vegetation Formation</b>	<b>Minimum SFAZ Threshold</b>	<b>Minimum LMZ Threshold</b>	<b>Maximum Threshold</b>	<b>Notes</b>
Shrubby Dry Sclerophyll Forest (shrub subformation)	7	10	30	Occasional intervals greater than 25 years may be desirable.
Wet Sclerophyll Forest (shrubby subformation))	25	30	60	Crown fires should be avoided in the lower end of the interval range.
Forested Wetlands	7	10	35	Some intervals greater than 20 years may be desirable.
Heathlands	7	10	30	Occasional intervals greater than 20 years may be desirable.
Rainforest	NA	NA	NA	Fire should be avoided

### 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 16 outlines safeguards to reduce the spread of weeds during fire management activities.

**Table 16: Safeguards when carrying out fire management activities in sites containing exotic plant species**

<b>Potential impact</b>	<b>Possible safeguards (or ameliorative measures) to mitigate the impact</b>
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 burning.</li> </ul>

#### 5.4 PROTECTION OF HISTORICAL 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 18, 19, 20 and 21 summarise the works required to achieve the bushfire management objectives of the plan. This should be read in conjunction with the Management Zone map (Figure 8). 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 17 below. This system is based on an effort/impact ratio where preventative actions that occur regardless of the Plan 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 17: 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, 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 18: Summary of fire management actions –Asset Protection Zones (Figure 8)

Zone Ref.	ID	Actions	Priority	2012-2017
	Entire Management Unit	Use suppression and fuel reduction methods that reduce the potential impact on the natural and cultural environment of the Reserve (Section 5).	2	✓
		Investigate complaints regarding fuel loads within the Reserve.	3	✓
1	Maintain existing 20 m APZ – currently mown grass.	Annually monitor grass growth within the 20 m APZ prior to the bushfire season and at least once mid-way through the bushfire season. Implement works as needed to ensure that the grass is maintained to <10cm.	1	✓
2	Maintain existing 20 m APZ – currently sparse canopy trees with fuel reduced understory.	Annually monitor fuel loads within the 20m of the house and implement works as needed to ensure the APZ is at a standard consistent with Section 4.2.1.	1	✓
3	Maintain existing APZ – currently mown grass	Annually monitor grass growth within the APZ prior to the bushfire season and at least once mid-way through the bushfire season. Implement works as needed to ensure that the grass is maintained to <10cm.	1	✓

Table 19: Summary of fire management actions –Strategic Fire Advantage Zones (Figure 8)

Zone Ref.	ID	Actions	Priority	2012	2013	2014	2015	2016	2017
Entire Management Unit		Extensive weed removal and long term control.	2	✓	✓	✓	✓	✓	✓
SFAZ 1		Conduct HR burn between the Mata Maria College in the east, the proposed control line in the north and the walking track in the south and west.	1	✓					
SFAZ 2		Conduct HR burn to approximately 100m to the north of the proposed control line. If possible the burn should extend into the property to the east.	1					✓	
SFAZ 3		Conduct HR burn between the proposed control line in the south and the informal bike track in the north. If possible the burn should extend into the property to the west.	1			✓			
SFAZ 4		Conduct HR burn between the walking track to the north and the creekline to the south. A hand tool control line will need to be constructed along the western boundary of the burn.	1						✓
SFAZ 5		Conduct HR burn between the Sydney Conference and Training Centre, the walking track to the south and the creekline to the north east.	1		✓				
SFAZ 6		Conduct HR burn to extend down to the north from the Uniting Church Conference Centre. Care should be taken not to burn into the rainforest vegetation at the base of the gully.	1				✓		

Table 20: Summary of fire management actions –Land Management Zone (Figure 8)

Zone Ref.	ID	Actions	Priority	2012	2013	2014	2015	2016	2017
Entire Management Unit		Use suppression methods that reduce the potential impact on environment and cultural values (refer Section 5).	2	✓	✓	✓	✓	✓	✓
		Conduct post-fire pest and weed control operations.	1	6 months after bushfire or prescribed burn					
		In cooperation with RFS and Police investigate and collect data on ignition source and location.	1	✓	✓	✓	✓	✓	✓
		Conduct post-fire surveys to assess the impacts on threatened species and EECs.	2	Within 6 months after bushfire or prescribed burn					
		All fires (both wildfires and prescribed burns) should be recorded and a detailed map of the fire perimeter produced. The map should be stored on Council's GIS system to enable analysis of fire frequency across the study area and the effects on biodiversity.	2	✓	✓	✓	✓	✓	✓
		Increase Police or Council Ranger presence if Reserve is subject to frequent arson events.	1	✓	✓	✓	✓	✓	✓
		Facilitate the protection of unknown Aboriginal and historical sites (Section 5.4).	2	✓	✓	✓	✓	✓	✓

Table 21: Summary of fire management actions – Surrounding properties

Zone Ref.	ID	Actions	Priority	2012-2017
Entire Management Unit		Undertake pre-bushfire season education and extension programs focussing on arson reduction and bushfire preparedness programs (refer to Section 4.6).	2	✓
		Investigate bushfire hazard complaints and undertake appropriate actions.	3	✓
		Increase police or Council Ranger presence if Reserve is subject to frequent arson events.	1	✓

## 7 MONITORING, REVIEW AND 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 Table 18 to 21 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) is an 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 Rural Fire Service and the NSW Fire Brigades. Matters that require a more significant variation should be discussed with the Rural Fire Service and the NSW Fire Brigades and any affected stakeholders.

# References

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