



## Bushfire Risk Assessment

Sydney Zoo – Bungarribee South

Prepared for  
**Sydney Zoo**

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Project Manager	Tammy Paartalu 02 8536 8600 Level 6, 299 Sussex Street, Sydney, NSW
Prepared by	Danielle Meggos
Reviewed by	Daniel Copland
Approved by	Steven Ward
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# Executive summary

Sydney Zoo is seeking approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the development and operation of a zoo (Sydney Zoo) within the Bungarribee Precinct in Western Sydney Parklands. The proposal involves the construction of the zoo and associated infrastructure (roads and car parks), and is to be assessed as State Significant Infrastructure via an Environmental Impact Statement (EIS). Eco Logical Australia (ELA) has been engaged by Sydney Zoo to prepare a Bushfire Risk Assessment (BRA) in support of the approval and to address the requirements of the Secretary's Environmental Assessment Requirements (SSD 7228).

This involved undertaking a comprehensive assessment of the fire risk posed to assets within and adjoining the Sydney Zoo. This Bushfire Risk Assessment aims to provide overarching strategies to guide bushfire management of the site. It is intended to enhance the resilience of future infrastructure associated with the zoo, protect human life from bushfires and mitigate the potential for the ignition and spread of bushfire within the site causing damage to assets.

When combined with vegetation on the adjoining Western Sydney Parklands, the retained vegetation within the site is of a size and arrangement that could support a bushfire; therefore it is considered a bushfire risk that could be dangerous to surrounding built assets, infrastructure and environmental assets and people that visit and reside in the area. Based on a range of existing characteristics observed and assessed during the site inspection, the bushfire risk for the site is currently considered moderate:

- Vegetated woodland areas within and adjoining the site capable of supporting a bushfire
- Unmanaged grassland areas within the Western Sydney Parklands
- Moderate construction levels of adjoining buildings.

The establishment of bushfire emergency management procedures and perimeter access roads/tracks around the site effectively address the bushfire risk and ensure the safety of life and property. Planning for future prescribed burning in conjunction with the adjoining Western Sydney Parklands and the NSW Rural Fire Service Cumberland Zone will further improve the survivability of assets within the site, and ensure the protection of life (including animals).

# 1 Background

Sydney Zoo is seeking approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of a zoo (Sydney Zoo) within the Bungaribee Precinct in Western Sydney Parklands. The proposal involves the construction of the zoo, car parking, and entrance.

The project was declared to be State Significant Development (SSD). Assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's Environmental Assessment Requirements (SEARs) for the project with regards to bushfire are:

- Bushfire and Incident Management – including technical information on the environmental protection equipment to be installed on the premises such as air, water and noise controls, spill clean-up equipment and fire management and containment measures.

This Bushfire Risk Assessment has been prepared to inform the EIS for the Project, and to satisfy bushfire management as required by the SEARs.

## 1.1 Proposal

The proposed development of Sydney Zoo located in South Bungaribee will include the development of a new Zoo containing a number of exhibits including native and exotic animals.

Key features of the project would include:

- Zoo
- Restaurant
- Car parking
- Gift Shop
- Bus Parking
- Roads.

Construction of the project is expected to take around 8 – 12 months to complete.

## 1.2 Study area

The Western Sydney Parklands (WSP) is a 27 km corridor stretching from Quakers Hills to Leppington in western Sydney (WSP 2011). Bungaribee South (referred to as the 'site in this report) falls within the new suburb of Bungaribee which is part of the City of Blacktown Local Government Area (LGA) and is part of the WSP. The Bungaribee Precinct covers an area approximately 216 ha. The study site consists of Lot 11, to be created by the subdivision of Lot 1 DP1103025. Lot 11 will be 16.5 hectares and is located in the most southern portion of the Bungaribee precinct and is bound by major roads Great Western Highway to the south, Doonside road to the east and Eastern Creek flows along the western boundary (**Figure 1**).

The construction footprint is a portion of the study area (**Figure 2**). The operational footprint is fully contained within the construction footprint of the project.

## 1.3 Legislation and policy

Fire management activities on the site are constrained by numerous Acts, plans, and guidelines. The most relevant documents are listed below:

- *Rural Fires Act 1997*
- *Threatened Species Conservation Act*
- *Environment Protection & Biodiversity Conservation Act 1999*
- *Planning for Bush Fire Protection 2006*
- *Bush fire Environmental Assessment Code for NSW 2006.*

### 1.3.1 Rural Fires Act 1997

The *Rural Fires Act 1997* (RF Act) ensures that an efficient fire prevention and suppression system is maintained state wide, in accordance with the clearly defined goal of protection of life and property. This is achieved through the objects of the act outlined in Section 3 which provide:

- (a) for the prevention, mitigation and suppression of bush and other fires in local government areas (or parts of areas) and other parts of the State constituted as rural fire districts, and*
- (b) for the co-ordination of bush fire fighting and bush fire prevention throughout the State, and*
- (c) for the protection of persons from injury or death, and property from damage, arising from fires, and*
- (c1) for the protection of infrastructure and environmental, economic, cultural, agricultural and community assets from damage arising from fires, and*
- (d) for the protection of the environment by requiring certain activities referred to in paragraphs (a)–(c1) to be carried out having regard to the principles of ecologically sustainable development described in section 6 (2) of the Protection of the Environment Administration Act 1991*

Under Section 63 of the RF Act, public authorities and landowners have a duty to prevent bushfire:

- (1) It is the duty of a public authority to take the notified steps (if any) and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of a bush fire on or from:*
  - (a) any land vested in or under its control or management, or*
  - (b) any highway, road, street, land or thoroughfare, the maintenance of which is charged on the authority.*
- (2) It is the duty of the owner or occupier of land to take the notified steps (if any) and any other practicable steps to prevent the occurrence of bush fires on, and to minimise the danger of the spread of bush fires on or from, that land.*
- (3) A public authority or owner or occupier is liable for the costs incurred by it in performing the duty imposed by this section.*
- (4) The Bush Fire Co-ordinating Committee may advise a person on whom a duty is imposed by this section of any steps (whether or not included in a bush fire risk management plan) that are necessary for the proper performance of the duty.*
- (5) In this section:*  
*notified steps means:*



(a) any steps that the Bush Fire Co-ordinating Committee advises a person to take under subsection (4), or

(b) any steps that are included in a bush fire risk management plan applying to the land.

Sydney Zoo's primary legislative responsibilities for fire management are defined in the RF Act. Like any landowner or occupier they have obligations to prevent the occurrence or spread of bush fires on and from their land as outlined in Section 63.

The bushfire obligations can reasonably be extended to include Prevention, Preparedness, Response and Recovery (PPRR) which includes a wide array of resourcing and management actions, including:

- management plans (inclusive of PPRR)
- fuel management and appropriate access
- safety
- cooperation with neighbours and fire authorities, etc.

### **1.3.2 Threatened Species Conservation Act 1995**

The *Threatened Species Conservation Act 1995* allows for the listing of threatened species and describes the procedure for listing. It also requires the preparation and implementation of threatened species recovery plans and threat abatement plans for managing threatening processes. The Act outlines the requirements for licensing by the Director-General of activities that are likely to harm a threatened species or destroy habitat.

The *Threatened Species Legislation Amendment Act 2004* aims to establish better frameworks and processes so that landholders, developers, farms, community groups and government agencies can more effectively contribute to the protecting the State's biodiversity. This Amendment Act relates to the native vegetation reform package, Priority Action Statements for individual species, listing of threatened species/populations/ecological community/key threatening processes, and biodiversity certification of environmental planning instruments. It provides local government and private landowners with greater responsibility in association with the protection and conservation of threatened species.

The *Threatened Species Conservation Regulation 2002* specifies the criteria to be met for listing threatened species, endangered populations and ecological communities.

High frequency fire resulting in the disruption of plants and animals and loss of vegetation is identified as a key threatening process under the TSC Act. The *Guidelines for Ecologically Sustainable Fire Management: NSW Biodiversity Strategy* (NPWS 2004) provides guidance to support ecologically sustainable fire management. They provide a useful tool in addressing the requirements of the TSC Act when undertaken fire management activities.

### **1.3.3 Environment Protection and Biodiversity Conservation Act 1999**

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects the environment through ecologically sustainable development and the protection of biodiversity. Some aspects of the EPBC Act include listing of nationally threatened flora and fauna species, processes for national environmental assessments and approvals, and integrating the management of important natural and cultural places. The EPBC Act addresses threatened species by requiring the preparation and implementation of species and community recovery plans, threat abatement plans and wildlife conservation plans. It also outlines requirements regarding access to biological resources, control of non-native species, and international movement of wildlife specimens.



The provisions of the EPBC Act may impact on fire management activities that can be undertaken. For example if an activity such as prescribed burning is likely to have a significant impact then it is considered a controlled action and will require approval and be subject to a formal assessment and approval process. The *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* provide guidance on determining whether an action is likely to have a significant impact on a matter protected under the EPBC Act.

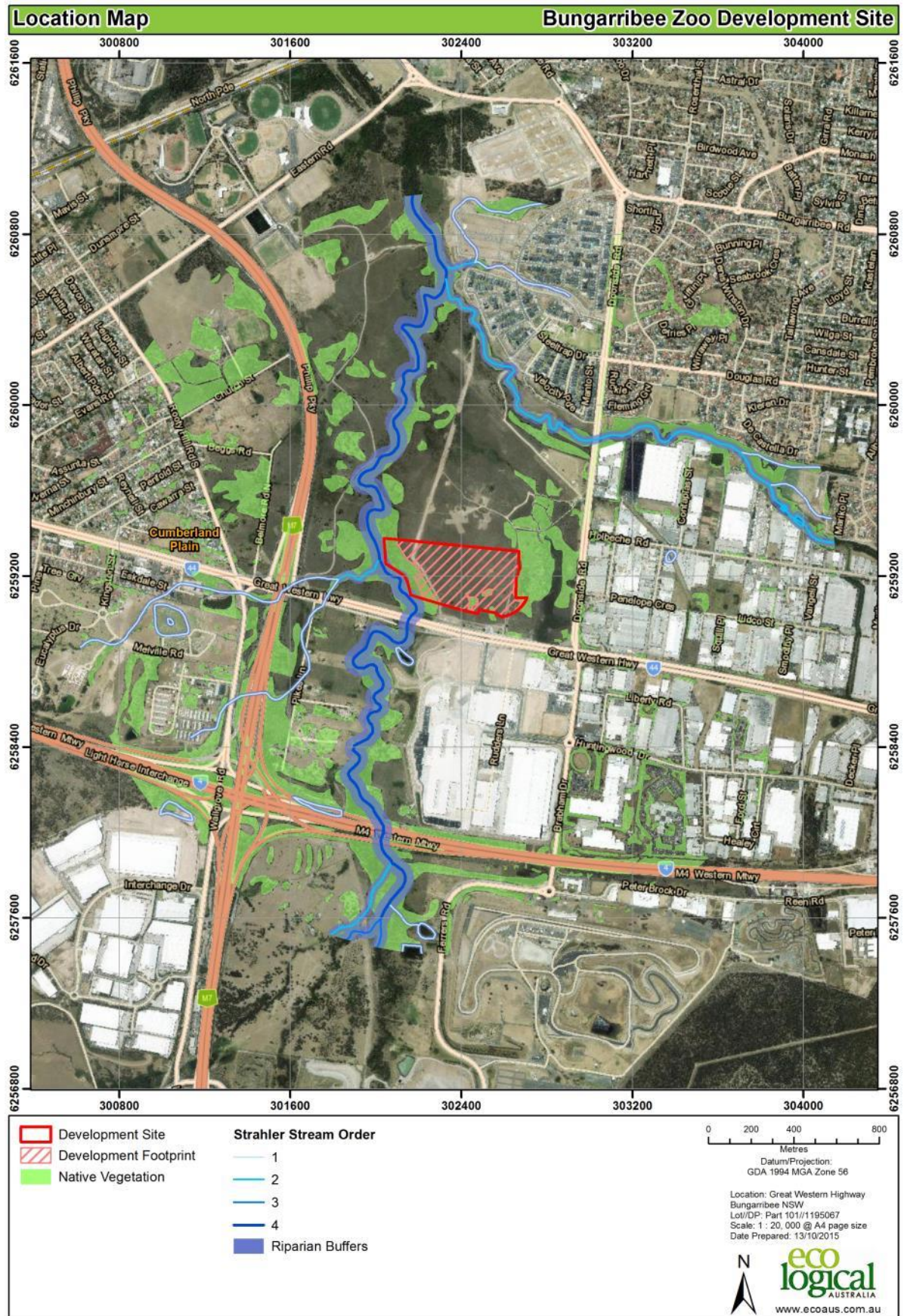


Figure 1: Location



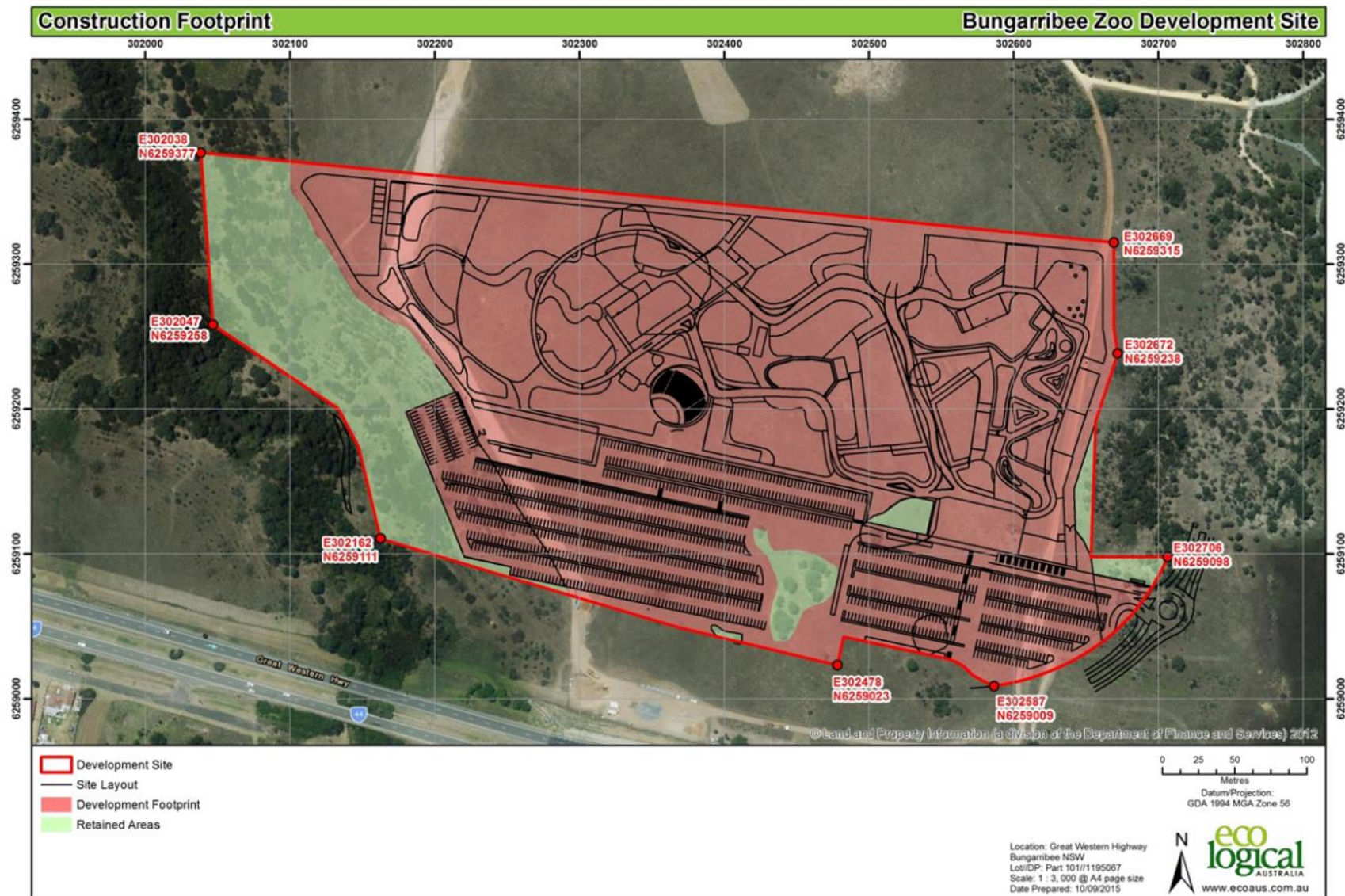


Figure 2: Construction footprint

## 2 Scope of the BRA

In order of priority, the objectives of bushfire management are to:

- a) protect human life;
- b) protect infrastructure and assets to maintain functionality before, and after the passage of destructive bushfires;
- c) to prevent the spread and occurrence of bush fires from within the site
- d) provide for bushfire protection work to be undertaken in an environmentally sustainable manner; and
- e) maintain fire regimes that are appropriate and necessary to conserve environmental values.

The BRA has been guided by the *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees*.

The principles of the NSW Rural Fire Service *Planning for Bush Fire Protection 2006* (RFS, 2006b) have also been applied particularly in relation to the assessment of bushfire hazards to future assets within site.

This BRA applies only to the Sydney Zoo Bungaribee South site as shown in **Figure 1** and does not apply to the broader Bungaribee South precinct.

This document is designed to provide specific overarching strategies to guide bushfire management of the site. It is intended to enhance the resilience of future infrastructure associated with the zoo, protect human life from bushfires and mitigate the potential for the ignition and spread of bushfire within the site causing damage to assets. Given the intended use of the site, the protection of animal life is also considered an important objective.

## 3 Bushfire hazard assessment

A bushfire hazard assessment for the study area has been undertaken based upon an analysis of the slope and vegetation and is shown in **Figure 3**. The assessment provides an indication of the varying levels of bushfire hazard affecting the site as well as a relative indication of bushfire management requirements.

The assessment is derived (spatially) through a classification of the slope and the vegetation formations (according to Keith, 2004) found on the site. These two classifications are then amalgamated to produce a final classification to determine the hazard rating. The hazard rating which reflects likely bush fire behaviour is applied. Generally, steep slopes combined with areas of high fuel vegetation (i.e. forests) lead to classification of the highest bush fire hazard.

### 3.1 Vegetation

There are two vegetation communities that exist within and surrounding the site; River Flat Eucalypt Forest (RFEF) in the Coastal Floodplain Wetlands class (Forested Wetland), and Shale Plains Woodland which is a sub-community of Cumberland Plain Woodland and is in the Coastal Valley Grassy Woodlands class. The predominant vegetation is currently considered to be the Cumberland Plain Woodland.

A Landscape Plan has been prepared that provides an indication of vegetation to be retained and revegetated within and adjoining the site (**Figure 4**).

### 3.2 Slope

The site and surrounds are relatively flat with slightly steeper areas along the banks of Eastern Creek to the west and Bungarribee Creek to the north as can be seen in **Figure 3**.

### 3.3 Radiant heat levels

The radiant heat levels anticipated for the site based on known vegetation type, effective slope, and managed separation distance between the development and the bushfire hazard have been determined. This is based on the methodology contained within PBP and *Australian Standard 3959 Construction of Buildings in bushfire-prone areas 2009*. The radiant heat levels applicable to the site are shown in **Figure 5**.

**Table 1** shows the expected radiant heat flux levels and the effects these will have on buildings and people. This is based on a modelled forest fire using a Fire Danger Index (FDI) of 100 on flat ground to determine the approximate distances for impacts.

**Table 1: Radiant heat levels and effects on buildings and people (Source: RFS, 2006b)**

Radiant heat flux	Likely effects	Approximate distances
2.1 kW/m <sup>2</sup>	Unprotected person will suffer pain after 1 minute exposure – non fatal	140 metres
3 kW/m <sup>2</sup>	Hazardous conditions. Firefighters expected to operate for a short period (10 minutes)	100 metres
4.7 kW/m <sup>2</sup>	Extreme conditions. Firefighter in protective clothing will feel pain. (60 seconds exposure)	70 metres
7 kW/m <sup>2</sup>	Likely fatal to unprotected person after exposure for several minutes	55 metres
10 kW/m <sup>2</sup>	Critical conditions. Firefighters not expected to operate in these conditions although they may be encountered.  Considered to be life threatening < 1 minute in protective equipment. Fabrics inside a building could ignite spontaneously with long exposures.	45 metres
12.5 kW/m <sup>2</sup>	Standard float glass could fail during the passage of a bush fire. Some timbers can ignite with prolonged exposure and with piloted ignition source (e.g. embers).	40 metres
19 kW/m <sup>2</sup>	Screened float glass could fail (BAL-19 construction) during the passage of a bush fire.	27 metres
29 kW/m <sup>2</sup>	Ignition of most timbers without piloted ignition (3 minutes exposure) during the passage of a bush fire. Toughened glass could fail.	20 metres
>29 – 40 kW/m <sup>2</sup>	Potential flame contact and increased radiant heat and ember attack.	15 - 20 metres
>40 – 110 kW/m <sup>2</sup>	Significant higher likelihood of flame contact. Coupled with the radiant heat and increased ember attack is a significant risk to most structures and building materials	0 – 15 metres











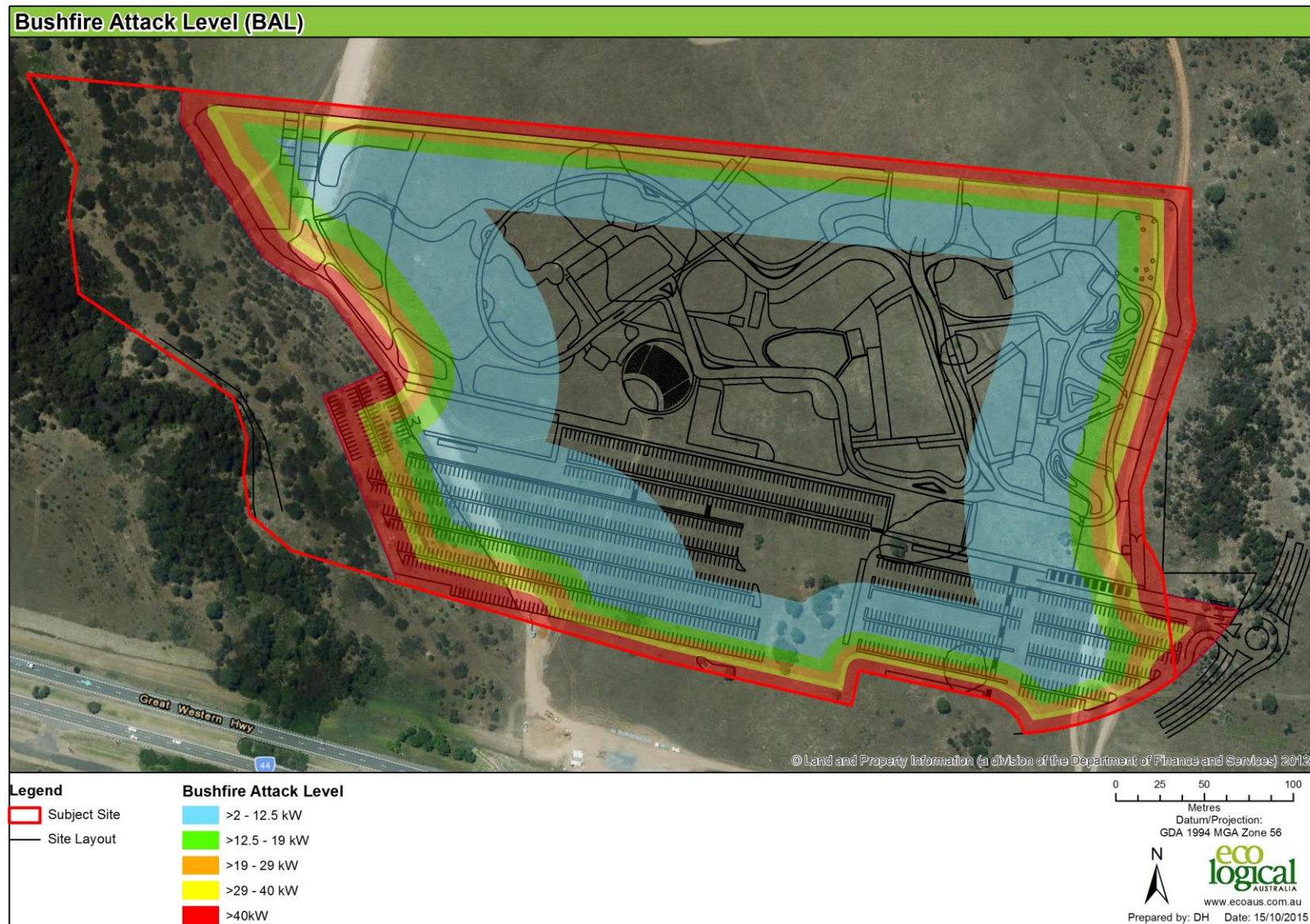


Figure 5: Radiant heat levels

## 4 Bushfire risk assessment

Bushfire risk assessment involves identifying the level of bushfire risk by applying likelihood and consequence ratings to key assets within and adjoining the site. A risk assessment has been undertaken using the *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees* (NSW Bush Fire Coordinating Committee, 2008). This document is endorsed by the NSW Bush Fire Coordinating Committee and provides a consistent framework for identifying bush fire risk.

### 4.1 Assets

Identifying the level of bush fire risk firstly involved identifying assets that are considered to be at risk from bushfire within and adjoining the site. Assets were categorised into four types:

- Human settlement (residential areas including urban bushland interface areas, schools, hospitals, nursing homes, and tourist facilities, etc.)
- Economic (grazing land, commercial/industrial, infrastructure, recreational, etc.)
- Environmental (Threatened species, populations and ecological communities, and locally important species and ecological communities, such as species and ecological communities especially sensitive to fire.
- Cultural (Aboriginal places and items of significance, and places and items arising from the early occupation of NSW by European or other non-indigenous settlers).

Currently the site is void of any human (built) assets. This will change following development and this assessment is based on the construction footprint shown in **Figure 2**. There are no known cultural assets within or surrounding the site that could potentially be impacted by bushfire. However there are human, economic and environmental assets within and surrounding the site which are detailed below and shown in **Figure 6**:

- Human (built) assets
  - Bungaribee residential interface
- Economic assets
  - Sydney Zoo - Bungaribee
  - Industrial development to the south of the Great Western Highway
  - Industrial development to the east of Doonside Road (Arndell Park)
  - Western Sydney Parklands
- Environmental Assets
  - Cumberland Plain Woodland.

### 4.2 Consequence and likelihood

The likelihood of a bush fire occurring was determined by considering ignition cause and patterns, known fire paths, access, containment potential and potential fire run (size of the vegetated area). Consequence ratings were determined specific to the asset type:

- Human settlement: potential fire behaviour using vegetation type, slope and separation distance was used to produce a threat rating for human settlement assets. The vulnerability of the asset to a bush fire was also assessed and a rating assigned.

- Economic: the level of economic impact (e.g. local, regional or state) and economic recovery costs (how long and complicated a financial recovery will be) of the asset were identified.
- Environmental: where minimum fire threshold was known it was assessed to determine risk of a bush fire occurring within the next 5 years. Assets within or above the fire threshold were not assessed as the negative impact of a fire within the 5 year period was determined as being low and may even be of benefit to the asset and surrounding habitat. The vulnerability of an environmental asset was determined by its conservation status

#### 4.3 Cumberland Zone Bush Fire Risk Management Plan

The Cumberland Zone Bush Fire Risk Management Plan (Cumberland BFMC, 2010) applies to the site. This was certified in 2010 and does not take into account recent development in the area including the newly established suburb of Bungarribee. It also does not take into account the establishment of the Western Sydney Parklands and regeneration of vegetation that may occur within this area.

Currently the BFRMP identifies the Doonside Road Interface to the east of the site (opposite side of Doonside Road) as an asset with a Medium Priority (Risk Rating). The associated treatment action to mitigate the risk is to 'conduct community engagement activity within area'. The likelihood of a bushfire occurring adjacent to Doonside Road (e.g. within the site) is identified as 'unlikely' whilst the consequence of a bushfire impacting on the Doonside Road Interface is identified as 'Major'.

#### 4.4 Sydney Zoo risk assessment

Given the proximity of the Doonside Road Interface to the suburb of Bungarribee, it is assumed that the same risk assessment identified in the BFRMP would apply. Bungarribee is a recently constructed suburb and has been developed in accordance with current bushfire planning provisions and addresses the requirements of *Planning for Bush Fire Protection* 2006, providing in increased level of protection to life and property.

The existing industrial development to the east of Doonside Road was constructed prior to the introduction of bushfire planning provisions through the *Rural Fires Act, 1997 and the Environmental Planning and Assessment Act, 1979* in August 2002. The existing structures are unlikely to address current bushfire and construction requirements. Regardless the 30 m separation provided by Doonside Road provides a suitable asset protection zone and defensible space should a bushfire occur along the eastern side of the Zoo.

The industrial development to the south of the Great Western Highway undergoing construction is more likely to have improved bushfire construction standards. Again the almost 60 m separation provided by the Great Western Highway provides a suitable asset protection zone and defensible space should a bushfire occur within or surrounding the Zoo.

Based on the above, the key assets requiring protection are those that will fall within the site. This includes the many animals that will inhabit the site, their enclosures and the many people who visit the zoo. The provision of access roads/tracks and car parking adjoining the retained vegetation to the west and the vegetation on the adjoining land to the east is considered adequate based on the level of risk posed. Further to this the access roads/tracks and car parking would provide protection from a grassland fire occurring to the north and south.

Utilising the methodology outlined in this section and the assumptions above, the bushfire risk for the Sydney Zoo and surrounding assets has been determined and is outlined in **Table 2**.

**Table 2: Risk assessment**

Asset Type	Asset Sub Type	Asset Name	Likelihood	Consequence	Risk
Economic	Tourist and recreational	Sydney Zoo	Likely	Moderate	<b>Medium</b>
Economic	Commercial	Doonside Interface	Unlikely	Minor	<b>Low</b>
Economic	Commercial	Eastern Creek	Unlikely	Minor	<b>Low</b>
Economic	Tourist and recreational	Western Sydney Parklands	Likely	Minor	<b>Medium</b>
Human Settlement	Residential	Bungaribee	Unlikely	Major	<b>Medium</b>
Environmental	EEC	Cumberland Plain Woodland	Likely	Minor	<b>Medium</b>

An area of River Flat Eucalypt Forest is to be retained along the western boundary of the site. This extends into a large expanse of vegetation along Eastern Creek within the Western Sydney Parklands. There is also Cumberland Plain Woodland vegetation along the eastern boundary of the site. This vegetation is mapped as bushfire prone land on the Blacktown Bush Fire Prone Land Map with potential for a bush fire to carry under certain weather conditions. The overall fire risk for the site in its current condition is considered to be moderate based on fuel loads from the woodland and grassland areas. However this risk can be mitigated by prescribed burning and the location of infrastructure such as roads and tracks adjoining these managed areas.

Some small degraded patches of Cumberland Plain Woodland currently occur within the site. Some of these will be retained, and there will also be some targeted revegetation and regeneration of Cumberland Plain Woodland, as well as landscaping of the site.

The existing unmanaged grassland to the north and south of the site has the potential to carry fast running grass fires. It is noted that additional planting is proposed within the adjoin Western Sydney Parklands as shown in **Figure 4**. Revegetation and regeneration of vegetation within the site and the broader Western Sydney Parklands area will lead to an increase in fuel loads over time which may have a flow on effect to fire risk.



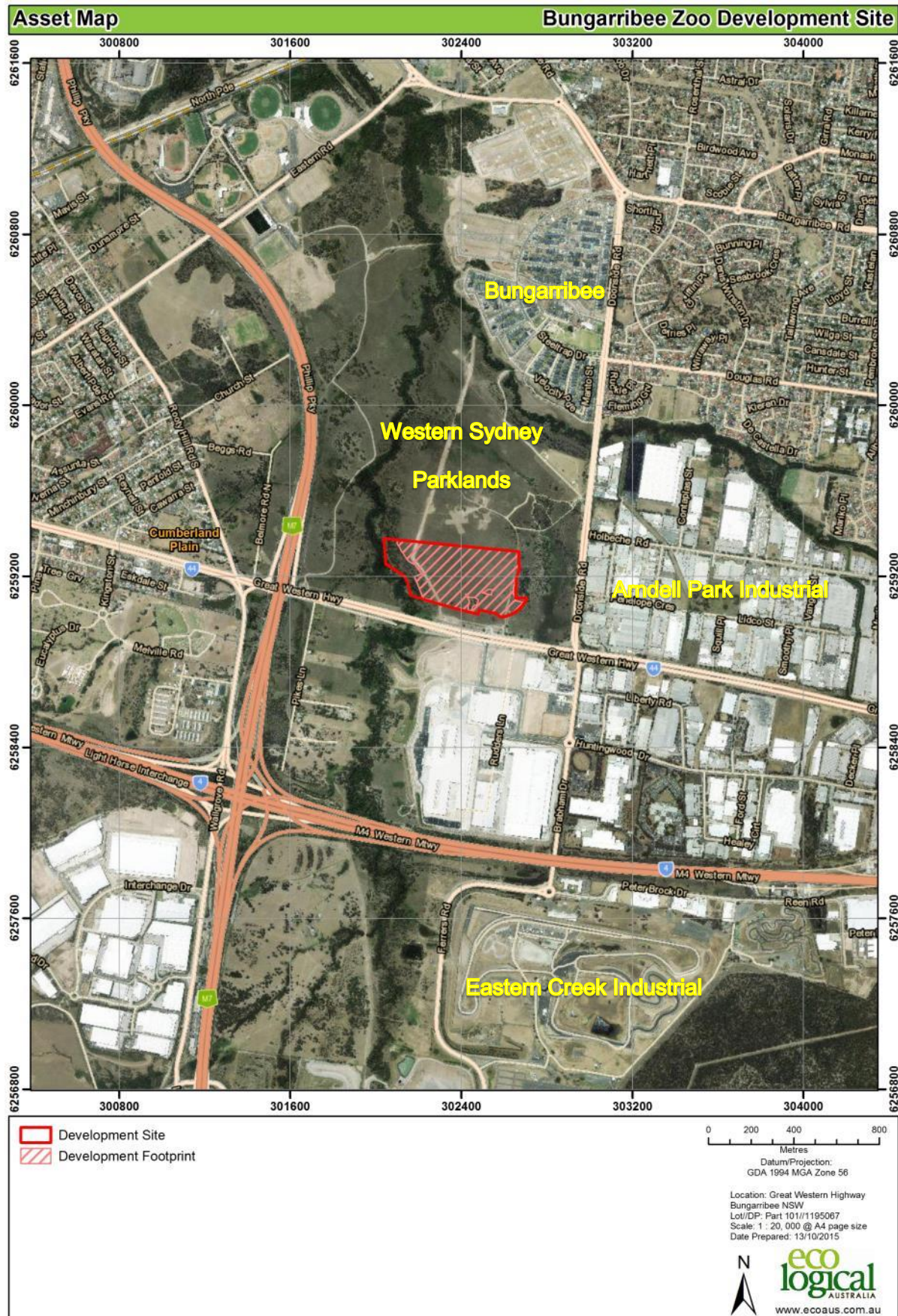


Figure 6: Assets

## 5 Fire management

### 5.1 Fire history

The frequency of fire within the study area is unknown with fire history data not provided within the Cumberland Zone Bush Fire Risk Management Plan applying to the site. The prevalence of woodland and grassland vegetation is considered a natural factor limiting the potential intensity of a bush fire event. Fire scarring was evident on some trees across the site suggesting relatively recent fires in the area.

### 5.2 Fire thresholds

Fire thresholds are the upper and lower time limits or range of fire intervals recommended to support ecologically sustainable fire management within vegetation communities. The lower fire thresholds used are the broad state-wide thresholds identified in the *Bush Fire Environmental Assessment Code* (RFS, 2006a). The upper fire thresholds are those identified in the *Guidelines for Ecologically Sustainable Fire Management* (Kenny et al. 2004). Detailed below are the relevant fire thresholds for vegetation communities within and adjoining the site.

**Table 3: Fire thresholds for key vegetation communities within site (Source: Cumberland Zone BFMC, 2010)**

Vegetation formation	Minimum SFAZ Threshold	Minimum LMZ Threshold	Maximum Threshold	Notes
Grassy woodland	5	8	40	Minimum interval of 10 years should apply in the southern Tablelands area. Occasional intervals greater than 15 years may be desirable.
Grassland	2	3	10	Occasional intervals greater than 7 years should be included in coastal areas. There was insufficient data to give a maximum interval; available evidence indicates maximum intervals should be approximately 10 years.
Forested wetlands	7	10	35	Some intervals greater than 20 years may be desirable.

### 5.3 Constraints to fire management

The BFRMP identifies the site as being within a Land Management Zone (LMZ). An LMZ aims to meet relevant land management objectives in areas where APZs or SFAZs are not considered appropriate or necessary. The management objective of an LMZ is to undertake mosaic burning to reduce the likelihood and spread of fires.

The CPW vegetation limits the application of fire management actions and greater emphasis needs to be given to active mitigation measures including:

- Adequate emergency management planning for the site.
- Appropriate management of landscaped areas within the site.
- Ongoing maintenance of access tracks/roads bordering vegetated areas.



## 5.4 Prescribed burning

Prescribed burning can be an important tool for the protection of life and assets. In this respect ecological burning can improve the characteristics of a community by eradicating weeds and encouraging species indicative of the community to regenerate. However the management of ecological communities such as the CPW within the site cannot be separated from the surrounding environment. In this sense, consideration is to be given to a mosaic of burnt and unburnt patches. There is significant research and findings on the effectiveness of mosaic burning for the survival of a range of flora and fauna species. Ideally for ecologically appropriate fire management, a range of fire frequencies should be maintained within the various vegetation communities that occur across the broader Cumberland Zone. Where the vegetation is at or above threshold Sydney Zoo should work in collaboration with the Western Sydney Parklands and the NSW RFS Cumberland Zone to plan appropriate mosaic hazard reduction burning within the area.

### 5.4.1 Environmental assessment of works

Bushfire hazard reduction works undertaken within the site will likely require some form of environmental assessment. The *Bush Fire Environmental Assessment Code* (RFS, 2006a) provides a streamlined environmental assessment for use in determining bush fire hazard reduction certificates.

### 5.4.2 Manual methods

Landscaped areas within the site should consider the following (based on (RFS 2006a, RFS 2006b, RFS 2006c):

- All cut material should be mulched and spread along the ground to prevent weeds and reduce soil erosion.

#### Canopy

- Trim branches where the tree canopy overhangs, or is within five metres of, buildings.
- Trim branches where they extend underneath buildings, particularly decking.
- Remove lower branches and thin secondary branches to a height of two meters.
- All branch removal should adhere to the pruning standards AS4373 *Pruning of Amenity Trees* and as listed below.

#### Groundcover

- 90% ground cover should be maintained to prevent soil erosion.
- Retain all low native ground covers.
- Large build-ups of litter such as leaves, twigs (less than 6 mm in diameter), and bark should be removed from the surface regularly during the fire season, however, no soil should be left exposed.
- Lawns and native grasses need to be kept short (10 cm) and green when possible.

#### Shrub Layer

- Retain clumps or islands of shrubs rather than continuous shrub layers.
- Remove shrubs within 2 m of any building.
- Do not remove shrubs where removal would leave the ground cover exposed.

## Pruning Standards

All pruning should be undertaken in accordance with AS4373 *Pruning of Amenity Trees* and as listed below and RFS *Standards for Asset Protection Zones* (RFS 2006c) advises pruning must be conducted in accordance with the following standards:

- Use sharp tools. These will enable clean cuts and will minimise damage to the tree.
- Decide which branches are to be removed before commencing work. Ensure that you maintain a balanced, natural distribution of foliage and branches.
- Remove only what is necessary.
- Cut branches just beyond bark ridges, leaving a small scar.
- Remove smaller branches and deadwood first.

### 5.4.3 Emergency hazard reduction

Emergency bush fire hazard reduction works are permitted on any land under Section 100C(2) of the *Rural Fires Act 1997*. Emergency works do not require approval under the *Environmental Planning and Assessment Act 1979* or the *Bush Fire Environmental Assessment Code* (RFS 2006a). These activities, however, should be assessed at the time of conduct to determine likely rehabilitation requirements. This is particularly important for issues such as soil erosion where rehabilitation delays may significantly increase impacts.

## 5.5 Management responsibilities

Overall management of the bushfire risk within the site is the responsibility of Sydney Zoo. The NSW Rural Fire Service is responsible for fire suppression efforts within and surrounding the site and for mapping of any fires that occur.

## 6 Emergency management

The preparation of bushfire emergency procedures for the development is the responsibility of Sydney Zoo. As such an emergency/evacuation plan is required consistent with the NSW Rural Fire Service *Guide to developing a Bush Fire Emergency Management and Evacuation Plan*.

A template for an Emergency Management and Evacuation Plan is available on the NSW Rural Fire Service website [http://www.rfs.nsw.gov.au/\\_data/assets/pdf\\_file/0003/29271/Bush-Fire-Emergency-Management-and-Evacuation-Plan.pdf](http://www.rfs.nsw.gov.au/_data/assets/pdf_file/0003/29271/Bush-Fire-Emergency-Management-and-Evacuation-Plan.pdf)

Given that there is no habitable accommodation currently proposed as part of the development, and visitors to the Zoo will have their own transportation arrangements the overall risk is considered low. Consideration should be given to restricting public access to the facility on Extreme, or Catastrophic fire weather days, or having adequate ‘trigger’ mechanisms in place should bushfire conditions exacerbate. Establishing a close relationship with the NSW Rural Fire Service Cumberland Zone (located at Regentville) is highly recommended as part of the bushfire emergency management for the site.

**Figure 5** can be used to inform the emergency management planning for the site by identifying areas that will be exposed to lower radiant heat levels during a bushfire event.

## 7 Conclusion and recommendations

Protection of life and property associated with the built environment is achieved primarily through the application of adequate Asset Protection Zones (APZs) and building construction standards. Arguably the APZ is the most important bushfire protection measure for the protection of buildings and as a consequence, protection of life and mitigating risk to infrastructure.

The undeveloped portion of the site is constrained due to the presence of Endangered Ecological Communities Cumberland Plain Woodland and River Flat Eucalypt Forest. This, combined with the low level of risk posed from bush fire, means that the implementation of hazard reduction measures required is minimal. To reflect this, a combination of active and passive mitigation measures is considered appropriate:

### 5.1 Fire Management and Hazard Reduction

Implement appropriate hazard reduction program in consultation with Western Sydney Parklands and Cumberland Zone Rural Fire Service where woodland vegetation is within or above threshold.

Maintain access roads and tracks within the site and consider the following ongoing management of any buildings and landscaped areas:

- Removal of combustible material, particularly litter in gutters, near buildings.
- Removing excess amounts of fuel from garden areas (including organic mulch).
- Ensuring garden plantings do not overhang any buildings, tree canopies are discontinuous, and shrubs are not positioned within 2 m of buildings.

This BRA should also be reviewed at least every 5 years to account for any revegetation or regeneration that occurs within and adjoining the site.

### 5.2 Community Safety

It is recommended that a bushfire emergency management plan be prepared as part of the overall emergency management of the zoo. Staff are to be trained in the implementation of this plan in the event of a bush fire.



Danielle Meggos  
**Bushfire Consultant**



Daniel Copland  
**Senior Bushfire Consultant**  
**FPAA BPAD Certified Practitioner No. BPD-L3-28853**

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# Appendix 1

The level of bush fire risk is determined using a combination of likelihood and consequence. The following is from *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees*.

## Assessing consequence ratings

Consequence is the outcome or impact of a bush fire event. There are four possible consequence ratings: minor, moderate, major, and catastrophic.

Consequence Rating	Description
<b>Minor</b>	<ul style="list-style-type: none"> <li>• No fatalities.</li> <li>• Some minor injuries with first aid treatment possibly required.</li> <li>• No persons are displaced.</li> <li>• Little or no personal support (physical, mental, emotional) required.</li> <li>• Inconsequential or no damage to an asset.</li> <li>• Little or no disruption to community.</li> <li>• Little or no financial loss.</li> </ul>
<b>Moderate</b>	<ul style="list-style-type: none"> <li>• Medical treatment required but no fatalities. Some hospitalisation.</li> <li>• Localised displacement of persons who return within 24 hours.</li> <li>• Personal support satisfied through local arrangements.</li> <li>• Localised damage to assets that is rectified by routine arrangements.</li> <li>• Community functioning as normal with some inconvenience.</li> <li>• Local economy impacted with additional financial support required to recover.</li> <li>• Small impact on environment / cultural asset with no long term effects</li> </ul>
<b>Major</b>	<ul style="list-style-type: none"> <li>• Possible fatalities.</li> <li>• Extensive injuries, significant hospitalisation.</li> <li>• Large number of persons displaced (more than 24 hours duration).</li> <li>• Significant resources required for personal support.</li> <li>• Significant damage to assets that requires external resources.</li> <li>• Community only partially functioning, some services unavailable.</li> <li>• Local or Regional economy impacted for a significant period of time with significant financial assistance required.</li> <li>• Significant damage to the environment/cultural asset which requires major rehabilitation or recovery works.</li> <li>• Localised extinction of native species (this may range from loss of a single population to loss of all of the species within the BFMC area (for a species which occupies a greater range than just the BFMC area).</li> </ul>

Consequence Rating	Description
<b>Catastrophic</b>	<ul style="list-style-type: none"> <li>Significant fatalities.</li> <li>Large number of severe injuries.</li> <li>Extended and large number requiring hospitalisation.</li> <li>General and widespread displacement of persons for extended duration.</li> <li>Extensive resources required for personal support.</li> <li>Extensive damage to assets.</li> <li>Community unable to function without significant support.</li> <li>Regional or State economy impacted for an extended period of time and financial assistance required.</li> <li>Permanent damage to the environment.</li> <li>Extinction of a native species in nature (This category is most relevant to species that are restricted to the BFMC area, or also occur in adjoining BFMC areas and are likely to be impacted upon by the same fire event). In nature means wild specimens and does not include flora or fauna bred or kept in captivity.</li> </ul>

The likelihood of bush fire risk for all assets is defined as the chance of a bush fire igniting and spreading. There are four possible likelihood ratings: unlikely, possible, likely and almost certain.

	<b>Fires are expected to spread and reach assets</b>	<b>Fires are not expected to spread and reach assets</b>
<b>Fires occur frequently</b>	Almost certain	Possible
<b>Fires occur infrequently</b>	Likely	Unlikely

Once the likelihood rating and consequence inputs have been determined, the risk level can be determined.

Consequence \ Likelihood	Minor	Moderate	Major	Catastrophic
Almost certain	High	Very High	Extreme	Extreme
Likely	Medium	High	Very High	Extreme
Possible	Low	Medium	High	Very High
Unlikely	Low	Low	Medium	High





#### HEAD OFFICE

Suite 2, Level 3  
668-672 Old Princes Highway  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

#### CANBERRA

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 6103 0148

#### COFFS HARBOUR

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

#### PERTH

Suite 1 & 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 08 9322 1358

#### DARWIN

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601

#### SYDNEY

Level 6  
299 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9264 0717

#### NEWCASTLE

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 4910 0126

#### ARMIDALE

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2681  
F 02 6772 1279

#### WOLLONGONG

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 4268 4361

#### BRISBANE

Level 3, 471 Adelaide Street  
Brisbane QLD 4000  
T 07 3503 7191

#### HUSKISSON

Unit 1 51 Owen Street  
Huskisson NSW 2540  
T 02 4201 2264  
F 02 4443 6655

#### NAROOMA

5/20 Cauty Street  
Narooma NSW 2546  
T 02 4476 1151  
F 02 4476 1161

#### MUDGEES

Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1230  
F 02 6372 9230

#### GOSFORD

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1220  
F 02 4322 2897

1300 646 131  
[www.ecoaus.com.au](http://www.ecoaus.com.au)