Management Plan

Kokoda Bushfire

Risk Statement: Moderate

This document will be reviewed on a five yearly basis, unless a process change occurs earlier than this period.

Doc No.	Version No.	Next Review Date	Owner
PLN-0066	3.01	25/06/2025	Superintendent - Environment & Farms

Revision Summary

First Issue	Issue Date	Implementation Requirements	Approved By
1.0	14 Jul 16	Drafted by R. Feeney to be included as an appendix to the BOMP, as required by OEH.	E & F Superintendent

Version No.	Revision Date	Summary of Revision Details	Approved By
2.0	26 Feb 20	Updated to new DCS	M Row
3.0	24 Jun 20	Updated following submission of Annual Review	
3.1	Mar 24	Updated to Evolution	D Shaw

Consultation Required	Hard Copy Locations
Not Applicable	Not Applicable

Associated Documents to be Reviewed
Not Applicable

Contents

1. OVERVIEW

1.1 Background

Northparkes Mining Services Pty Limited (Northparkes) is the manager of the Northparkes Joint Venture, an unincorporated joint venture between Evolution Mining (Northparkes) Pty Ltd (80%); Sumitomo Metal Mining Oceania Pty Ltd (13.3%) and SC Mineral Resources (6.7%). Northparkes is a copper-gold operation in Goonumbla, situated 27 kilometres north-west of the town of Parkes.

Construction of the ore processing plant and associated facilities began in 1993. Open cut mining commenced on the E22 and E27 ore bodies in late 1993. Development of the E26 lift 1 block cave underground mine began in 1994, with full scale production commencing in 1997.

1.2 Mining Context

Operations at Northparkes primarily comprises underground mining from multiple ore sources that feed a processing plant with a capacity of 6.5 million tonnes per annum (Mtpa). The underground mine is accessed via a decline ramp from the surface for people and materials with ore transported to the surface via inclined conveyors and a hoisting shaft, with a nominal capacity of 7.2 Mtpa. Northparkes utilises low cost block and sub-level cave mining and exploits industry leading technology, such as semi-autonomous loaders and various cave monitoring systems.

The ore processing operation consists of four stages: crushing, grinding, flotation and thickening / filtering. In addition to producing concentrate, the ore processing team also manages tailings disposal. The concentrator was constructed in two modules. Each module consists of its own grinding circuit with a single flotation circuit, concentrate thickener and filter. After extracting the copper and gold bearing minerals, the tailings are combined in a single tailings thickener before being deposited in the active tailings storage facility.

Northparkes' copper concentrate is transported to a rail siding at Goonumbla where it is then transported by rail to Port Kembla, for shipping to overseas customers.

1.3 Kokoda Biodiversity Offset Bushfire Management

Northparkes manages Kokoda in accordance with the Northparkes Biodiversity Offset Management Plan (BOMP), which guides the short, medium and long term conservation and management actions at Kokoda. The BOMP was prepared to fulfil the NSW Development Consent (DC11_0060) and Commonwealth Project Approval (EPBC 2013/6788) requirements and provides a framework for the implementation of ecological management actions, regeneration strategies, controls and monitoring programs at Kokoda.

One of the requirements included in the BOMP is that Northparkes develop a Bush Fire Management Plan (BFMP) for the Kokoda. Additionally, included in the second round of comments on the BOMP from the Office of Environment and Heritage (OEH) was the requirement to develop an ecological burn strategy for the Kokoda. This requirement will be address in this Management Plan.

2. SCOPE

This document applies to all activities undertaken by Northparkes including mining and exploration activities, processing of copper / gold ore resources, project development, maintenance activities, mine closure, logistics, associated service and support functions, bore fields, farming operations and products.

3. PURPOSE / OBJECTIVES

The aim of this BFMP is to facilitate the long term management of Kokoda in relation to bush fire.

Specific objectives of the BFMP are to:

- Support the BOMP by providing information on bush fire management for Kokoda.
- Provide information on fire management in relation to particular threatened species and ecological communities known to occur within the Kokoda.
- Provide information on emergency response in the circumstance of a bush fire emergency at the Kokoda or an adjacent property.
- Provide details of the communication process with the neighbours around Kokoda, as well as the Mandagery Rural Fire Brigade

For information relating to other aspects of the management of Kokoda, refer to Northparkes mines Biodiversity Offset Management Plan.

4. RESPONSIBILITIES

General role responsibilities are outlined in the Health, Safety and Environment Responsibilities and Accountabilities Procedure (PRO-0080). Personnel carrying out work under this document must be familiar with and comply with it in full. The following persons have specific responsibility:

Table 1: Responsibilities

Role	Responsibility
All Personell	– ensure staff and contractors accessing the Kokoda Offset Site are informed and trained where relevant in relation to controls on activities within the Offset Sites; – receive training regarding controls on activities within the Kokoda Offset Site; – report any instances of uncontrolled or malicious burn; – observe boundaries of the Kokoda Offset Site when undertaking work on site; and – undertake activities in the Kokoda Offset Site in line with directions from the Operations Manager and People, Safety and Environment Manager.
PSE Manager	– co-ordinate the day to day implementation of the BOMP and BFMP, including the implementation of all management activities; – undertake biannual inspections of the Kokoda Offset Site; – assess the effectiveness of the management strategies and instigate the adaptive management process as required; – ensure that all relevant records are effectively maintained on site; – review this managmement plan on a five yearly basis – ensure that personnel involved in the carrying out and monitoring of the BOMP/BFMP activities and values are appropriately qualified, licensed and experienced to undertake the task; – manage/control access to the Kokoda Offset Site;
Managing Director	– ensure that sufficient time and resources are allocated to allow for the implementation of biodiversity management and monitoring strategies as outlined in the BOMP/BFMP; – authorise internal and external reporting requirements as well as subsequent revisions of this BFMP; and – oversee implementation of the BFMP to ensure compliance with approval requirements.

5. DEFINITIONS

Table 2: Definitions

Key Word	Definition
BC Act	Biodiversity Conservation Act 2016 (NSW)
BFMP	Bushfire Management Plan
BOMP	Biodiversity Offset Management Plan
CEEC	Critically Endangered Ecological Community
DNG	Derived Native Grassland
DoPIE	Commonwealth Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)
ha	Hectares
DP&E	NSW Department of Planning and Environment
TEC	Threatened Ecological Community

6. SITE CONTEXT

The following sections provide a summary of the characteristics and biodiversity values of Kokoda as relevant to this BFMP. Further description of the baseline condition and environment of Kokoda is provided in the Environmental Assessment and the Preliminary Documentation.

6.1 Location

Kokoda is strategically located along a north-south potential corridor of remnant woodland and forest vegetation that runs along ridges and hills from north of Eugowra in the south, to east of Narromine in the north. The north-south potential corridor includes Goobang National Park, the largest conserved remnant of woodland and forest vegetation in the Central West region of NSW.

Kokoda is located approximately 12 kilometres north-west of Nangar National Park, approximately 8 kilometres south of Goobang National Park, approximately 12 kilometres west of Mandagery State Forest, approximately 17 kilometres east of Cookamidgera State Forest, and approximately 20 kilometres east of Back Yamma State Forest (refer to Figure 1).

Kokoda comprises lower fertility soils in the northern sections, predominately cleared for grazing, and dense woodland covered slopes and ridge lines in the south of the property. Sheep and cattle grazing was undertaken across the property prior to purchase by Rio Tinto and is likely to have been the predominant land use for many years. All stock were removed from the property in February 2015 following purchase of the property.

To the north of Kokoda, the predominant land use is agriculture, primarily cropping but also grazing. This agricultural area is largely confined to the lower and flatter areas, occurring between Goobang National Park and the southern portion of Kokoda.

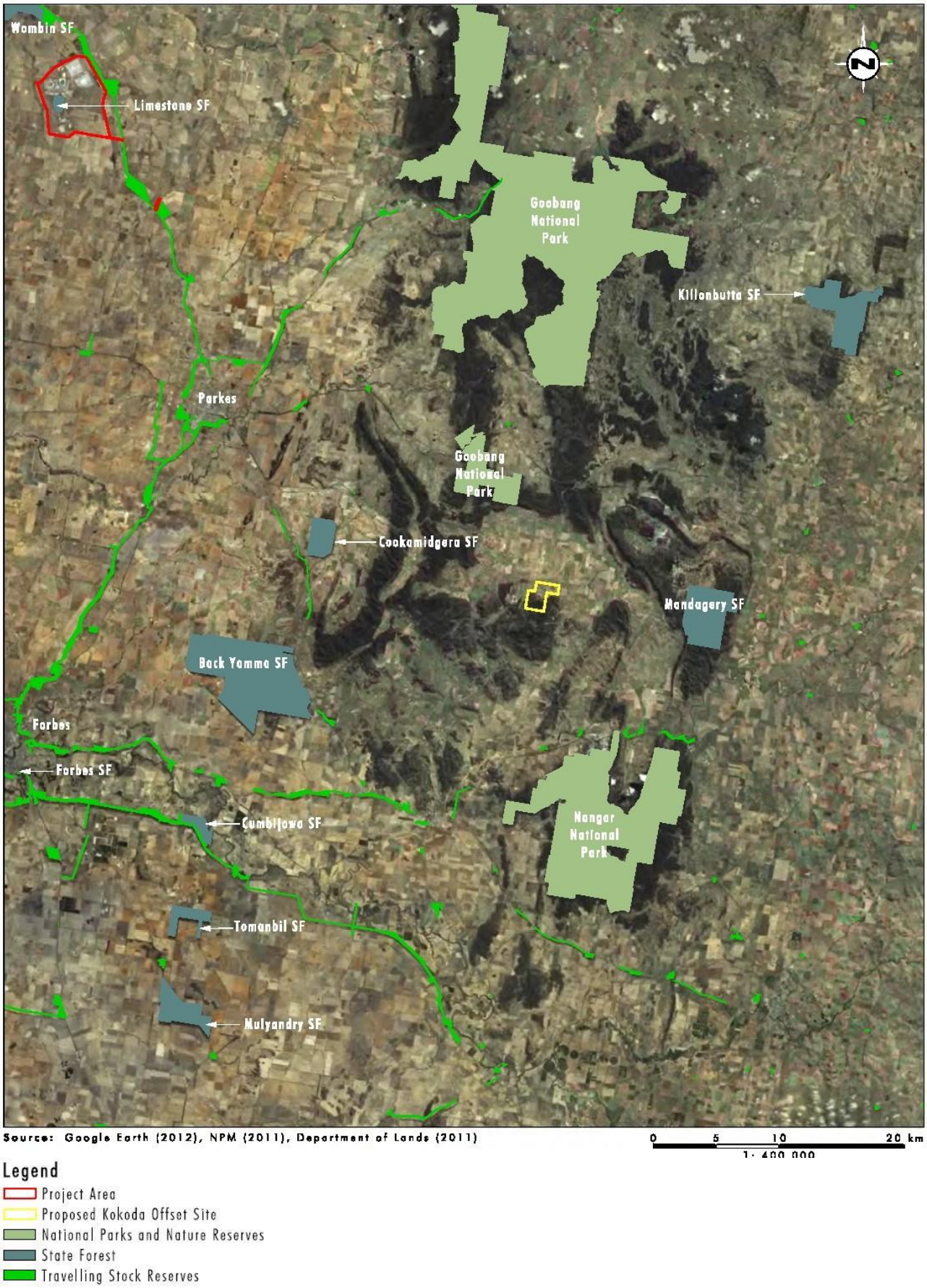

Figure 1: Location of Kokoda Biodiversity Offset

6.2 Climate

The climate in Mandagery district is relatively typical of the central west, with mean maximum temperatures of 33.5° C during summer, and mean minimum temperatures of 2.4°C during winter (Figure 2). Additionally, mean rainfall is highest in February with 66.1mm and lowest in April with 29.9mm. For more information on climate in Mandagery, refer to Figure 2.

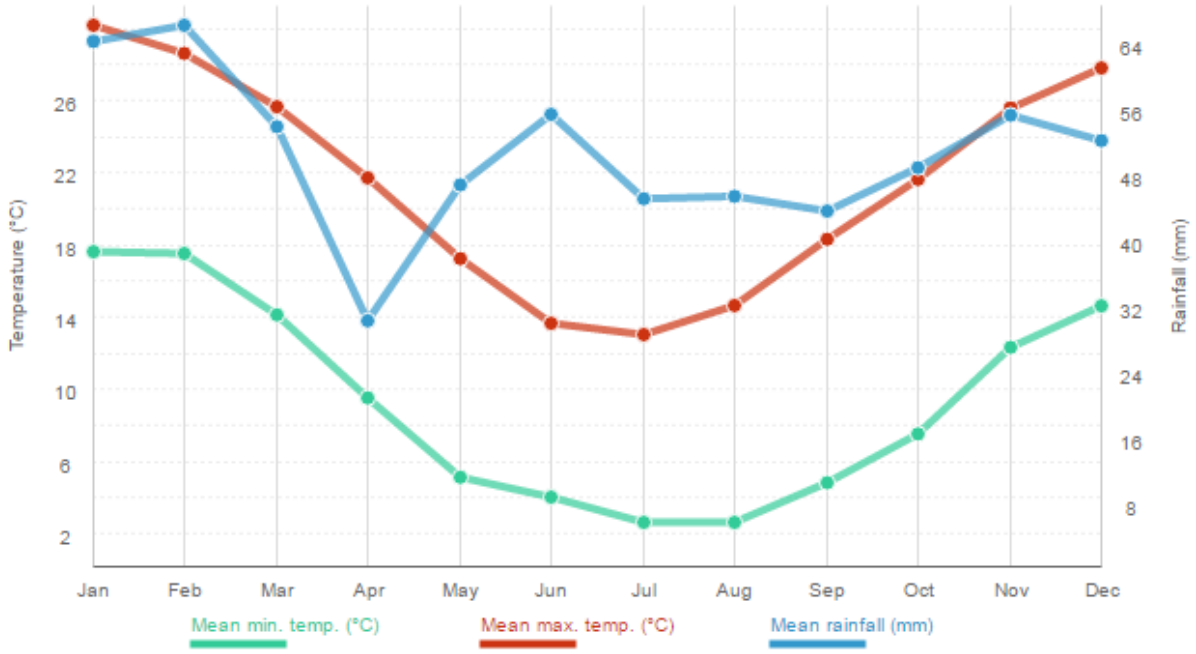

Figure 2: Mean Temperature and Rainfall Data for Mandagery (MLA, 2016)

6.3 Historical Land Use

Kokoda is located within a predominately agricultural area that is dominated by grazing activities. Prior being purchased by Northparkes, Kokoda was operated as sheep grazing operation.

6.4 Land Tenure and Conservation Mechanism

Kokoda will be secured in perpetuity conservation. Kokoda has been purchased by Northparkes and will be secured in perpetuity.

6.5 Key Ecological Values

Kokoda provides conservation of threatened ecological communities and known habitat for threatened fauna species. Threatened ecological communities, vegetation communities and threatened species known to occur at Kokoda will be discussed in Sections 6.5.1 and 6.5.2.

6.5.1 Threatened Ecological Communities and vegetation communities

A total of 11 vegetation communities have been recorded in Kokoda, 3 of which are listed Threatened Ecological Communities (TECs). Vegetation communities recorded on Kokoda are listed in below.

Table 3: Vegetation communities recorded at Kokoda

Vegetation Community	BC Act Status	EPBC Act Status	Vegetation within Kokoda (ha)
Grey Box Grassy Woodland	EEC	EEC	13
Grey Box Grassy DNG	EEC	EEC	96
White Box Grassy Woodland	EEC	CEEC	2.2
Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest	-	-	150

Vegetation Community	BC Act Status	EPBC Act Status	Vegetation within Kokoda (ha)
Rocky Rise Shrubby Woodland	-	-	26
Grey Box – Ironbark Woodland	-	-	25
Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine DNG	-	-	15
Dwyer's Red Gum Creekline Woodland	-	-	9.4
Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Woodland Low Quality	-	-	8.6
Mugga Ironbark Woodland	-	-	1.9
Farm Tracks and Dams – Disturbed Land	-	-	2.5
Total			350[1]

1 = Rounding of totals applied (numbers less than 1 – 2 decimal places, numbers between 1 and 10 – 1 decimal place, and greater than 10 - no decimal places)

CEEC = Critically Endangered Ecological Community

EEC = Endangered Ecological Community

EPBC Act = Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

BC Act = Biodiversity Conservation *Act 2016*

DNG = Derived Native Grassland

ha = Hectares

The 13 hectares of Grey Box Grassy Woodland and 96 hectares of Grey Box Derived Native Grassland on Kokoda conforms to the BC Act listed *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions* EEC and the EPBC Act listed *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* EEC.

The 2.2 hectares of White Box Grassy Woodland on Kokoda conforms to the BC Act listed White Box – Yellow Box – Blakely's Red Gum Woodland EEC and the EPBC Act listed White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grassland CEEC.
The 96 hectares of Grey Box Grassy Woodland DNG and 15 hectares of Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine DNG within Kokoda will be managed back to woodland form.

6.5.2 Threatened species

No threatened flora species have been recorded in Kokoda.

Twelve threatened fauna species have been recorded at Kokoda (Table 4).

Table 4: Threatened fauna species recorded within Kokoda

Common Name	Scientific Name	Status	
		BC Act	EPBC Act
Glossy black-cockatoo	*Calyptorhynchus lathami*	V	-
Superb parrot	*Polytelis swainsonii*	V	V
Little lorikeet	*Glossopsitta pusilla*	V	-
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	-
Speckled warbler	*Chthonicola saggitatus*	V	-
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	-
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	-
Varied sittella	*Daphoenositta chrysoptera*	V	-
Diamond firetail	*Stagonopleura guttata*	V	-
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V	-
Little pied bat	*Chalinolobus picatus*	V	-
Yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	V	-

V = Vulnerable Species
BC Act = *Biodiversity Conservation Act 2016*
EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

The grey-crowned babbler, brown treecreeper and the superb parrot have been the most commonly recorded threatened fauna species across Kokoda. The grey-crowned babbler and the brown treecreeper are both sedentary birds and will utilise the site across all seasons whereas the superb parrot is a seasonally nomadic species which will largely utilise Kokoda for foraging during spring and summer. Given the array of varied habitats within the site, there is a high potential that other threatened fauna species may occur within Kokoda.

7. FACTORS IMPACTING BUSH FIRE RISK

7.1 Components of Bushfire

Bush fires requires three components to burn; fuel, air and heat. These three factors together are known as the fire triangle (Figure 3). Removal or modification of any one of these three components will extinguish or reduce the fire and is the basis of all firefighting theory.

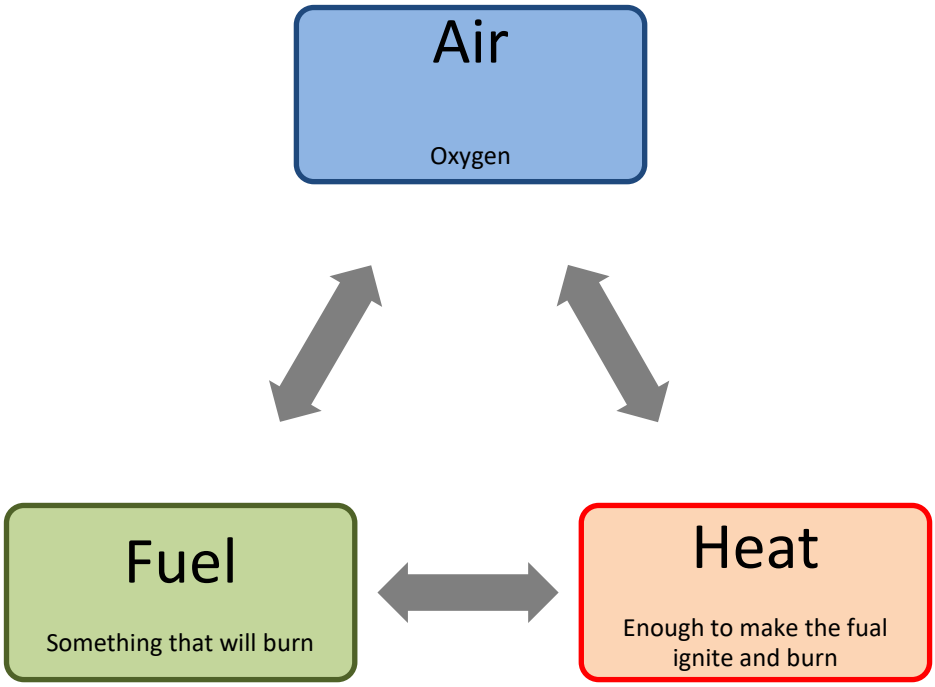

Figure 3: Fire Triangle

7.2 Conditions Associated with Bushfires

Conditions associated with bush fire intensity and the speed at which a bush fire will spread will depend on the following five elements; ambient temperature, fuel load, fuel moisture, wind speed and slope angle. These elements will be discussed in further depth in the following sections.

7.2.1 Fuel load

In general, the greater the fuel load, the hotter and more intense the fire. Other factors that impact how quickly fuel will burn is it if is concentrated with adequate spacing (which will burn faster) compared to fuel that is heavily compacted or scattered fuel sources. Smaller pieces of fuel such as twigs, litter and branches burn quickly, particularly when they are dry and loosely arranged. Some types of grasses burn very rapidly, while larger fuels, such as tree trunks, do not burn as easily.

Many of Australia's native plants burn easily. The high oil content in eucalyptus species makes them particularly combustible. The vast areas of dry grass common in mid-to-late summer also burn readily. In the southern part of Kokoda, there is a large fuel load on the ground in terms of fallen woody debris. Additionally, as time passes and Kokoda has more time to regenerate, the fuel load will increase. This will have to be adaptively managed as Kokoda undergoes various stages of restoration.

Landscape Function Analysis surveys are undertaken at Kokoda to track rehabilitation success. These surveys will be used to monitor the fuel load at Kokoda.

7.2.2 Fuel moisture

Dry fuel will burn quickly, but damp or wet fuel may not burn at all. As a consequence, the time since rainfall and the amount of rain received is an important consideration in assessing bush fire danger. Often a measure of the drought factor, or moisture deficit, will be used as an indicator of extreme bush fire weather conditions. Fuel moisture is at its lowest during the fire season, which for Kokoda is spring/ summer (refer to Figure 2). For more information on the climate at Kokoda, refer to Section 6.2.

7.2.3 Wind speed

Wind acts to drive a fire by blowing the flames into fresh fuel, bringing it to ignition point and providing a continuous supply of oxygen. Wind also promotes the rapid spread of fire by spotting, which is the ignition of new fires by burning embers lofted into the air by wind. Spotting can occur up to 30km downwind from the fire front. There is a threshold wind speed of around 12 to 15km/h which makes a significant difference in the behaviour of bushfires in the open. When wind speeds are below this threshold, fires with heavy fuel loads burn slowly. However, even a slight increase in wind speed above this threshold results in a significant increase in fire behaviour and advancement. Doubling the wind speed will quadruple the rate of spread of the fire. However above about 50 km/h this relationship begins to break down, and above 80 km/h the rate of spread in grasslands reduces. This occurs because the head fire breaks up into narrow tongues, many of which become self-extinguishing. The width of a fire front has an influence on the rate of spread and a wind shift can immediately widen the forward edge of a fire.

7.2.4 Ambient temperature

The higher the temperature the more likely it is that a fire will start or continue to burn. Fuel is closer to its ignition point at high temperatures and pre-heated fuel loads burn faster. Mandagery district has a mean maximum temperature of 33.5º C during summer, but can have temperatures above 40.0º C during summer. Refer to Section 6.2 for more information on the climate at Kokoda.

7.2.5 Relative humidity

Relative humidity is the most commonly used measure of atmospheric moisture and is defined as the ratio of the amount of water vapour actually measured to that which air could hold at saturation. Very low relative humidity of lower than 20 per cent, causes fuels to dry out and become more flammable.

Additionally, dry air promotes a greater intensity fire than moist air. Plants become more flammable at a low humidity because they release their moisture more easily. Relative humidity at Kokoda has the greatest potential for bush fire during the fire seasons, which occurs in spring/ summer at Kokoda (Refer to Figure 2).

Fires pre-heat their fuel source through radiation and convection. As a consequence of these heat transfer effects, fires accelerate when travelling uphill and decelerate travelling downhill. The steepness of the slope plays an important role in the rate of fire spread. The speed of a fire front advancing will double with every 10 degree increase in slope so that on a 20 degree slope, its speed of advance is four times greater than on flat ground.

Kokoda has areas of relatively flat ground in the northern section of the property, as well as hilly sections in the southern end of the property.

7.2.6 Origin

Bushfires can originate from both human activity and natural causes. Lightning is the predominant natural source of bush fire, accounting for about half of all ignitions in Australia. Fires of human origin currently account for the remainder and are classified as accidental or deliberate. Fires lit deliberately can be the result of arson or designed to achieve a beneficial outcome but experience sudden adverse weather conditions which results in their uncontrollable spread.

Unfortunately deliberate and accidentally lit fires are more prevalent near populated areas and have a disproportionately higher risk of infrastructure impact. Arsonists place people and property at serious and unnecessary risk, particularly when igniting fires on extreme fire weather days.

7.3 Bushfire Risk Potential

The centre of the bush fire risk triangle is bush fire risk. Bush fire risk can be understood as the likelihood of whether a bush fire will start, whether it will spread and whether it has consequences on, or impacts human life, property or the environment. As with the fire triangle, removal or modification of any one of the three components will reduce the risk (Fgure 4).

Many factors contribute to the components of risk. Some of them cannot be modified (e.g. weather and natural ignitions), however there are many that can either by reducing or entirely eliminating their contribution to the risk triangle. For example, reducing bush fire fuel loads is an important action that will reduce the likelihood of bushfires spreading in the wider landscape, as well as reducing consequences on properties. Additionally, the risk of bush fires can be reduced by implementing various strategies or through managing the factors that influence bush fire risk. Figure 4 outlines a number of strategies and factors that can influence bush fire risk.

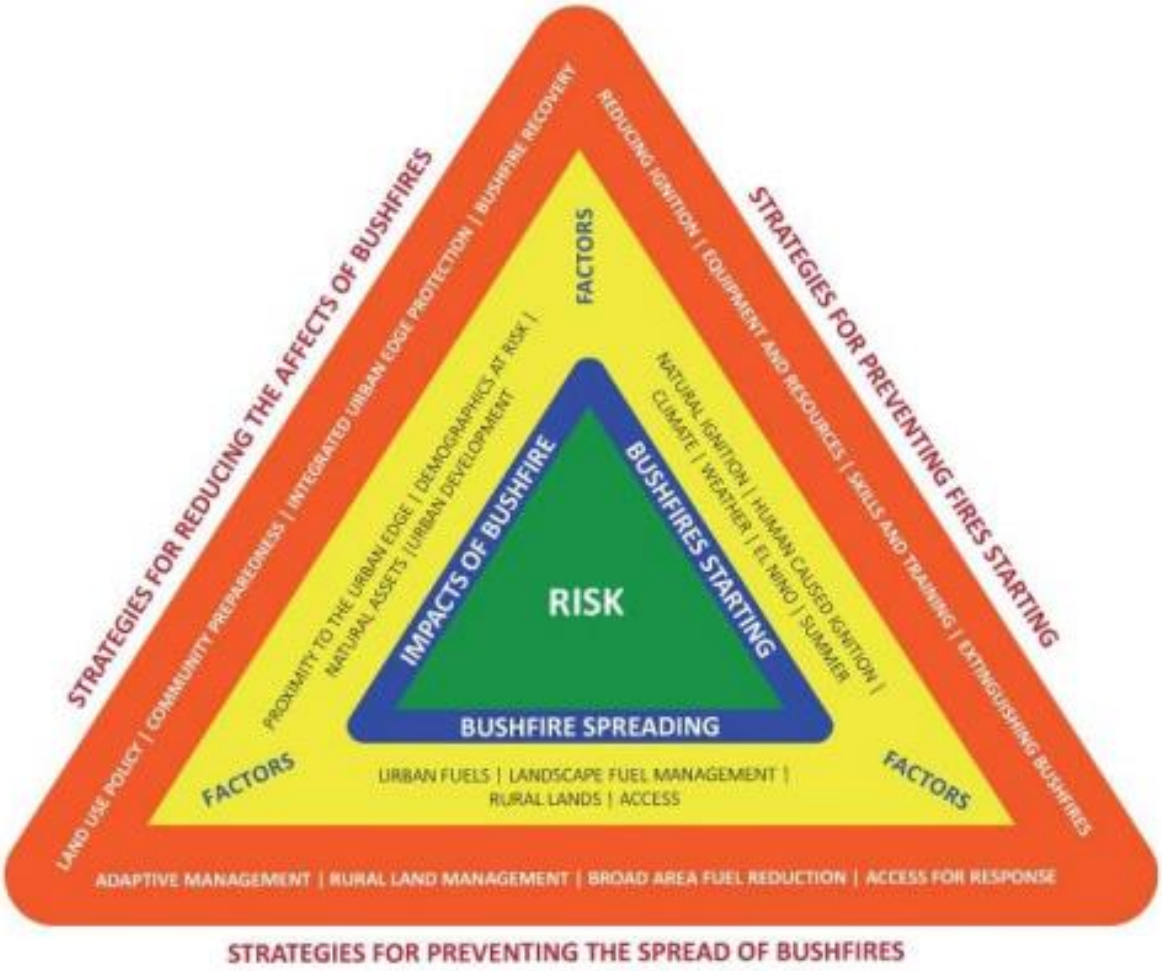

Figure 4: Bushfire risk triangle (which includes strategies to reduce bush fire risk)

The highest risk period for bush fire at Kokoda is during spring through to summer. The greatest danger occurs after the dry winter/spring period, before the onset of the rainy weather common in summer. Figure 5 illustrates the fire seasons across Australia.

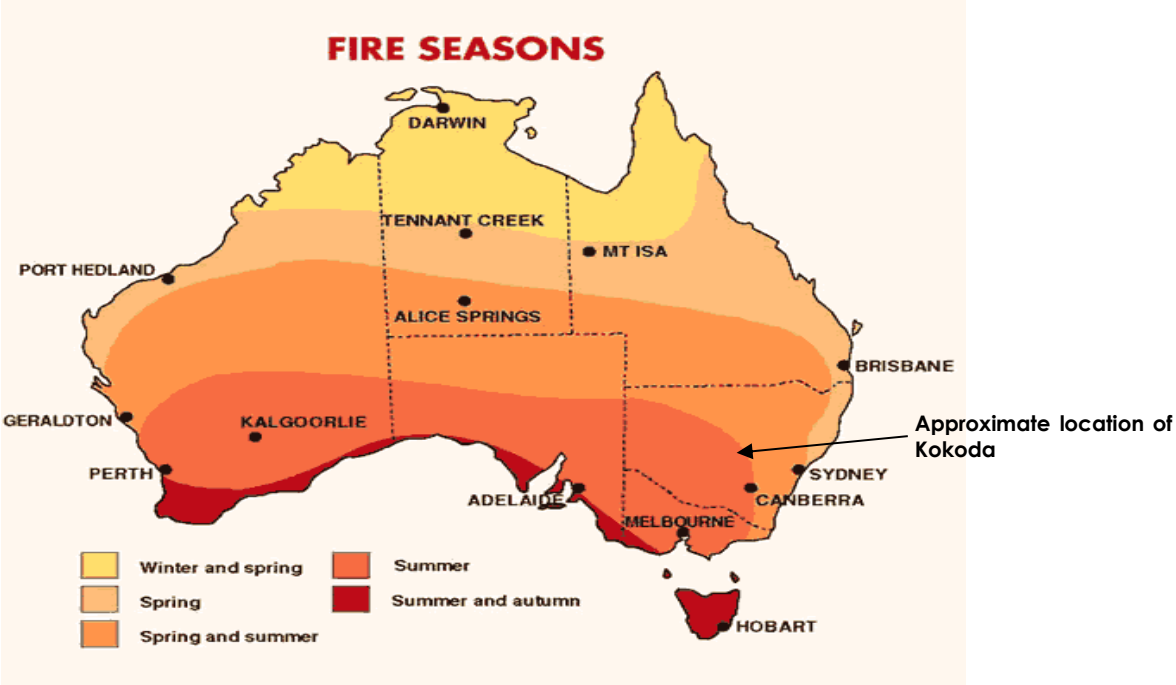

Figure 5: Fire seasons across Australia with approximate location of Kokoda

7.4 Assets at risk from fire

The following assets are at risk in the event of a fire at Kokoda;

- Neighbouring dwellings;
- Fences;
- Internal and external access roads; and
- Service infrastructure (powerlines and phone lines).

The risks to each of these assets will be described in further detail in the sections below.

7.4.1 Residential dwellings

A residential dwelling exists on the Kokoda property, but is located outside of the Offset Site boundary. The dwelling exists in the grassland area of the property, close to an ephemeral watercourse in the north-west of the property. It is not seen as a major fire risk due to the lack of woodland vegetation in the near vicinity.

There is one neighbour who has a residence that is approximately 2 km from the north eastern boundary of Kokoda. Open grassland mainly exists between Kokoda and this residence (towards the north east). There is a patch of remnant woodland to the south of the resident (north of Kokoda).

7.4.2 Fences

A windstorm has made significant damage to the fence on the south eastern and southern boundaries of Kokoda. This is currently being reinstated. While the fence lines are being reinstated, Northparkes will investigate the viability and value of clearing along the fence lines to create a defined fire break. This would provide much needed access in the event of a bushfire. This access may assist in the control of the bush fire and minimise impacts on the ecological values on the property as a result of fire.

7.4.3 Internal and External Access Roads

Roads will be maintained to assist in providing accessing for monitoring purposes, as well as access in the event of a bushfire.

7.4.4 Service Infrastructure

A powerline provides electricity to the dwelling on the Kokoda property. Power is switched off at the circuit breakers when the property is unoccupied, to minimise the potential of an electrical fire.

7.5 Fire History

Kokoda is located within Mandagery in the Cabonne local government area, which falls within the Canobolas Zone of the NSW Rural Fire Service. The Canobolas Zone produces an annual report, which summarises the number of incidents (including fire incidents) that have occurred in the zone over the 12 month period. Figure outlines the number of fire incidents that occurred in the Canobolas zone between 2010/2011and 2013/2014.

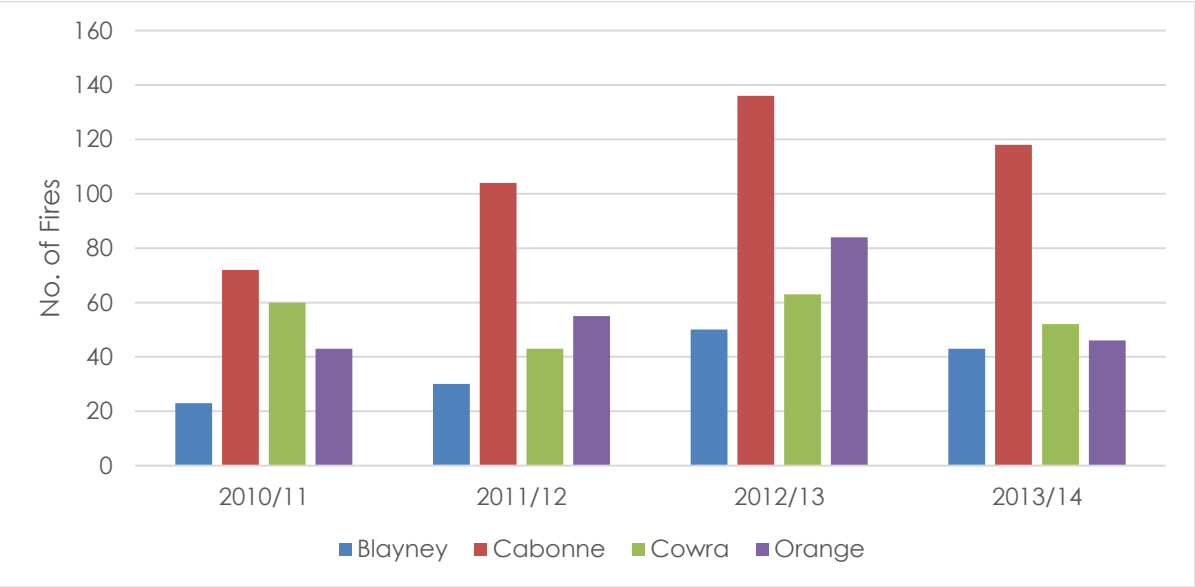

Figure 6: Number of fire incidents that occurred in the in the local government areas of Blayney, Cabonne, Cowra and Orange between 2010/2011 and 2013/2014 fire seasons (Kokoda is located in the Cabonne local government area)

The size of the fires was also reported in the Canobolas Zone Annual Report for 2013/2014 (Figure 7). During the 2013/2014 fire season, a total of 154 fire incidents were recorded during summer. Of these, the vast majority (89%) were restricted to less than 10 ha in size. Across the Canobolas Zone, a total of 1021 ha was lost due to fires throughout the 2013/2014 reporting period.

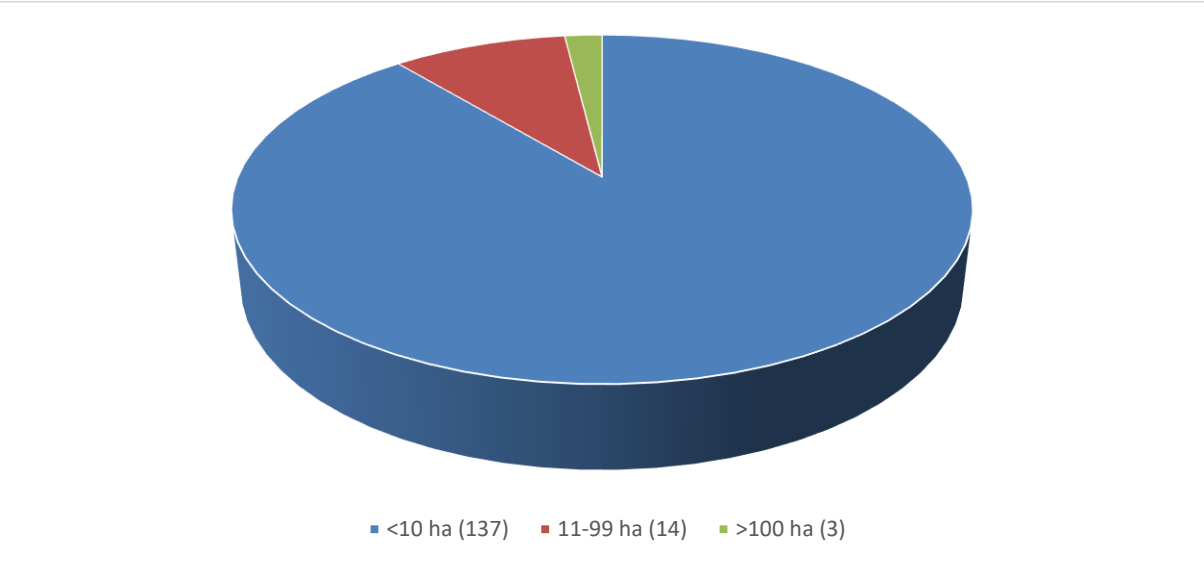

Figure 7: Canobolas Zone fire incidents by size for the 2013/ 2014 summer

7.6 Threatened Species Management

7.6.1 Threatened species hazard reduction list

The Threatened Species Hazard Reduction List is a component of the Bush Fire Environmental Assessment Code (2006) that provides conditions relating to undertaking hazard reduction works when threatened species, endangered populations or ecological communities are known to occur at a site. Table 5 outlines the threatened species or threatened ecological communities known to occur at Kokoda with the species specific conditions from the Threatened Species Hazard Reduction list.

Table 5: Threatened species known to occur at Kokoda with their species specific conditions from the Threatened Species Hazard Reduction List

Common Name	Scientific Name	Status		Conditions relating to use of fire	Conditions relating to mechanical forms of hazard reduction
		BC Act	EPBC Act		
Glossy black-cockatoo	*Calyptorhynchus lathami*	V		No burning of Allocasuarina thickets	Yes, but avoid Allocasuarina thickets
Superb parrot	*Polytelis swainsonii*	V	V	Only use low intensity fire, and only between May and end of July. Avoid burning of River Red Gum and Callitris, and protect hollow bearing trees	No slashing between September and end of December, and no trittering or tree removal
Little lorikeet	*Glossopsitta pusilla*	V		No species specific conditions specified	No species specific conditions specified
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V		No species specific conditions specified	No slashing, trittering or tree removal
Speckled warbler	*Chthonicola saggitatus*	V		No species specific conditions specified	No slashing, trittering or tree removal
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	V		No species specific conditions specified	No species specific conditions specified
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V		No species specific conditions specified	No slashing, trittering or tree removal
Varied sittella	*Daphoenositta chrysoptera*	V		No species specific conditions specified	No species specific conditions specified
Diamond firetail	*Stagonopleura guttata*	V		No species specific conditions specified	No slashing, trittering or tree removal
Eastern bentwing-bat	*Miniopterus schreibersii oceanensis*	V		No fire around known roost sites	No slashing around maternity caves
Little pied bat	*Chalinolobus picatus*	V		No species specific conditions specified	No species specific conditions specified
Yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	V		No species specific conditions specified	No species specific conditions specified
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions		E	E	No fire more than once every 15 years	No slashing, trittering or tree removal
White Box Yellow Box Blakely's Red Gum Woodland		E	CE	No fire more than once every 5 year	Slashing, but no trittering or tree removal

7.7 Hazard Reduction

There are several different methods to undertaken hazard reduction including controlled burning, mechanical clearing like slashing undergrowth, or even reducing the ground fuel by hand.

The NSW Rural Fire Service's standards for low intensity bush fire hazard reduction burning (for private landholders) outlines the requirements for undertaking a safe and successful hazard reduction burn. The objective of a low intensity bush fire hazard reduction burn is to minimise the potential impacts of a bush fire on life, property and the environment. A low intensity fire is characterised by:

- Low flame heights- Flame heights should average about one meter, but may be higher in patches of heavy or elevated fuels
- Low scorch height – Scorch height should be less than five meters. Scorch height is the height to which tree leaves are killed from the heat of the fire
- Slow rate of spread- The fire should spread only at a slow walking pace

A successful low intensity hazard reduction burn will reduce the fuel load so that it creates a safe defensible space around an asset. It should also minimise the impact from the burn on the environment.

In carrying out a burn, the following factors need to be considered:

- The fuel load and structure
- The effects on the environment and community
- The specific zone objectives
- If there are adequate fire breaks and control lines
- The season and weather conditions
- The topography and fire behaviour
- What lighting patterns to use
- Condition a test burn
- What safety measures may be needed
- Mopping up afterwards; and
- If you need to report the results

For more information on any of these consideration for a hazard reduction burn, refer to Appendix A – NSW Rural Fire Service standards for low intensity burn hazard reduction burning (for private landholders).

8. ECOLOGICAL BURN STRATEGY

An Ecological Burn Strategy has been developed to assist with the management of the Kokoda. Refer to the following sections for more information on the burn strategy for Kokoda.

8.1 Ecological Burn Planning

The ecological burn plan for Kokoda will following the cycle outlined in Figure 8.

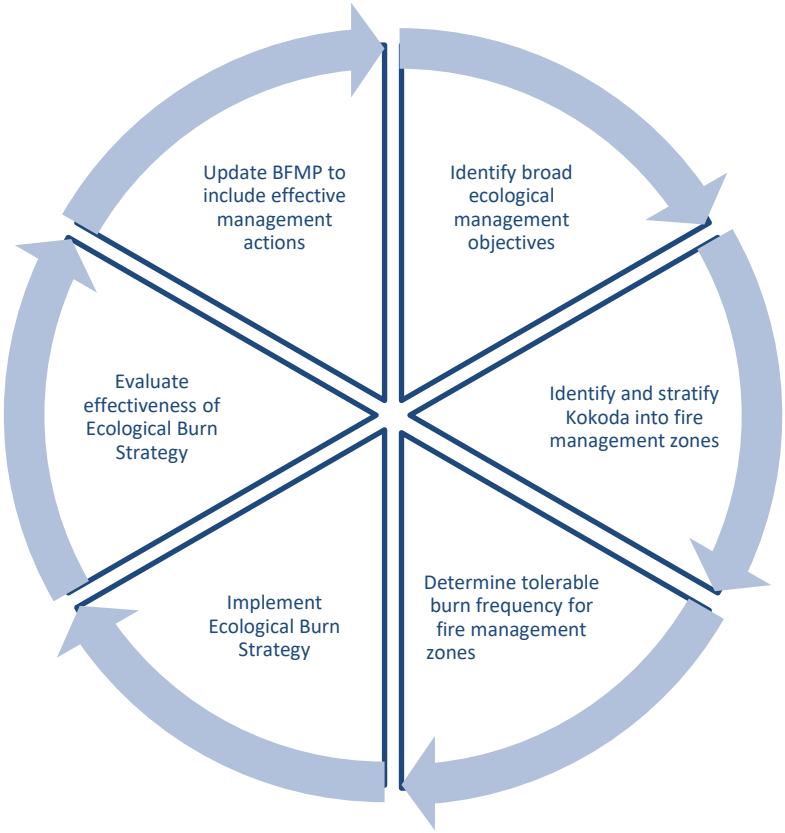

Figure 8: Ecological burn planning cycle

8.2 Ecological Management Objectives

The objective of this BFMP is to facilitate the long term conservation and enhancement of the ecological values at Kokoda through implementing appropriate fire management to the property. Specific ecological management objectives of the BFMP include:

- Support the BOMP by managing Kokoda in accordance with the short, medium and long term management objectives for the offset area
- Implement a fire management plan that enhances biodiversity at Kokoda, particularly for threatened species and threatened ecological communities at Kokoda.

For information relating to other aspects of the management of Kokoda, refer to Northparkes mines Biodiversity Offset Management Plan.

8.3 Kokoda broad fire management zones

The Kokoda Offset Site has been stratified into five broad fire management zone (refer Table 6), based primarily on vegetation communities. Table 6 below provides a summary of the fire management zones identified within the Kokoda Offset Site.

Table 6: Fire Management Zones at the Kokoda Offset Site

Broad fire management zone	Vegetation types	Area (ha)
Forest	• Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest	149.9
Woodland	• Grey Box Grassy Woodland (EEC/ EEC) • White Box Grassy Woodland (EEC/ CEEC) • Rocky Rise Shrubby Woodland • Grey Box – Ironbark Woodland • Dwyer's Red Gum Creekline Woodland • Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Woodland Low Quality • Mugga Ironbark Woodland	86.0
Grassland and areas regenerating to woodland	• Grey Box Grassy Woodland - DNG (EEC/ EEC) • Dwyer's Red Gum – Grey Box – Mugga Ironbark – Black Cypress Pine Forest DNG	111.2
Waterbody	• Farm Tracks and Dams – Disturbed Land	1.0
Modified landscape / assets	• Farm Tracks and Dams – Disturbed Land	1.6
	Total	350 ha

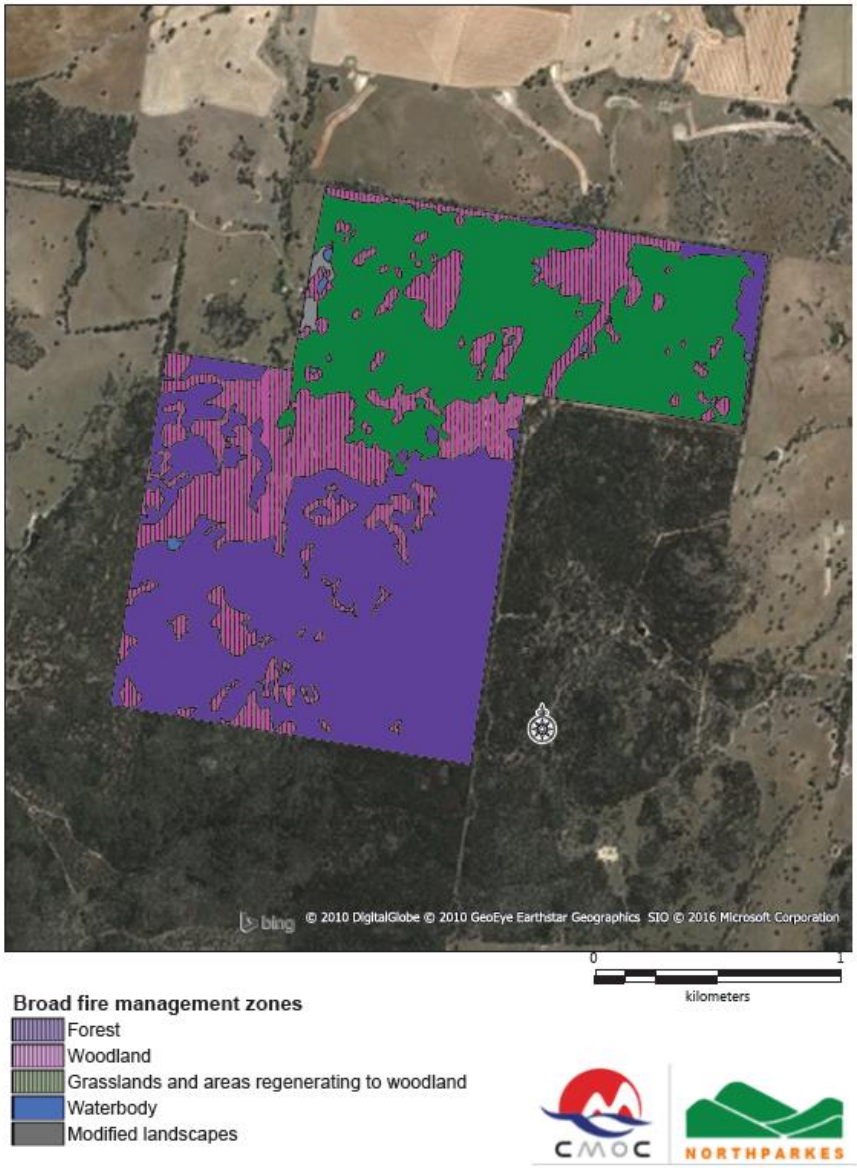

Figure 9: Broad fire management zone at Kokoda

8.4 Bushfire Considerations of Landscape Management Zones

The following factors should be considered when there is fire (planned or unplanned) at Kokoda:

Table 7: Bushfire considerations of landscape management zones

Fire management zone	Category	Considerations
Forest	Fuel Load	Forest areas contain eucalyptus species that, due to their high oil content, are particularly combustible The large volume of woody debris on the ground at Kokoda provides increased material to burn High potential for canopy fire (the most high risk type of bush fire) due to dense forested vegetation
	Fuel moisture	Towards the end of the fire season in March and April, the average rainfall deceases, potentially resulting in drier fuel load which may increase fire potential
	Ambient temperature	The ambient temperature in the Mandagery district has a higher mean temperature over summer, resulting in increased fire potential
	Slope angle	The forest area of Kokoda is generally sloped, which would increase the fire potential if the fire front was travelling in a southern direction
Woodland	Fuel Load	Forest areas contain eucalyptus species that, due to their high oil content, are particularly combustible Lower volume of woody debris on the ground than forest areas may make these areas less susceptible to intense fires As woodland areas are less densely vegetated, the chance of a canopy fire (is decreased companied to in the forested areas
	Fuel moisture	Woodland areas contain high level of green ground cover, which is less combustible due to the high moisture content
	Ambient temperature	The ambient temperature in the Mandagery district has a higher mean temperature over summer, resulting in increased fire potential
Grasslands and areas regenerating to woodland	Fuel Load	Decreased fuel load compared to forest and woodland areas However, with increase revegetation, the ground layer will become denser and have an increase fire potential
	Fuel moisture	Grassland areas are dominated by green groundcover, which has a relatively low fire potential However, during the summer months, very dry ground cover will be susceptible to bushfire.
	Ambient temperature	The ambient temperature in the Mandagery district has a higher mean temperature over summer, resulting in increased fire potential
Waterbody	NA	Waterbody's provide protection from bush fire due to availability of water source to refill firefighting trucks
Modified landscapes	NA	Low burn potential due to low level of vegetation.

8.5 Timeframe for Implementation of Hazard Reduction and Ecological Burn Strategies

The following hazard reduction timeframes will be implemented (as a minimum) for the fire management zones at Kokoda (Table 8).

Table 8: Hazard reduction timeframes for the fire management zones at Kokoda

Fire management zone	Mechanical hazard reduction timeframe	Ecological burn timeframe	Justification
Forest	No mechanical hazard reduction planned If mechanical hazard reduction is necessary due to safety, the method and timing must consider the conditions for glossy black cockatoo, superb parrot, brown treecreeper (eastern sub sp.), speckled warbler, grey-crowned babbler (eastern sub sp.), diamond firetail, Grey Box Woodland EEC and White Box Woodland CEEC.	No ecological burning to be undertaken more than once every 15 years When ecological burning is undertaken, it must consider the conditions for superb parrot, glossy black cockatoo and eastern bent-wing bat	The Threatened Species Hazard Reduction List for the Bush Fire Environmental Assessment Code outlines specific conditions relating to fire and mechanical forms for hazard reduce in relation to threatened species. Mechanical Hazard Reduction No slashing, trittering or tree removal is allowed for the following species/ TECs that have been recorded at Kokoda -Brown treecreeper (eastern sub.sp) -Speckled warbler -Grey-crowned babbler (eastern sub.sp) -Diamond firetail -Grey box woodland EEC No slashing between September and the end of December, and no trittering or tree removal is allowed for Superb Parrot No mechanical forms of hazard reduction allowed in *Allocasuarina* thickets for glossy black cockatoo No slashing, trittering or tree removal for Grey Box Woodland EEC Ecological Burn Superb parrot- only use low intensity fire and only between May and the end of July. Avoid burning of River Red Gum and Callitirs, and protect hollow bearing trees
Woodland	No mechanical hazard reduction planned If mechanical hazard reduction is necessary due to safety, the method and timing must consider the conditions for glossy black cockatoo, superb parrot, brown treecreeper (eastern sub sp.), speckled warbler, grey-crowned babbler (eastern sub sp.), diamond firetail, Grey Box Woodland EEC and White Box Woodland CEEC.	No ecological burning to be undertaken more than once every 15 years When ecological burning is undertaken, it must consider the conditions for superb parrot, glossy black cockatoo and eastern bent-wing bat	The majority of the woodland communities at Kokoda provide offsets for TECs or threatened species habitat potentially impacted by the Northparkes Mines Step Change Project Therefore any hazard reduction undertaken at Kokoda should comply with the conditions outlined in the Threatened Species Hazard Reduction List. The Threatened Species Hazard Reduction List for the Bush Fire Environmental Assessment Code outlines specific conditions relating to fire and mechanical forms for hazard reduce in relation to threatened species. Mechanical Hazard Reduction No slashing, trittering or tree removal is allowed for the following species/ TECs that have been recorded at Kokoda -Brown treecreeper (eastern sub.sp) -Speckled warbler

Fire management zone	Mechanical hazard reduction timeframe	Ecological burn timeframe	Justification
			-Grey-crowned babbler (eastern sub.sp) -Diamond firetail -Grey box woodland EEC No slashing between September and the end of December, and no trittering or tree removal is allowed for Superb Parrot No mechanical forms of hazard reduction allowed in *Allocasuarina* thickets for glossy black cockatoo No slashing, trittering or tree removal for Grey Box Woodland EEC No trittering or tree removal for White Box Woodland CEEC Ecological Burn Superb parrot- only use low intensity fire and only between May and the end of July. Avoid burning of River Red Gum and Callitirs, and protect hollow bearing trees Grey Box Woodland EEC is conditioned to have no fire more than once every 15 years White box woodland is no fire more than once every 5 years
Grassland and areas regenerating to woodland	Evaluate introducing crash grazing/ slashing to manage ground cover after 5 years	No ecological burning to be undertaken until minimum of 15 years	As these are areas assigned for regeneration and revegetation burning will be excluded (as much as practical), to allow young vegetation communities to mature to a stage where they are able to withstand bush fireand regenerate naturally following a fire event. This is nominally at least 15 years, but is dependent on the success of land establishment and the vegetation community present. Areas containing TECs (including Grey Box Grassy Woodland - DNG (EEC/ EEC)) should be excluded from fire. Planned burns in these areas should be at a frequency and intensity that does not threatened the persistence of the TEC.
Waterbody	Conduct yearly checks of waterbody access	No ecological burns will be required at the waterbodies	Yearly checks of waterbody access are to be undertaken to assess if a fire truck could access them in the instance of a bush fire at Kokoda or an adjacent property.
Modified landscape / assets	Conduct yearly assessment of mechanical hazard reduction around assets	No ecological burns will be required at modified landscapes/ assets	Modified landscapes around assets (in particular the house) will be assessed yearly to see if hazard reduction is required. Modified landscapes around the house will be mowed (mechanical hazard reduction) if the fuel load is assessed to be a hazard.

9. EMERGENCY MANAGEMENT

The following procedure should be activated in the case of a bush fire at Kokoda or an adjacent property.

9.1 Emergency response

In the event of a bush fire at Kokoda or on an adjacent property, the emergency procedure will follow the emergency information outlined by the NSW Rural Fire Service. Northparkes Mines does have an emergency response team, however, due to the location of Kokoda compared to the mine site, Northparkes will follow the RFS's emergency response procedure in relation to bush fires at Kokoda. To report a fire at Kokoda or an adjacent property:

- Call triple zero (000)

It is essential that the person reporting the emergency stays on the phone and provides all relevant information to the operator. Do not hang up the phone until the operator tells you to do so.

9.2 Fire trails and access

Access to the Kokoda Biodiversity Offset Site is via Chatmans Lane, off Reedy Creek Road. Otherwise, the property is surrounded by a boundary fence. There are no designated tracks across the grassland section of the property. Access to the forested area in the southern section of the property is limited, with three tracks providing access to this area. These tracks are regularly maintained. For more information on property access and tracks, refer to Figure 8.

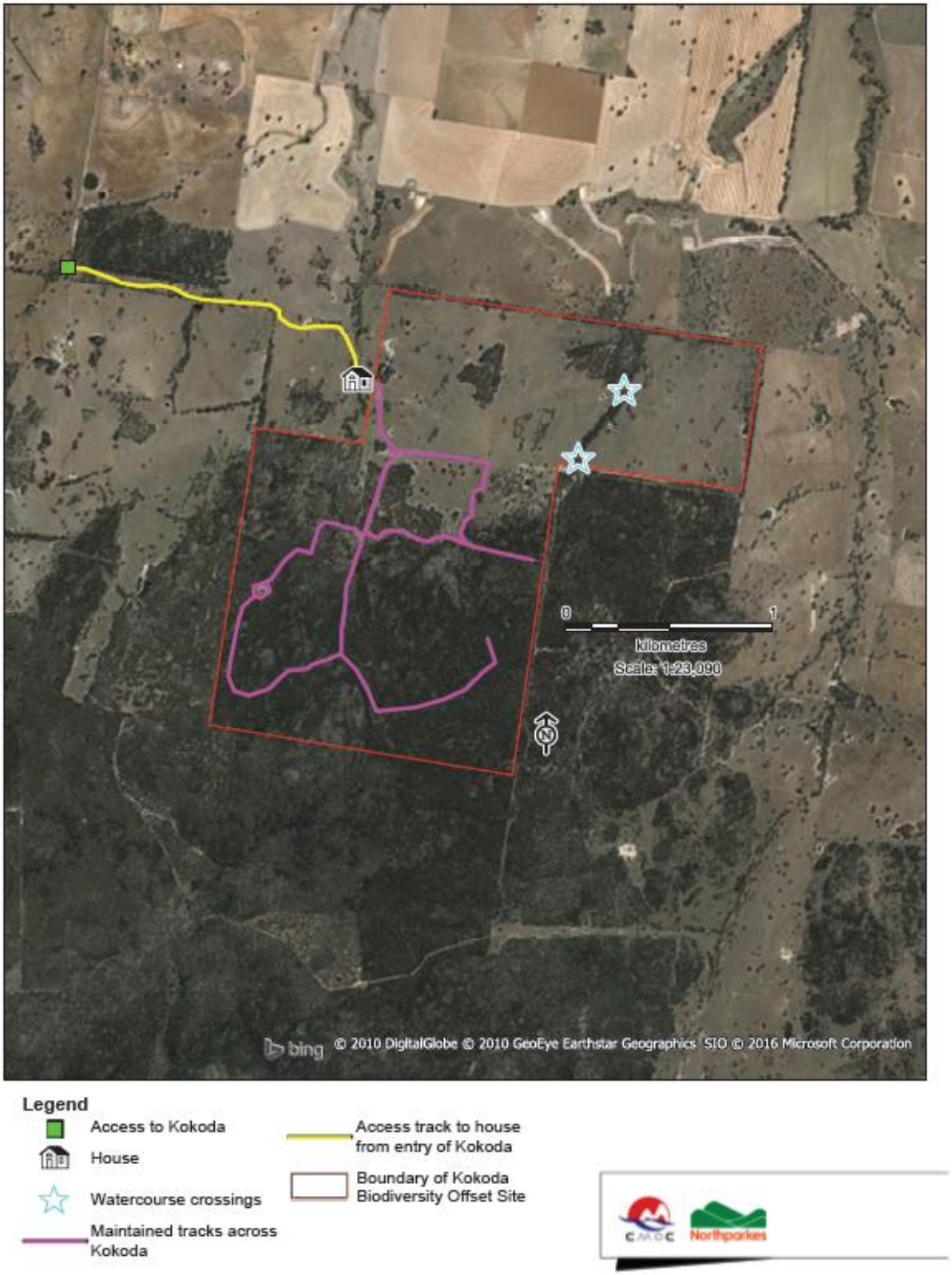

Figure 1: Access and tracks at Kokoda

9.3 Utilities and Facilities

There are several farm dams (including one located within the forested area) and two ephemeral creek lines across the Kokoda offset property that can be used to draw water for firefighting. Additionally, the farm house has access to electricity and running water.

9.4 Contacts

Kokoda is located within the Canobolas Zone of the RFS. This Zone is located in the Central West of NSW and combines the Rural Fire Districts of Blayney, Cowra, Cabonne and Orange. Within this zone, Kokoda is within the Mandagery brigade. The following contacts are relevant to a bush fire emergency at Kokoda:

Table 9: Emergency contacts for the Kokoda Biodiversity Offset Site

Name/ Position	Contact	Why they should be contacted
Emergency Services (Police/ Fire/ Ambulance)	000	Bushfire
Canobolas Zone NSW RFS	02 6363 6666	For any information relating to bush fire in Canobolas Zone
Bush fire information line	1800 NSW RFS (1800 679 737)	Current major incident activity Current total fire bans Advice on protecting your property and other fire related safety information Building development
Northparkes Mines Environment Phone	0418 206 471	Environmental enquiries relating to Kokoda
Northparkes Mines general enquires	02 6861 3000	General enquires for Northparkes Mines

10. MONITORING

Monitoring will be undertaken at Kokoda in accordance with the Northparkes BOMP. Included in this is biannual inspection of Kokoda. If any maintenance relating to bush management are required at Kokoda, these will recorded during the biannual inspections. The results of the biannual inspection are included in an annual report. In addition, Northparkes environmental staff undertake several ad hoc visits to Kokoda throughout the year.

11. COMMUNICATION AND TRAINING

As a limited number of Northparkes staff visit Kokoda as art of their role, training and communication relating to Kokoda will be limited to the Environment and Farms team. If staff members outside of this area are to visit Kokoda, they will be accompanied by an Environment and Farms staff member, who will give a short site induction to any visiting guests to the site. However, where required, the following communication channels will be used regarding activities at Kokoda:

- Monthly HSE meetings
- Level 2 Risk Assessments (where relevant)
- Management meetings; and
- Environmental reports.

As Kokoda is located over 50 kilometres from Northparkes Mines, information regarding a bush fire at Kokoda will not be included in the general site inductions.

To increase the bush firefighting knowledge at Northparkes, three members of the Environment and Farming team have joined the Mandagery brigade of the RFS. These employees will be available to assist with bush fire call outs at Kokoda or the adjacent properties (where applicable). In addition, these employees provide an interface with the community that Kokoda is located within through involvement in the RFS. This involvement will also provide a pathway for two way communication regarding fire hazards and learnings relating to Kokoda. Membership to the Mandagery RFS will be maintained by a minimum of one Northparkes representative.

12. REVIEWS AND CONSULTATION

This BFMP will be reviewed every three years to:

- refine and make improvements to the management strategies; and
- review and update the emergency procedures, access and track details and contact information included in this management plan.

The review will look for opportunities to improve the management strategies as well as further develop and forecast the longer term performance indicators and completion criteria. Adaptive management amendments to this BFMP that are made for continual improvement do not require submission to the relevant authorities for approval if they are consistent with the overall objectives of this management plan.

Northparkes will consult with OEH and RFS (as required) regarding the implementation this BFMP.

13. ADAPTIVE MANAGEMENT PROCESS

Adaptive management of this BFMP will be responsive to any new and relevant data that may arise through the biannual inspections, legislative change or any through consultation with the RFS. This will enable a flexible approach to management, allowing ongoing feedback and refinement of this BFMP. Adaptive management will be a key mechanism to address the risks to the successful implementation of this BFMP. Adaptive management steps include regular review of this BFMP, including adaptation of management actions, recognising potential risks to the successful implementation of this BFMP and having a frame work in place for corrective actions.

The adaptive management process is outlined in Figure 9.

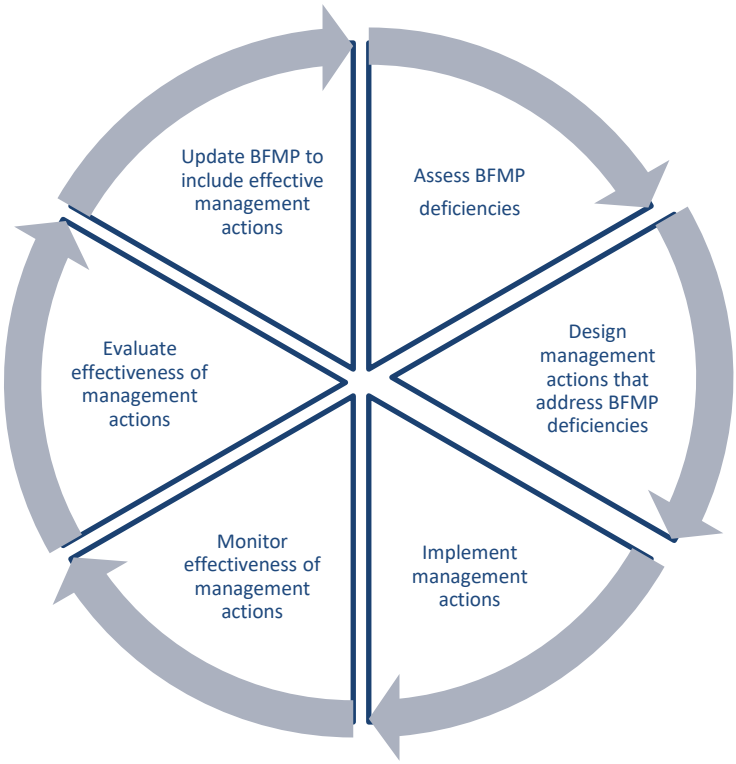

Figure 2: Adaptive management process for this BFMP

14. REQUIREMENTS UNDER LEGISLATION

14.1 National

14.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation. The EPBC Act provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as matters of national environmental significance. In addition, the EPBC Act confers jurisdiction over actions that have a significant impact on the environment where the actions affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency (even if that significant impact is not on one of the nine matters of 'national environmental significance').

The Northparkes Mines Step Change Project was approved with conditions under the EPBC Act in 2014 (Project Approval EPBC 2013/6788) and this Development Consent contains conditions relating to the Kokoda Biodiversity Offset Area, including the production of a BOMP for Kokoda.

14.2 New South Wales

14.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) governs land-use planning and development in NSW. The EP&A Act provides for the proper management, development and conservation of natural and artificial resources for the purpose of promoting the social and economic welfare of the community and the environment. The Act provides protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats. The Act also allows for the assessment of project applications and provides for increased opportunity for public involvement and participation in environmental planning and assessment. The EP&A Act also includes provisions for bush fire management, particularly where a Bush Fire Risk Management Plan applies or where land is mapped as a bush fire prone area.

The Northparkes Mines Step Change Project was approved with conditions under the EP&A Act in 2014 (DC11_0060), which, under condition 37, includes the requirement to include a detailed description of the measures that will be put in place for bush fire management for Kokoda. The EP&A Act is administered by the Department of Planning and Environment in NSW.

14.2.2 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NP&W Act) provides for the care, control and management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and state game reserves. In addition, the NP&W Act provides for the bush fire management in a schedule 2 amendment through providing potential exemptions from the offences of harming or picking, or damaging the habitat of, threatened species, endangered populations or endangered ecological communities when carrying out vegetation clearing work under proposed section 100R of the *Rural Fires Act 1997* (with any such exemption subject to compliance with the 10/50 Vegetation Clearing Code of Practice). The National Parks and Wildlife Act 1974 (NP&W Act) is administered by the National Parks and Wildlife Service in NSW.

14.2.3 Biodiversity Conservation Act 2016

In New South Wales, threatened species are managed under the *Biodiversity Conservation Act 2016* (BC Act), which is administered by the Department of Planning, Industry and Environment (DoPIE). The purpose of this Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act sets out a number of specific objects relating to the conservation of biological diversity and the promotion of ecologically sustainable development. Threatened species, ecological communities and key threatening processes are identified and classified by a scientific committee and are listed on the schedules of the BC Act.

14.2.4 Native Vegetation Act 2003

The *Native Vegetation Act 2003* regulates the clearing of native vegetation on land in NSW (except where exempt under Schedule 1 of the Act). The *Native Vegetation Act 2003* is administered by OEH and the Local Land Services (LLS).

14.2.5 Rural Fires Act 1997

The *Rural Fires Act 1997* (RF Act) provides for the management of the NSW rural fire service, the preparation of draft bush fire management plans, classifies bush fire prone land and outlines requirements for bush fire hazard reduction. The RF Act also outlines the requirements of bush fire environmental assessment codes and defines vegetation clearing works that can occur under the RF Act.

In relation to threatened species, the RF Act outlines under section 66 (7) a notice requiring the establishment of a fire break cannot require an occupier or owner to kill or remove any trees that are reasonably necessary for the protection of threatened species, populations, ecological communities or critical habitats within the meaning of the BC Act. Additionally, under subdivision 3 section 100c (4) bush fire hazard reduction work may be carried out on land despite any requirement for an approval, consent or other authorisation for the work make under the *Native Vegetation Act 2003*, the BC Act, the NP&W Act or any other Act or instrument made under the Act if:

a) the work is carried out in accordance with a bush fire risk management plan that applies to the land; and
b) there is a bush fire hazard reduction certificate in force in respect of the work and the work is carried out in accordance with any conditions specified in the certificate, and;
c) the work is carried out in accordance with the provisions of any bush fire code applying to the land specified in the certificate.

The RF Act is administered by the NSW Rural Fire Service.

14.2.6 Rural Fires and Environmental Assessment Legislation Amendment Act 2002

the *Rural Fires and Environmental Assessment Legislation Amendment Act 2002* amended the RF Act and EP&A Act to provide significant improvements in bush fire safety. In particular, this amendment includes requirements for bush fire prone lands (including the preparation of a bush fire prone land map identifying vegetation within local government areas that has the potential to support a bush fire), bush fire hazards and bush fire emergencies, among others.

14.2.7 Rural Fires Amendment (Vegetation Clearing) Act 2014

The Rural Fires Amendment (Vegetation Clearing) 2014 amends the RF Act to provide provisions for:

- The clearing of trees and vegetation within 10 meters of specified bush fire prone buildings; and
- The clearing of undergrowth within 50 meters of specified bush fire prone buildings.

Additionally, areas that are comply with these requirements will be known as '10/50' vegetation clearing entitlement areas and will be determined by the Rural Fire Service (RFS).

This amendment to the legislation was made to make preparing for bush fire safety easier while making sure that the environment, personal safety and landowners' rights are still protected.

14.2.8 Water Management Act 2000

The *Water Management Act 2000* is based on the concept of ecologically sustainable development – development today that will not threaten the ability of future generations to meet their needs. The Act recognises:

- the fundamental health of our rivers and groundwater systems and associated wetlands, floodplains, estuaries has to be protected
- the management of water must be integrated with other natural resources such as vegetation, soils and land

- to be properly effective, water management must be a shared responsibility between the government and the community
- water management decisions must involve consideration of environmental, social, economic, cultural and heritage aspects
- social and economic benefits to the state will result from the sustainable and efficient use of water.

The *Water Management Act 2000* is relevant to the current BFMP for potential bush fire management works that may impact on water quality in waterways such as earthworks for firebreaks etc.

14.2.9 Bushfire Environmental Assessment Code for New South Wales (2006)

The Bushfire Environmental Assessment Code (2006) (the Code) was established to provide a streamlined environmental assessment process for use by issuing authorities and certifying authorities in determining bush fire hazard reduction certificates.
It is a requirement of section 100J of the RF Act that the Commissioner, in preparing this Code, has regard to:

a) the principles of ecological sustainable development, and
b) considerations under section 111 of the EP&A Act.

The Code outlines standards for the protection of biodiversity, through the Threatened Species Hazard Reduction Map and Threatened Species Hazard Reduction List. The management actions identified within these lists must be imposed as a condition of any bush fire hazard reduction certificates issued for a piece of land.

15. REFERENCE MATERIALS

Table 10: Reference Materials

Document Title	ID No. | Year
Meat and Livestock Australia (MLA) (2016) Climate History for Mandagery. Accessed on 01/07/2016 from http://weather.mla.com.au/climate-history/nsw/mandagery	2016
Emergency Services Agency (ESA) (2014) The ACT Strategic Bushfire Management Plan 2014- 2019. Accessed on 24/06/2016 from http://esa.act.gov.au/wp-content/uploads/The-ACT-Strategic-Bushfire-Management-Plan.pdf	2014
Bureau of Meteorology (BoM) (2009) Bushfire Weather. Accessed on 1/07/2016 from http://www.bom.gov.au/weather-services/bushfire/about-bushfire-weather.shtml	2009

16. ATTACHMENTS

16.1 Appendix A - NSW Rural Fire Service standards for low intensity burn hazard reduction burning (for private landholders)

standards

for low intensity bush fire hazard reduction burning (for private landholders)

low intensity

NSW RURAL FIRE SERVICE

Table of Contents

INTRODUCTION

This document explains the best way to carry out low intensity bush fire hazard reduction burning. While most of the information outlined here relates to dry open Eucalypt forest, it can also be applied to any bush fire hazard reduction burning once you have assessed the fuel load and weather conditions.

Before you start any hazard reduction burning, you need to ensure that you have the required environmental approvals. In many cases your local NSW Rural Fire Service (RFS) Fire Control Centre will be able to issue you with a Bush Fire Hazard Reduction Certificate (which provides most of the necessary approvals) or advise you on how to obtain other approvals.

You may also be required to obtain a Fire Permit before you conduct any burning. For details of the restrictions on lighting of fires, see the RFS document *Before You Light That Fire*.

Burning of vegetation can potentially be hazardous. **Ultimately you are responsible for any fire you light and if it escapes you may be liable for the damage it causes.** Before you start you should be confident that you can carry out the burn. In some cases it may be safer and more practical for you to rake up the material and conduct a pile burn. For information on pile burns see the RFS document *Standards for Pile Burning*.

BUSH FIRE HAZARD REDUCTION BURNING

The objective of a low intensity bush fire hazard reduction burn is to minimise the potential impacts of a bush fire on life, property and the environment. Following the conditions on your Hazard Reduction Certificate and the requirements in these Standards will provide the necessary consideration of environmental and cultural heritage values.

The characteristics of a low intensity burn include:

- **Low flame heights** - Flame heights should average about one metre, but may be higher in patches of heavy or elevated fuels.
- **Low scorch height** - Scorch height should be less than five metres. Scorch height is the height to which tree leaves are killed from the heat of the fire.
- **Slow rate of spread** - The fire should spread only at a slow walking pace.

3

OBJECTIVES FOR BUSH FIRE HAZARD REDUCTION BURNING

A successful low intensity hazard reduction burn will reduce the fuel load so that it creates a safe 'defensible space' around an asset. It should also minimise the impact from the burn on the environment.

In carrying out a burn, you need to consider:

1. the fuel load and structure
2. the effects on the environment and community
3. the specific zone objectives
4. if there are adequate fire breaks and control lines
5. the season and weather conditions
6. the topography and fire behaviour
7. what lighting patterns to use
8. conducting a test burn
9. what safety measures may be needed
10. mopping up afterwards
11. if you need to report the results.

In some cases (for example, if a bush fire hazard reduction burn is intended to cover many hectares) a detailed, written burn plan may be required. If in doubt, you should contact your local RFS Fire Control Centre to see if a burn plan is needed.

STEP 1. CONSIDER BUSH FIRE FUEL LOAD AND STRUCTURE

Bush fire fuel is vegetation that will burn. The most hazardous fuels are fine fuels that will burn during the intense initial passage of the fire front. Fine fuels include the dead or dry leaf litter, grass, twigs (less than 6 mm in diameter) and bark that gathers on the ground or is suspended in the shrub layer of a bushland area.

The rate of spread and behaviour of a fire is affected by both:

- **Fuel load** - the quantity (usually expressed in tonnes per hectare of fine fuel. More fuel will give a hotter fire.
- **Fuel structure –** the arrangement of shrubs and litter fuels. Fire will spread more easily through a continuous fuel layer. Shrubs, loose bark and vines provide a ladder for fire to climb into trees.

The objective of hazard reduction is to reduce, but not totally remove, the amount of fine fuel and to modify the fuel structure. With low fine fuel loads, a fire is difficult to light or sustain (like lighting a log fire without small kindling). With less suspended fine fuel, a fire is less likely to spread into the tree canopy.

Before conducting a hazard reduction burn, consider how the fuel load will affect the fire behaviour, and whether you are capable of controlling it. In areas of high fine fuel loads, a fire will be easy to light and you will need to be sure that you have the necessary people and equipment to control the fire and maintain a low intensity. As a rule of thumb, on flat ground, doubling the fuel load will double the forward rate of spread of the fire.

For more information about fuel assessment techniques, contact your local RFS Fire Control Centre.

STEP 2. CONSIDER THE EFFECTS ON THE ENVIRONMENT AND COMMUNITY

In some cases the area that you want to burn may have particular environmental values. To minimise possible environmental damage you need to comply with any conditions listed on your Hazard Reduction Certificate.

These conditions will take into account environmental factors such as:

- the presence of threatened species or endangered ecological communities;
- the risk of soil erosion or mass movement;
- fire history and minimum fire frequency intervals for specific vegetation types;
- the location of waterbodies and waterside vegetation; and
- the effect of smoke on the local community.

The conditions on your Certificate may include measures to protect biodiversity by limiting the frequency of burns, or excluding fire from specific areas. Failure to comply with the conditions will result in fines if damage is done to the environment.

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Riverside or creek (riparian) vegetation is sensitive to fire and is important for maintaining water quality and aquatic habitat. Every effort should be made to keep fire out of these areas.

Ensuring that fires are of low intensity will protect tree canopies and any tree-dwelling animals such as koalas. Low intensity fires are often also patchy, which reduces the potential for soil erosion if significant rain falls after the burn.

The smoke produced from hazard reduction burning has the potential to impact upon other people. Weather conditions may limit smoke dispersal, causing it to linger in the area, so it is important to consider if smoke-sensitive areas such as schools, hospitals, neighbours with health concerns or nursing homes are nearby. Make sure you discuss your plans with any neighbours and occupiers of properties that may be affected by the burn.

A No Burn Notice, which may prevent hazard reduction burning, is issued on days of predicted high air pollution. Your local RFS will advise you of pollution concerns or lighting bans when you notify them 24 hours before your burn. Notification is a requirement of your approval, and ensures that people who may be affected by smoke or embers are aware of the activity and don't mistakenly report the activity as a wild fire.

To minimise the impact of smoke, burning should be restricted to daylight hours whenever possible.

Large fires near roads may produce smoke that could be a traffic hazard. There are some cases where smoke from fires has caused serious accidents. The local traffic authority (generally RTA or Council) should be contacted at least two weeks prior to a planned burn. They will determine the best way to manage the effects of smoke on traffic. Road safety measures such as signage or traffic flow controls may be required.

STEP 3. DETERMINE SPECIFIC ZONE OBJECTIVES

Local Bush Fire Risk Management Plans (prepared by local fire authorities and land management agencies) divide the landscape into four zones: Land Management Zones, Strategic Fire Advantage Zones, Asset Protection Zones and Fire Exclusion Zones. The specific objectives of your burn will depend on the zone in which the work is being conducted. The zone in which your burn is planned will be identified on your Bush Fire Hazard Reduction Certificate.

The following are examples of objectives for each zone:

ZONE	OBJECTIVES
Asset Protection Zone (APZ)	• reduce fine fuel load and structure to a level that provides a safe 'defensible space' around an asset; • reduce fine fuels within the zone to prevent a ground fire reaching the asset; and • reduce vertical structure of the fine fuels by reducing shrub fuels.
Strategic Fire Advantage Zone (SFAZ)	• reduce fine fuel load and structure to a level that provides firefighters with an area in which they have a high probability of success in containing bushfires burning within, or into, the area • reduce fine fuels by approximately 50-80% within area; and • reduce vertical structure of the fine fuels by reducing shrub fuels.
Land Management Zone (LMZ)	• provide a mosaic of areas with varying fuel load structures; • maintain or enhance biodiversity; and • provide fuel reduced areas in which firefighting suppression efforts are safer and have greater chance of success.
Fire Exclusion Zone (FEZ)	• protect fire sensitive areas such as rainforest, cultural sites, plantations and commercial crops.

STEP 4. ENSURE THAT THERE ARE ADEQUATE FIRE BREAKS AND CONTROL LINES

When planning your hazard reduction burn, it is important to think about the need for well-placed control lines and fire breaks. A control line is a planned, defined perimeter used to stop the fire escaping from the designated burn area. Control lines may be a combination of roads, earth breaks (hand or machine constructed), streams, areas that are already bare of fuels (rock shelves, green crop areas or recently burnt) or cleared land.

You should create a basic map of your plan, even if it is a sketch. This should include the location of assets, existing and proposed control lines and the proposed burn area. This will help you show your intentions to others who are helping with the burn (for guidance with burn plans, contact your local RFS Fire Control Centre).

You must establish if further work is required to make existing control lines suitable (i.e. they may require cutting back or grading). Alternately you may be required to create a control line. If doing so, be sure to take into consideration any environmental impacts that may result, particularly soil erosion.

Constructing a Control Line

To construct a control line, determine the best place for the line and clear all leaf litter and other fuel (down to mineral earth) to at least one metre wide. Control lines work best when as straight as possible, but need to be directed around trees. Try to place the control line where vegetation has already been disturbed.

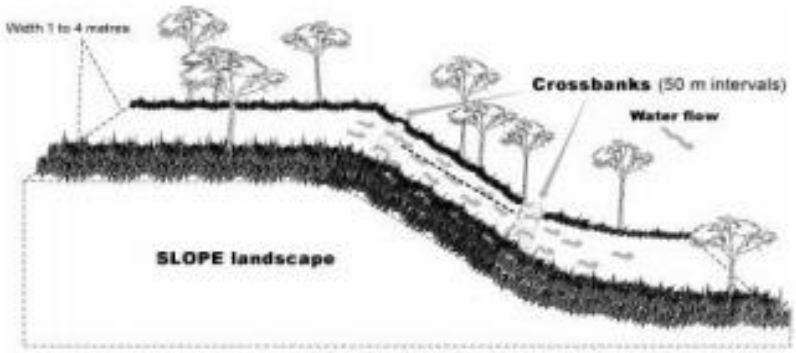
Rake the accumulated litter into the area on the side of the trail that will be burned, and spread the litter out over a wide area. Clear around the base of trees for approximately one metre and also around any large logs lying on the ground close to the control line. This will prevent the fire travelling up the trees (particularly trees with a rough bark surface or with hollows at the base). It is preferable to leave large logs unburned as they provide critical habitat for many native animals.

The width of a control line should be the minimum distance necessary to safely conduct the burn, however the width must not exceed four metres.

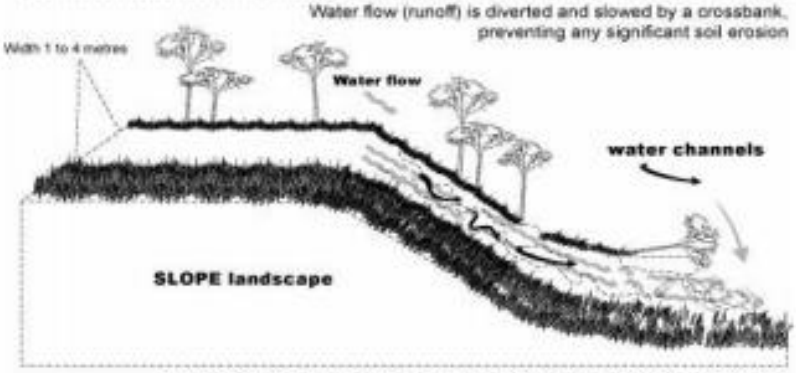
Control lines constructed down slopes (perpendicular to contours) with a width greater than one metre, require drainage structures to minimise water flow and subsequent soil erosion. There are many types of drainage structures, but the most simple to construct and possibly the most effective are crossbanks.

Crossbanks are mounds of earth that act like speed humps to slow down and divert the flow of water. Crossbanks should divert water away from the control line and onto a stable surface such as a vegetated or non-erosive surface. It is important that water flow is not diverted directly into a water course.

When drainage structures are required they should be placed at intervals of at least one every 50 metres.



Water flow (runoff) is diverted and slowed by a crossbank, preventing any significant soil erosion



Unmanaged water flow down a control line may cause significant soil erosion

Any control lines constructed for the purpose of a bush fire hazard reduction burn must be allowed to regenerate with natural vegetation following the burn.

The person responsible for bush fire hazard reduction work is responsible for its control. The law has severe penalties if a fire escapes its control lines onto your neighbour's property or into any environmentally sensitive location.

STEP 5. DETERMINE THE SEASON AND WEATHER CONDITIONS FOR A LOW INTENSITY BUSH FIRE HAZARD REDUCTION BURN

(a) Selecting the season

Selection of the right year and season to carry out hazard reduction burning is crucial to meet your fuel reduction and environmental goals, and minimise the potential for escape or re-ignition at a later date.

In southern NSW (generally from the Illawarra south) bush fire hazard reduction burning is typically conducted in autumn. Burning in late spring (after fuels have dried out sufficiently following winter rainfall) is usually avoided because there is potential for re-ignition in summer when rainfall is lowest and conditions are hot and dry. Spring burning in the south should only be carried out by, or with the assistance of, very experienced burning crews and should be avoided in years of below average rainfall.

In northern NSW (generally Sydney north, and more particularly north of the Hunter district) bush fire hazard reduction burning is generally conducted in early spring, when fuels have dried out during the usual dry winter. If fuels are sufficiently dry, a burn may also be conducted during autumn and winter. In most years, the onset of typical summer rainfall patterns reduces the potential for re-ignition during summer. Spring burning in years of below average rainfall should only be carried out by, or with the assistance of, very experienced burning crews.

(b) Selecting the appropriate day and time of the day

Fire behaviour is contolled by fuel and weather conditions. To minimise the risk of escape and to ensure calm fire behaviour, burning should be carried out when the weather conditions are suitable.

The four important weather elements for low intensity burning are:

(i) Temperature
Temperature affects the fire behaviour and moisture levels in the fuel. Ideally temperatures should be less than 25°C for low intensity burning. Temperatures are normally at a minimum early in the morning (3-4 am) and at a maximum early to mid-afternoon (2-3 pm).

(ii) Relative humidity
Relative humidity affects fire behaviour by altering fuel moisture levels. Relative humidity is usually highest overnight and lowest in the early afternoon. As a general rule, burning should only occur when the relative humidity is 50% and rising. Relative humidity forecasts and observations can be obtained from the Bureau of Meteorology website.

(iii) Wind speed and direction
Wind speed directly influences the rate of spread of the fire, thus increasing or decreasing the intensity of the burn. Wind speed usually strengthens mid-morning and reduces late evening. Low intensity burns are best carried out in wind conditions less than 15 km/h as measured in the open. The direction of the wind affects the direction in which the fire develops as well as how fast it progresses.

(iv) Atmospheric stability
To minimise the risk of escape, low intensity burning requires stable atmospheric conditions. Stable conditions are usually associated with a high-pressure system dominating the local weather pattern, with clear skies and light winds. Unfortunately a very stable atmosphere usually means that smoke will linger in the air. Rapid changes in atmospheric conditions such as unstable weather and high winds associated with the passage of a frontal system can affect the fire's behaviour.

In forest areas with deeply shaded fuels it may not be possible to burn successfully under the above weather conditions.

As an alternative, you may contact the local RFS Fire Control Centre to be given the Forest Fire Danger Index (FFDI) score and ways to measure your fuel load, to determine if the conditions are suitable to burn. An FFDI score is calculated based on all the weather elements and gives the best indication of potential fire behaviour. These scores are used for the fire danger signs. Low intensity burning should be performed when the FFDI is less than indicated in the table below.

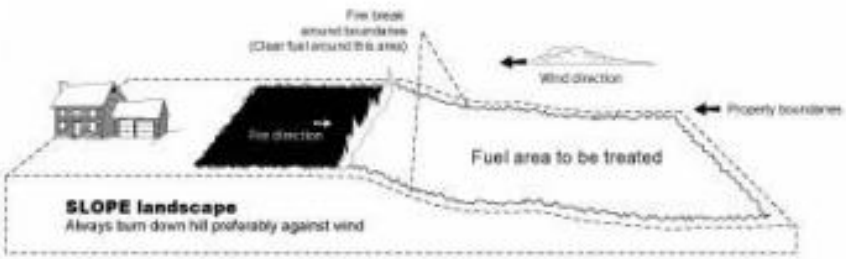
Table 1 Forest Fire Danger Index limits for low intensity bush fire hazard reduction burning.

Fuel Load (t/ha)	Forest Fire Danger Index (FFDI)						
	2	4	6	8	10	15	>15
5	burn	burn	burn	burn	burn	burn	don't
10	burn	burn	burn	burn	burn	don't	don't
15	burn	burn	burn	burn	don't	don't	don't
20	burn	burn	don't	don't	don't	don't	don't
>25	burn	don't	don't	don't	don't	don't	don't

STEP 6. CONSIDER TOPOGRAPHY AND FIRE BEHAVIOUR

- Fires burning on level ground will have a different intensity and rate of spread from a similar fire (under the same weather conditions) travelling up a slope or down a slope.
- On an uphill slope an increase of 10 degrees will cause a fire to double the rate of spread and therefore the speed of the fire. If the angle is increased to 20 degrees then the spread of the fire will be increased fourfold.
- On a downhill slope, the figures will be reversed which means the fire will travel slower. Generally fires lit for reducing a hazard should be lit at the top of a slope to burn downwards.

- The aspect or direction the fuel faces is of importance, as the fuel may be more moist on some aspects or drier on others. Generally, fuels facing west, northwest or north are exposed to longer periods of sun during the day and will be drier than those on other aspects. The dry fuels will burn more readily, increasing the potential for erratic fire behaviour.



STEP 7. LIGHTING PATTERNS

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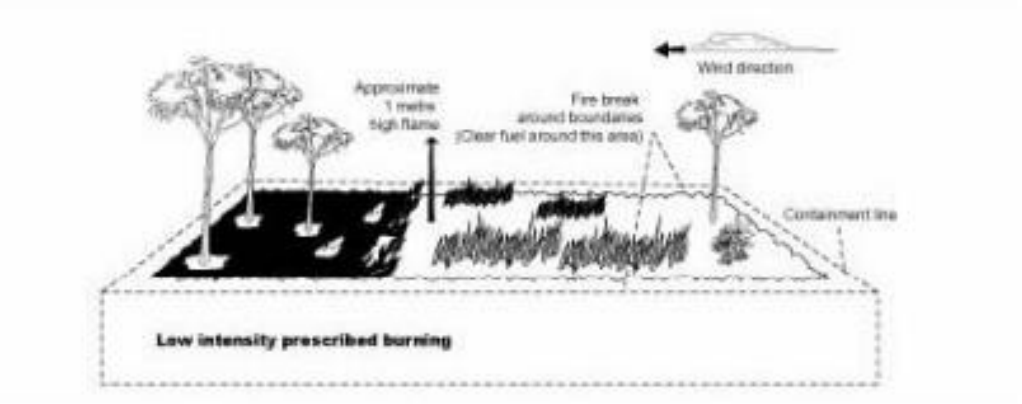
Lighting patterns strongly influence the area that will burn and the flame height generated. Different lighting patterns can be used to achieve different burn coverage, intensity and environmental controls.

The pattern of lighting a fire can also help to keep fire out of environmentally sensitive areas such as riparian vegetation (vegetation found along rivers, streams, lakes and wetlands).

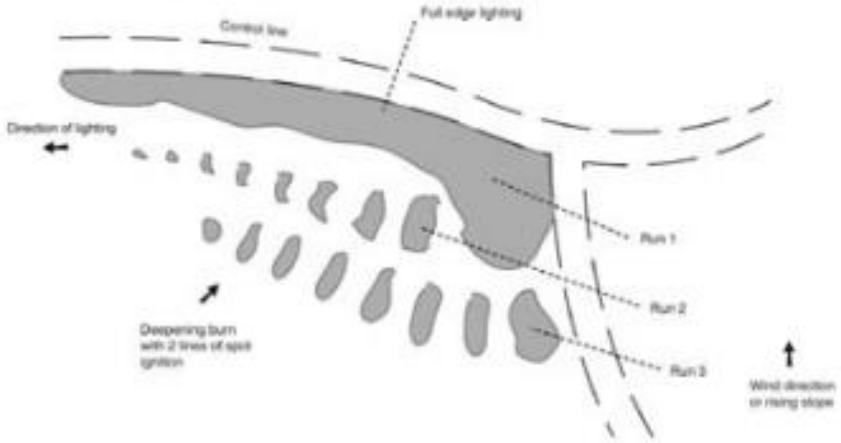
Lighting patterns to minimise environmental impacts:

- Burn when the higher parts of the topography (ridges) are drier, and the lower parts (valleys and gullies) are moist. To assess the likelihood of gully fuels burning, prior to the burning day collect gully fuel litter in the afternoon and, in a cleared area (such as the centre of a track), attempt to burn it. If fuels burn easily then burning should be delayed until rain has fallen.



- Use spot fires as they burn slower and with less intensity than a line of fire. The figure below clearly illustrates the spot lighting method.
- To minimise fire burning through stream areas, use a widely spaced spot lighting pattern (10 to 20 metres between spots) in areas adjacent to the streams, and do not light directly within any riparian vegetation or within 20 metres of the stream.

Implementing a spot ignition burning pattern for a low intensity burn:



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- Make certain that your lighting pattern ensures that no fires are lit downslope of other personnel working in the burn area.
- Ensure that all personnel are familiar with the burn plan and lighting pattern.

STEP 8. CONDUCT A TEST BURN

It is important to test that conditions are suitable before lighting your low intensity burn. There are two steps to conducting a test burn:

(a) Use the burning leaf method to determine the fuel moisture.

A sample leaf (dead) should be taken from above and below the surface of the litter layer. Sheltered from any wind, light the end of each leaf. The aim is to discover the angle at which a small flame either goes out or flares up. The diagram below provides a guide.

There should be a difference between the two leaves. If the subsurface leaves are not moister than the surface leaves, the burn should not proceed.

Leaf burns if held straight down or does not burn at all
All fuels too wet if this leaf is in the area to be burnt.
OK if only in wet area not to be burnt.

Leaf burns if angled downwards
Fine fuels from this leaf's position will only burn if on a slope or in the wind.
OK if the leaf was from the bottom of the litter in the burn area, or from a wet area not to be burnt.

Leaf burns if level
Fine fuels from this leaf's position will burn, but very slowly unless helped by wind, slope and fuel continuity.

Leaf can be angled upwards and still burns
Fine fuels from this leaf position are dry enough to burn.
OK if this leaf is from the top of the litter, risky if from the bottom.

Leaf burns if held straight up
All fine fuels are very dry and flammable. Fire will spot if windy.
DON'T BURN

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(b) Light a small test fire.

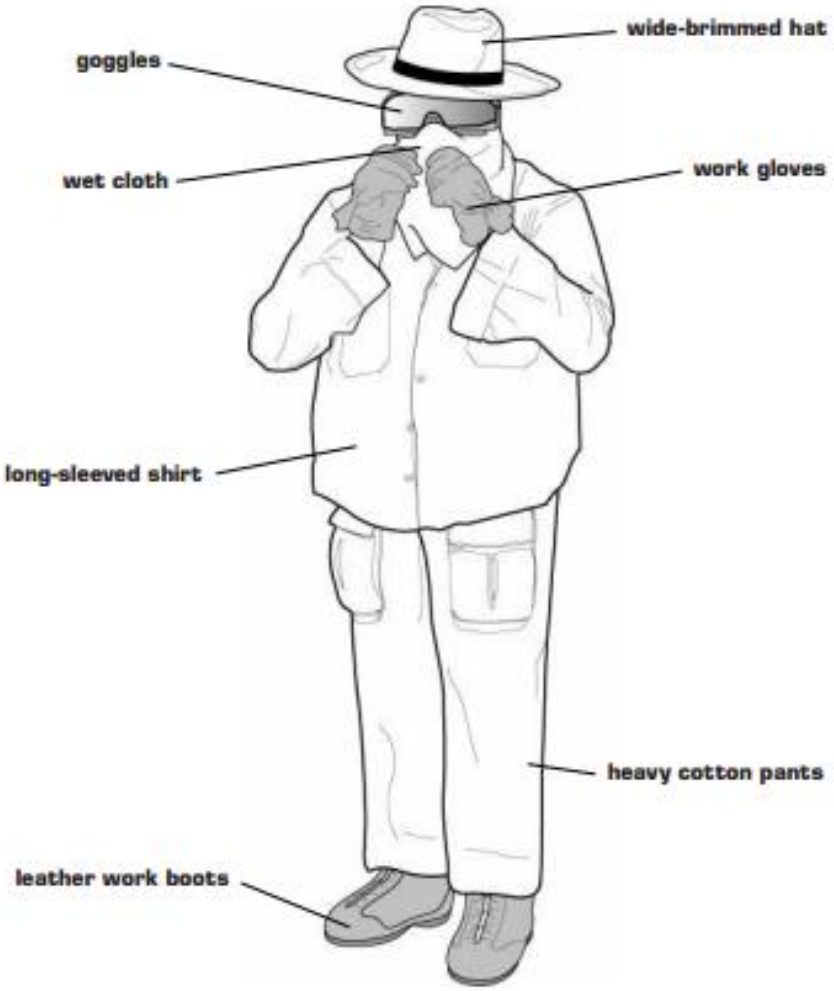
Having assessed that weather conditions are within a desirable range (Step 5), and with suppression equipment close at hand, light a test fire in a prepared area approximately five metres square on flat ground. Observe the test fire flame heights and rate of spread. If the height of flames burning in surface fuels consistently exceeds one metre, then the test fire should be immediately extinguished and your hazard reduction burn should be postponed.

STEP 9. ENSURE PERSONAL SAFETY CONSIDERATIONS ARE IMPLEMENTED

Your safety, and the safety of others assisting you during any hazard reduction burning is of utmost importance. You should discuss personal safety issues with your local RFS.

Before lighting the burn, everyone involved should consider:

- Wear natural fabrics (e.g. cotton, denim or wool). Synthetic fabrics can melt or burn.
- A long-sleeved shirt made from thick cotton or wool is ideal to prevent burns to the upper body and arms (e.g. flannelette or cotton drill work shirt).
- Sturdy leather work boots along with a pair of woollen socks prevent burns to the feet.
- A pair of heavy cotton pants will shield your legs from the radiant heat emitted from the fire (e.g. denim jeans or oil-free overalls).
- By wearing a wide-brimmed hat you can stop embers from dropping onto your head or down the back of your shirt.
- Work gloves will protect your hands.
- A good pair of goggles will safeguard your eyes against any embers and debris that may be in the air.
- Cover your nose and mouth with a wet handkerchief or piece of cloth to prevent inhalation of smoke and embers.



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Prior to burning:

- Drink plenty of water throughout the day to avoid dehydration.
- Ensure the area to be treated is clear of personnel before burning begins.
- Ensure that adequate resources are available to conduct the burn in the prevailing and expected conditions, and contain the burn to the planned area.
- Use the attached checklist to ensure you are adequately prepared to conduct the burn.

During the burn:

- Ensure the burn is monitored at appropriate times until the risk of the fire escaping the planned area, and/or trees falling across roads and trails has passed.
- Working arrangements should ensure that personnel are not working alone or out of sight of others.
- Ensure that any safety hazards are immediately reported to the person supervising the fire.

The highest risk of fire trapping people conducting a burn is when they are working within the burn area perimeter. Additional safety precautions need to be planned and implemented in such circumstances and all personnel briefed about the precautions.

STEP 10. MOP UP AND PATROL

When you have completed the burn make sure that any logs or trees that are still burning are properly extinguished. In large bush fire hazard reductions the perimeter should be extinguished to a depth of at least 10 metres from all fire edges.

You should be regularly patrolling the perimeter to ensure that there is no ignition from burning embers of unburnt areas outside the perimeter of the area being treated. Under drier conditions, the area may need patrolling for several days following the bush fire hazard reduction work.

STEP 11. REPORTING

Ensure that you report on the completion of works by returning the completion form from the Bush Fire Hazard Reduction Certificate to the address indicated on the Certificate.

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CHECKLIST FOR LOW INTENSITY HAZARD REDUCTION BURNING

PRIOR TO BURNING:
MAKE SURE YOU HAVE:

- ☐ **Obtained a Bush Fire Hazard Reduction Certificate**
- ☐ **Obtained a Fire Permit (See "Before You Light That Fire")**
- ☐ **Either :**
  - ○ Selected the appropriate season and weather conditions having considered:
    - Temperature
    - Relative humidity
    - Wind speed and direction
    - Atmospheric stability

  OR
  - ○ Contacted the RFS for a Forest Fire Danger Index (FFDI), determined your fuel load, then cross checked with Table 1 to determine whether the chosen day is suitable.

- ☐ **Made a map of burn site taking into consideration:**
  - ○ Location of assets and control lines
  - ○ Direction of fire travel
  - ○ Areas of dry and moist fuel loads
  - ○ Most appropriate lighting patterns
  - ○ Placement of personnel during burn
    - Safe escape routes
    - Safety zones

- ☐ **Established control lines around the burn area including:**
  - ○ Drainage structures if necessary
  - ○ Cleared areas under trees and around logs

- ☐ **Conducted a test burn**

- ☐ **Notified all necessary parties:**
  - ○ RFS (24 hours prior to burning) or NSWFB
  - ○ Neighbours
  - ○ RTA (if traffic control is necessary)

- ☐ **Ensured that all personnel are familiar with details of the burn plan and adequately prepared:**
  - ○ Appropriate experience
  - ○ Protective clothing
  - ○ Food and water
  - ○ Awareness of safe burning procedures and first aid

- ☐ **Considered emergency procedures:**
  - ○ Efficient communication system
  - ○ First Aid Kit

AT COMPLETION OF BURN:
HAVE YOU:

- ☐ **Extinguished all necessary burning material**
- ☐ **Returned the completion form from the Bush Fire Hazard Reduction Certificate**

HOW CAN I FIND OUT MORE?

The following documents are available from your local Fire Control Centre and from the NSW RFS website at **www.rfs.nsw.gov.au.**

- Before You Light That Fire
- Standards for Asset Protection Zones
- Standards for Pile Burning
- Application Instructions for a Bush Fire Hazard Reduction Certificate

If you require any further information please contact:

- your local NSW Rural Fire Service Fire Control Centre. Location details are available on the RFS website or
- call the NSW RFS Enquiry Line 1800 679 737 (Monday to Friday, 9am to 5pm), or
- the NSW RFS website at **www.rfs.nsw.gov.au.**

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