Final
Fire Management Plan

NATIONAL
PARKS AND
WILDLIFE
SERVICE

Goulburn River National Park
&Munghorn Gap Nature Reserve

Department of
Environment and Conservation (NSW)
NSW NATIONAL PARKS AND WILDLIFE SERVICE

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FINAL FIRE MANAGEMENT PLAN
for
GOULBURN RIVER NATIONAL PARK AND MUNGHORN GAP NATURE RESERVE

This fire management plan was placed on public exhibition from 18/10/04 to 21/11/04. Very few comments were received. All were considered outside the scope of the plan. Therefore the Draft Plan was adopted without changes.

For additional information or enquires on the management of fire in Goulburn River National Park and Munghorn Gap Nature Reserve, please visit the Mudgee Area Office at 1/160 Church Street, Mudgee NSW 2850, or telephone (02) 6372 7199 during business hours.

Erratum: Please note that this Plan was first drafted in 2002. It has had minor review to update it to 2004. Some contextual and timing inconsistencies may still exist.

This final has been approved for adoption by the

_____
Geoff Luscombe, Regional Manager, Blue Mountains Region,
NSW National Parks and Wildlife Service

And

_____
Bob Conroy, Director, Central Branch NSW National Parks and Wildlife Service

FINAL

FIRE MANAGEMENT PLAN

Goulburn River National Park and Munghorn Gap Nature Reserve

NSW National Parks and Wildlife Service
Blue Mountains Region
July 2002 with updates to September 2004

Acknowledgements

The author of this plan was Steven House, Director of Eco Logical Australia Pty Ltd in conjunction with Steve Dimitriadis and Andrew Morison, Director of Eco Logical Australia Pty Ltd. The project was managed by Dave Crust, Manager of the Mudgee Area, and Greg Lowe, Ranger for Goulburn River National Park of the Blue Mountains Region, N.S.W National Parks and Wildlife Service (NPWS). Redrafting and updating in 2004 was completed by Arthur Henry, Fire Management Officer Blue Mountains Region.

Valuable advice was provided by Ross Bradstock, Principal Research Scientist of the NPWS Biodiversity Research Group, Anthony Ferguson, Fire Officer of the Landscape Conservation Division and Pam O'Neill, Ranger, Hunter Range Area. The Mudgee, Merriwa and Rylstone Rural Fire Services provided valuable local knowledge to this plan.

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Executive Summary

Planning and consultative process

This Fire Management Plan has been developed to provide direction for fire management activities, including bushfire suppression, in Goulburn River National Park and Munghorn Gap Nature Reserve. The plan will emphasise the protection of life and property as well as providing direction for land managers in the protection of the natural and cultural heritage of Goulburn River National Park and Munghorn Gap Nature Reserve.

Research in Goulburn River National Park and Munghorn Gap Nature Reserve has recorded the presence of 22 different threatened plants and animals. This plan will deal with the protection of these species and communities through the implementation of appropriate fire management regimes to promote biodiversity.

Areas have been prioritised for fuel management treatment by assessing bush fire threat to assets, in consultation with local Bush Fire Management Committees, volunteer Rural Fire Brigades, park neighbours and other stakeholders.

The co-operation of the community will be critical to the success of the plan. Neighbours will need to manage fuels near their own assets to complement work undertaken in the reserves.

Although every effort has been made to ensure accuracy of details from existing databases, additional information is continually being collected and management concepts and practices evolving. Therefore, it is proposed that this plan will have a shelf life of five years before a review is undertaken.

Fire management objectives

In accordance with Sections 63 & 64 and Part 1, Section 3 of the *Rural Fires Act (1997)* and also in accordance with the *National Parks and Wildlife Act (1974)*, the primary objectives for fire management in Goulburn River National Park and Munghorn Gap Nature Reserve are:

- To prevent the occurrence of human caused unplanned bushfires on the reserves.
- To suppress unplanned bushfires occurring on the reserves.
- To minimise the potential for spread of bushfires on, from, or into the reserves.
- To protect from bushfires, persons and property on, or immediately adjacent to, the reserves.
- To manage bushfires to avoid the extinction of all species which are known to occur naturally within the reserves.
- To protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features known to exist within the reserves.

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Strategies for life and property protection

Community Fireguard programs will be encouraged in neighbouring areas to assist in community education relating to fire and fire preparedness. This will provide an opportunity to work with adjoining landholders and neighbouring communities to achieve fire management objectives. Suppression of unplanned fire will be given the utmost priority wherever possible. Any fire advantage provided by trails and fire breaks will be maintained regularly, particularly where they provide protection to assets, life and property.

Strategies for fire management

A system of land zoning based on fire management attributes will be implemented, in accordance with current NPWS policy. Areas with similar attributes will be grouped into zones, and each zone will have stated measurable management objectives. Currently there are two zones attached to this plan. They are the Strategic Fire Management Zone and the Land Management Zone. This system of zoning will be underwritten by a commitment to co-operative fire management involving fire management authorities and adjoining landholders/neighbours.

Strategies for heritage management

This fire plan aims to ensure that fire is managed in a manner that prevents loss or degradation of biodiversity over time. In order to achieve this a number of ecological principles will be considered and applied. These include considering and applying appropriate fire regimes for vegetation communities, giving due consideration to threatened flora and fauna response to fire, and above all applying the precautionary principle to prescribed burning.

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1 Introduction

1.1 Scope and purpose

Under the *Rural Fires Act* 1997, the National Parks and Wildlife Service (NPWS, or the Service) is a prescribed fire fighting authority and is responsible for the control and suppression of all fires on areas that it manages. This responsibility also extends to fuel management with the Service being responsible for the implementation of fuel management programmes to protect life and property. The Service may also under the Act, suppress or assist in the control and suppression of fires within eight kilometres of any land that it manages.

This Fire Management Plan fulfils NPWS responsibilities under Sections 38 s4 and 44 s3 of the *Rural Fires Act* 1997 and should be implemented accordingly.

Section 50 of the *Rural Fires Act* 1997 sets up provisions for the establishment of Bush Fire Management Committees (BFMCs) with the task of developing and co-ordinating co-operative fire management between fire authorities across the state. The Service is a member of these committees, which are responsible for the development of both co-operative fire fighting and programmes for the reduction of bushfire hazards.

Within the scope of this plan the Service is an active member of the following Bush Fire Management Committees:

- Mudgee Bush Fire Management Committee
- Rylstone Bush Fire Management Committee
- Merriwa Bush Fire Management Committee
- Muswellbrook Bush Fire Management Committee

Under Section 52 of the Rural Fires Act, each Bush Fire Management Committee is to prepare two kinds of bush fire management plans for the rural fire Region or other part of the state for which it is constituted. These plans are:

- A plan of operations, and
- A bush fire risk management plan.

This Plan has been prepared in accordance with the policies and procedures detailed in the NPWS Fire Management Manual, NPWS Strategy for Fire Management and the relevant Plan of Management. The Plan has considered the bush fire environment, bush fire risks and management strategies, prescribed burning program and priorities identified in the Sydney Basin Fire Management Strategy, and cooperative fire fighting agreements outlined in the relevant District Bush Fire Management Committee Risk Management and Operations Plans

Appendix 1 provides a glossary of terms used in this document.

1.2 Fire Management Objectives and Performance Indicators

Each fire management objective is listed below. Performance indicators complement each objective and will be used as a means of gauging the effectiveness and success of the plan. The data for the performance indicators will be obtained from performance reporting and monitoring as indicated under each objective.

OBJECTIVE 1

To prevent the occurrence of human caused unplanned fires on the reserve.

Performance Indicator

i. *On reserves with a history of unplanned fire, ignitions caused by humans are progressively reduced over the planning period.*

ii. *On reserves, with no history of unplanned fire, there is no increase in ignitions caused by humans over the planning period.*

Performance Reporting and Monitoring

- Fire causes included in wildfire situation reports by Regions.
- PARKOPS collates and analyses data and prepares NPWS performance report.

Planning Notes

- Consider causes of human induced unplanned fire ignitions eg. arson, burning off, camping, cooking, railways, powerlines, machinery etc.
- Develop bushfire prevention strategies for reducing the frequency of these fires eg surveillance, investigations, law enforcement, public education, fire bans, closures, access control etc.

OBJECTIVE 2

To suppress unplanned fires occurring on the reserve.

Performance Indicator

i. *Fires occurring on the reserve are suppressed within appropriate control lines on the reserve, safely, with minimum environmental damage and cost during the planning period.*

Performance Reporting and Monitoring

- Fire suppression response included in wildfire situation reports by Regions.

- Fire suppression and rehabilitation costs included in financial reporting system.
- Assessments of cost effectiveness included in post incident debrief.
- PARKOPS collates and analyses data and prepares NPWS performance report.

Planning Notes

- Consider ignition causes, location and frequency.
- Determine bushfire management zones.
- Identify wildfire suppression advantages.
- Identify preferred suppression strategies for bushfire management zones.
- Identify wildfire suppression resource and coordination needs.

OBJECTIVE 3

To minimise the potential for spread of wildfires on, from or into the reserve.

Performance Indicator

i. Wildfires starting in the reserve are suppressed within the reserve and fires starting outside of the reserve are prevented from entering the reserve, safely, and with minimum environmental damage and cost during the planning period.

Performance Reporting and Monitoring

- Fire origin and movement is included in wildfire situation reports by Regions.
- PARKOPS collates and analyses data and prepares NPWS performance report.

Planning Notes

- Consider ignition causes, location and frequency.
- Determine bushfire management zones.
- Identify wildfire suppression advantages.
- Identify preferred suppression strategies for bushfire management zones.
- Identify wildfire suppression resourcing and coordination needs.
- Develop strategies for preventing fires from leaving or entering the reserve.

OBJECTIVE 4

To protect from bushfires occurring on the reserve, persons and property on, or immediately adjacent to, the reserve.

Performance Indicator

i. No death or injury to persons, or destruction of property, caused by on-park bushfires in the planning period.

Performance Reporting and Monitoring

- Known, or suspected, deaths, injuries and property losses included in wildfire situation reports by Regions.
- Deaths, injuries and property losses verified in post operation analysis by Regions.
- PARKOPS collates and analyses data and prepares NPWS performance report.

Planning Notes

- Undertake a bushfire risk analysis.
- Map assets at risk.
- Determine bushfire management zones.
- Develop bushfire risk management options (fire bans, area closures, refuges, evacuation strategies, hazard reduction, siting of facilities, community education, community fireguard etc).
- Identify preferred wildfire suppression resourcing and coordination needs.

OBJECTIVE 5

To manage bushfires to avoid the extinction of all species which are known to occur naturally within the reserve.

Performance Indicators.

i. Fire regimes are maintained within specified ecological thresholds across more than 50% of the area of each plant community on the reserve.

ii. No significant decline of species populations (common or endangered) due to inappropriate fire regimes, suppression operations or other fire management works, occurs during the planning period.

Performance Reporting and Monitoring

- The perimeters and intensity of all fires, and the areas affected by suppression operations, are mapped.
- Fire regimes are mapped and evaluated in relation to ecological planning guidelines and a summary report on the state of fire regimes and biodiversity is prepared and submitted to PARKOPS annually.
- Region monitoring of the responses of common indicator species, endangered species and key habitat attributes in relation to different fire regimes is undertaken and included in its annual performance report
- Bushfire Research Unit analyses data and prepares a NPWS performance report.
- Regions regularly evaluate the effects of wildfire suppression activities and the results of rehabilitation works.
- The locations of likely future bushfire suppression operations are anticipated and ways of mitigating potential impacts evaluated before each fire season.
- Ecological guidelines are evaluated as results from monitoring and research projects are received.

Planning Notes.

- Map vegetation communities (Identify threatened flora and fauna).
- Map the occurrence of past fires.
- Determine bushfire management zones.
- Determine ecological guidelines for appropriate fire regimes.
- Map and evaluate fire regimes in relation to ecological guidelines - integrate across all management zones.
- Identify areas where fire regimes are likely to be detrimental, or could become detrimental, during the life of the plan.
- Evaluate the overall significance of inappropriate - or potentially inappropriate - fire regimes (see performance indicators above).
- Identify strategies and actions (eg fire suppression, prevention works or prescribed burning) to remedy the significant occurrence of inappropriate fire regimes. (Note: in some instances planned use of fire may be needed to create appropriate fire regimes).
- Identify rehabilitation strategies for the mitigation of adverse effects of fire suppression operations.
- Identify resources and coordination required to implement strategies.
- Implement region monitoring of indicator and endangered species responses to differing fire regimes.

OBJECTIVE 6

To protect from damage by bushfires all Aboriginal sites, historic places and culturally significant features which are known to exist within the reserve.

Performance Indicator**.**

i. No damage caused to known Aboriginal sites, historic places and culturally significant features as a result of bushfires during the planning period.

Performance Reporting and Monitoring

- Known or suspected damage included in wildfire situation reports by Regions.
- Damage verified in post operational analysis by Regions.
- PARKOPS collates and analyses data and prepares NPWS performance report.

Planning Notes

- Undertake bushfire risk analysis.
- Map assets at risk.
- Determine bushfire management zones.
- Identify hazard reduction and bushfire prevention strategies**.**
- Identify preferred wildfire suppression strategies.
- Identify rehabilitation strategies for the mitigation of the adverse effects of fire suppression operations.
- Identify resources and coordination required to implement strategies.

1.3 The Planning Context

1.3.1 Legislation

The Service has statutory obligations under the *Rural Fires Act 1997* to protect life and property on its lands and to prevent fire from leaving land vested in or under its control. Under the *National Parks and Wildlife Act 1974* the Service is empowered with the authority to conserve the natural and cultural heritage of NSW.

This authority extends to the protection of heritage off reserve and is given greater legislative backing through the *Threatened Species Conservation Act 1995*. These obligations, though not mutually exclusive, require a flexible approach to fire management.

The Service must give appropriate consideration in its fire management planning to the requirements of protection for both human life and property as well as the protection of the environment. Thus by its fire management policies the Service

must not only safeguard the direct protection of human life, it must also ensure the protection, for future generations, of the natural and cultural values of NSW.

Under the *Rural Fires Act 1997* the NPWS is a recognised Fire Authority. The Act provides for the authority to undertake appropriate measures to prevent fire from entering or leaving its parks and reserves. As a prescribed organisation the NPWS is required to implement the provisions of Bush Fire Management Plans. The Service can act to suppress fires up to eight kilometres from its reserve boundaries in collaboration with local brigades and park neighbours in accordance with provisions of local Bushfire Management Plans.

1.3.2 Management objectives of the reserve (Plan of Management)

A Plan of Management was adopted by the NPWS in 2003. The Plan requires that a Fire Management Plan be prepared for the reserves. Its three main objectives outlined for fire management in the reserves are:

- To reduce the risk of bushfire damage to life and property both within and immediately adjacent to the park.
- To effectively manage bushfires for the protection and conservation of the natural, cultural, scenic and recreational features of the park.
- To promote effective and efficient utilisation of local bushfire fighting resources through co-operative planning and operational arrangements.

The Plan of Management also recognises the importance of a co-operative approach to fire management.

1.3.3 Fire management policies of the NPWS

Service policies concerning fire and fire management include the following:

- The Service regards fire as a natural phenomenon; one of the continuing physical factors of the Australian environment.
- The Service recognises the evolutionary adaptation of many native species of plants and animals to fire regimes.
- The Service accepts that fire can be a useful management tool.
- Fire is and will be used as a fuel reducing agent where this does not conflict with management objectives.
- Where life and property are directly threatened by fuel conditions, all steps will be taken to minimise risks, with other management needs regarded as secondary considerations.

All prevention and suppression works will, where possible, be pre-planned and coordinated with neighbours and other agencies likely to be affected by Service activities. The Service will undertake fire prevention programmes, through public education and through local supervision and enforcement of the Acts and regulations applying to fires.

The Service supports the principle of co-operative approach to fire suppression to most effectively use fire-fighting resources within the community. The *NPWS Corporate Plan* identifies fire management as a priority corporate issue (fire management is covered within Priority Corporate Issue No.3: *Park and Reserve Management*).

1.3.4 Local-Regional environmental plans

Goulburn River National Park and Munghorn Gap Nature Reserve fall within four shires. Merriwa, Mudgee, and Muswellbrook are zoned under the relevant Local Environmental Plans as 8(a) National Parks and Nature Reserves which allows for activities to be carried out that are permissible under the National Parks and Wildlife Act, 1974. Rylstone Shire draft Local Environmental Plan has zoned the reserves as rural 1(a). **[SEPP No. 4 — Development without Consent allows certain types of development by public authorities without the need for formal development applications. This SEPP over-rides the requirements set out in LEP's]**. There are no Regional Environmental Plans that apply to this area.

Both reserves are administered under the National Parks and Wildlife Act, 1974. However, this fire plan recognises that adjoining Local Government Areas may have particular requirements with respect to fire management.

1.3.5 Fire management policies-regulations of involved organisations

The NPWS is represented on local Bushfire Management Committees (BFMC), including Merriwa, Mudgee, Rylstone and Muswellbrook. As required by the *Rural Fires Act 1997*, each Bush Fire Management Committee (BFMC) is to prepare and submit a Bush Fire Management Plan, comprising a Risk Management and Operational Plan, to co-ordinate the activities of organisations for the prevention, control and suppression of bush fires. All four Committees have adopted coordinated fire fighting policies based on the Policy Statement of the Coordinating Committee and the Manual of Procedures for Coordinated Fire Fighting.

The reserves are situated in close proximity to the Ulan Coal Mine, which has a policy involving the immediate suppression of all unplanned fires , as there is a risk to a range of assets such as ventilation shafts. The Ulan mine works in close co-operation with the Merriwa BFMC with respect to fire management activities.

The NSW Environmental Protection Authority (EPA) sets guidelines, which regard smoke from an activity on the property of a landholder to be classed as air pollution. Air quality in population centres can be affected by hazard reduction burning. Hazard reduction burning has been made exempt from EPA guidelines for pollution, however the NPWS will consider the effects of every hazard reduction burn on air quality and every burn plan will take smoke management into account as part of the overall planning process.

1.3.6 NSW Biodiversity Strategy

The *NSW Biodiversity Strategy (1999)* has been adopted by the New South Wales Government and develops a collaborative approach to biodiversity conservation. Its over-riding goal is: "to protect the native biological diversity of NSW and maintain ecological processes and systems".

Inappropriate fire regimes have been identified as one of the nine types of threats to biological diversity that exists within the state of New South Wales. Indeed inappropriate fire regimes are a key-threatening factor in many Australian ecosystems.

This issue is targeted within the Biodiversity Strategy by **Objective 3.4**, 'Improve fire management regimes', and requires the following priority action (no. 43), 'Manage fire in accordance with Ecologically Sustainable Development Principles'. In addition supporting actions (44 & 45) require ongoing research to be undertaken on the effects of fire on biodiversity and land management practices. The NPWS is identified as a leading organisation in the achievement of this objective. This document is intended to assist managers in achieving the above goals listed in the NSW Biodiversity Strategy.

The strategy is reflected in the NPWS Fire Management Manual, which offers a structure for fire management plans and states that:

- Fire management operations will take into account the protection of natural resources.
- The Service will collect information on the biology of native plants in relation to fire.
- Databases on the conservation requirements of species in relation to fire may be established and reviewed as new information is acquired.
- Research should provide data that will be of value in making management decisions.
- Researchers should make available the practical application of research.

2 Description of the Reserve

2.1 Location

Goulburn River National Park and Munghorn Gap Nature Reserve (the reserves) are located approximately 200 kilometres north-west of Sydney and 35 kilometres north-east of Mudgee (See map 1). The reserves are located in the Upper Hunter River Catchment, with Goulburn River NP straddling the Great Dividing Range and Munghorn Gap NR located on the western slopes.

Goulburn River NP is an area of approximately 71 050 Ha, extending in an east-west direction for approximately 70km with a variable north-south width of around 15km. Munghorn Gap NR is somewhat smaller at around 6100 Ha, with a deeply incised boundary.

The rugged lands within the reserves are generally surrounded by undulating country that has been cleared for agricultural purposes. The exception to this is the rugged plateau within Wollemi National Park, located to the south-east of the reserves.

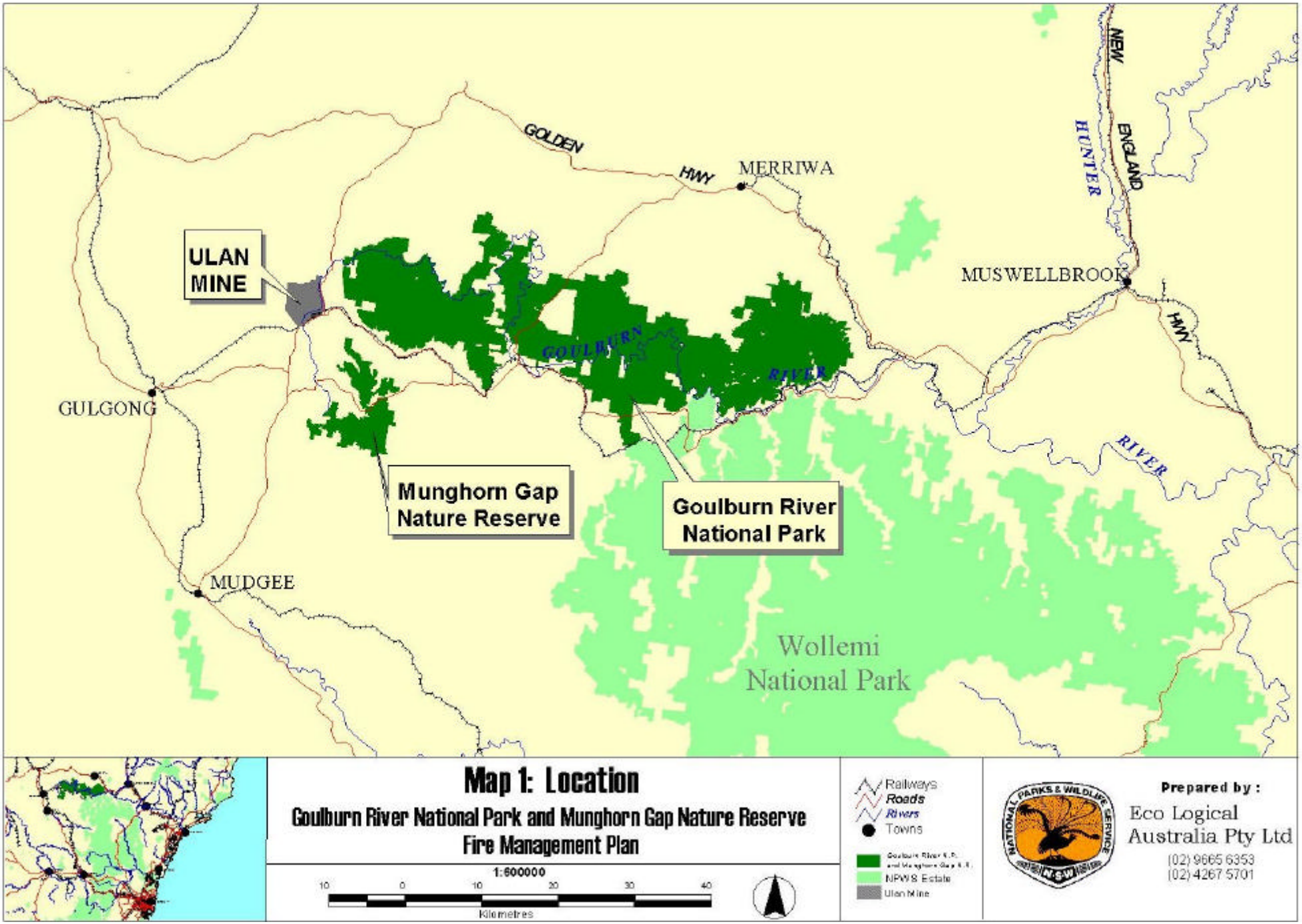
2.2 Terrain

The Reserves encompass large areas of rugged sandstone plateau. They are located within the structural geology of the Gunnedah Basin, which is a major subdivision of the Sydney Bowen Basin. The sandstone plateau has been dissected by a complex pattern of creeks that form much of the Goulburn River catchment. The creeks flow within a spectacular valley with, in many sections, sheer cliffs flanking a flat sandy riverbed. Both reserves exhibit a range in elevation with Munghorn Gap NR (406-755 metres A.S.L.) being somewhat higher than Goulburn River NP (144-674 metres A.S.L.). The rugged nature of the reserves is clearly shown in Map 2.

2.3 Biodiversity

Recent flora and fauna studies have revealed a rich diversity in species and community assemblages. A number of factors are believed to contribute to this including, variation in soils, ruggedness and climatic differences due to both a large elevation gradient and the position of the reserves relative to the Great Dividing Range. This position facilitates a mix of both coastal and western species.

A number of studies have been undertaken within the reserves. Of these 'The Fauna of Goulburn River National Park' (NPWS, 2001a) and 'Vegetation Survey for Fire Management Purposes' (NPWS, 1999) are the most notable. They include a wealth of information relating to communities, assemblages and species that are beyond the scope of this plan. The location of significant biodiversity values are identified in map 3.


ULAN MINE
GOLDEN HWY
MERRIWA
NEW ENGLAND HWY
HUNTER RIVER
MUSWELLBROOK
GOULBURN RIVER
GULGONG
Munghorn Gap Nature Reserve
Goulburn River National Park
MUDGEE
Wollemi National Park
Map 1: Location
Goulburn River National Park and Munghorn Gap Nature Reserve
Fire Management Plan
1:600000
10 0 10 20 30 40
Kilometres
Railways
Roads
Rivers
Towns
NPWS Estate
Ulan Mine
Prepared by :
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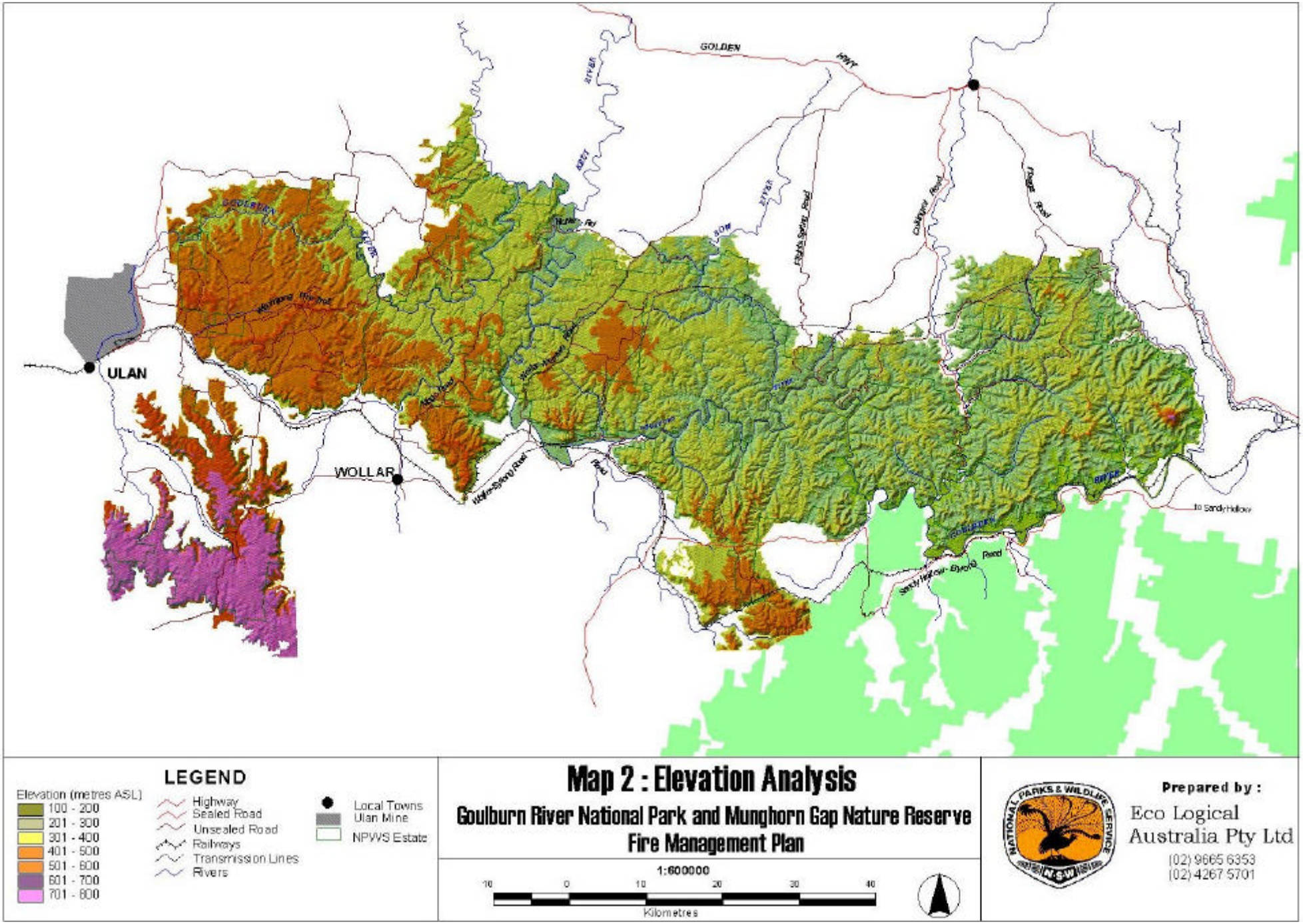

Map 2 : Elevation Analysis

Goulburn River National Park and Munghorn Gap Nature Reserve
Fire Management Plan

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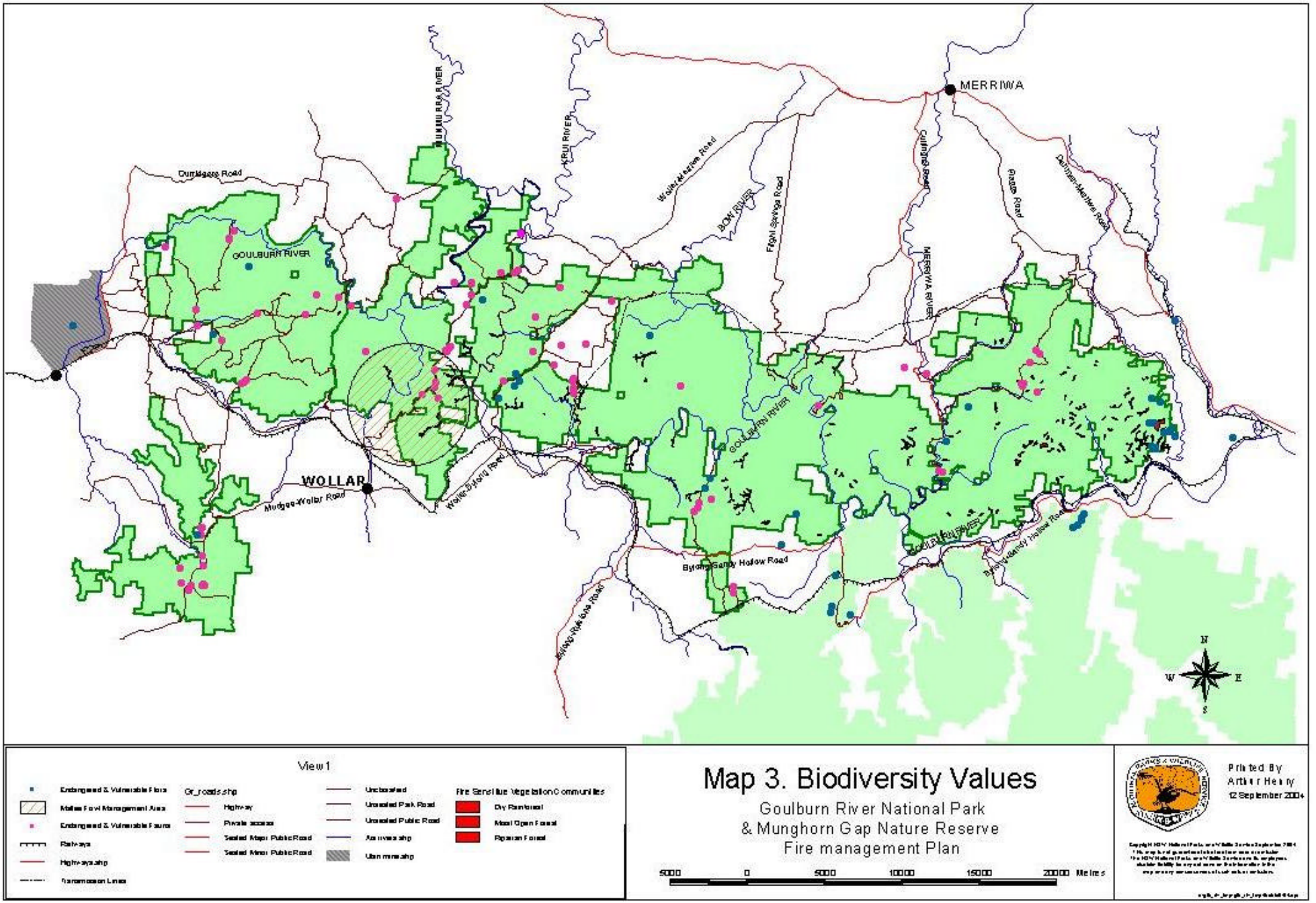
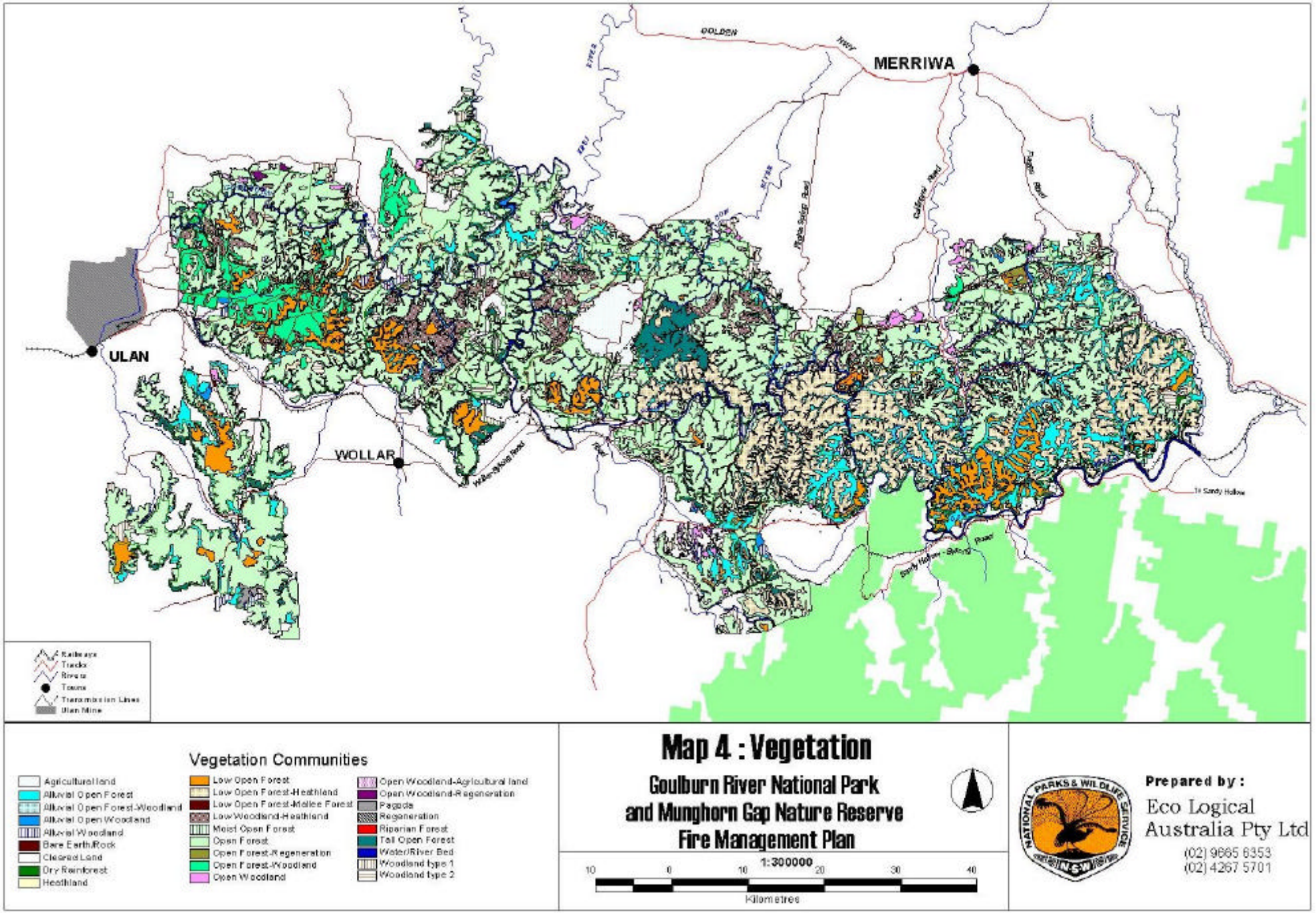


Map 3. Biodiversity Values

Goulburn River National Park
& Munghorn Gap Nature Reserve
Fire management Plan

Printed By
Arthur Healy
12 September 2004


MERRIWA
ULAN
WOLLAR
Railways
Tracks
Rivers
Towns
Transmission Lines
Ulan Mine
Vegetation Communities
Agricultural land
Alluvial Open Forest
Alluvial Open Forest-Woodland
Alluvial Open Woodland
Alluvial Woodland
Bare Earth/Rock
Cleared Land
Dry Rainforest
Heathland
Low Open Forest
Low Open Forest-Heathland
Low Open Forest-Mallee Forest
Low Woodland-Heathland
Moist Open Forest
Open Forest
Open Forest-Regeneration
Open Forest-Woodland
Open Woodland
Open Woodland-Agricultural land
Open Woodland-Regeneration
Pagoda
Regeneration
Riparian Forest
Tall Open Forest
Water/River Bed
Woodland type 1
Woodland type 2
Map 4 : Vegetation
Goulburn River National Park
and Munghorn Gap Nature Reserve
Fire Management Plan
1:300000
10 0 10 20 30 40
Kilometres
Prepared by :
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2.3.1 Flora

Records of 906 species of flora are available from vegetation surveys undertaken within the reserves. Of these 2 are listed as endangered (E1) and 5 are listed as vulnerable (V) under the NSW TSC Act (1995). A further 12 are listed as protected (P13) under the NPW Act (1964). At the time of writing the majority of this information is stored within an MS-access database held by the NPWS Central Directorate. It is not stored within the NPWS Atlas of NSW Wildlife. Of the 27 Vegetation communities listed by Hill (1999), 8 are considered to be of conservation significance, as they are either poorly or very poorly conserved on a regional scale. The location of vegetation communities found in the area is identified in map 4, see previous page.

Table 1: Threatened Flora

Scientific Name	Legal Status	Records
Cynanchum elegans	E1	2
Grevillea obtusiflora	E1	1
Homoranthus darwinioides	V	8
Kennedia retrorsa	V	9
Lasiopetalum longistamineum	V	2
Ozothamnus tessellatus	V	10
Persoonia marginata	V	3

2.3.2 Fauna

The NPWS Atlas of NSW Wildlife has a total of 268 individual species recorded within the 2 reserves. Of this 3 species are listed as endangered and 16 listed as vulnerable under the NSW TSC Act. The species are identified in Table 2 below.

Table 2: Threatened Fauna

Common Name	Scientific Name	Legal Status	Records
Malleefowl	*Leipoa ocellata*	E1	2
Regent Honeyeater	*Xanthomyza phrygia*	E1	45
Swift Parrot	*Lathamus discolor*	E1	1
Barking Owl	*Ninox connivens*	V	1
Brush-tailed Rock-wallaby	*Petrogale penicillata*	V	4
Common Bent-wing Bat	*Miniopterus schreibersii*	V	1
Eastern Cave Bat	*Vespadelus troughtoni*	V	10
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	1
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V	12
Greater Long-eared Bat	*Nyctophilus timoriensis*	V	10
Koala	*Phascolarctos cinereus*	V	4
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	9
Masked Owl	*Tyto novaehollandiae*	V	2

Painted Honeyeater	*Grantiella picta*	V	8
Pink-tailed Worm Lizard	*Aprasia parapulchella*	V	1
Powerful Owl	*Ninox strenua*	V	8
Square-tailed Kite	*Lophoictinia isura*	V	5
Squirrel Glider	*Petaurus norfolcensis*	V	1
Turquoise Parrot	*Neophema pulchella*	V	19

2.4 Cultural heritage

2.4.1 Aboriginal

The area has a wealth of Aboriginal Heritage sites with 399 known sites recorded within the Aboriginal Sites Register. Being one of the lowest points on the Great Dividing Range it is believed to have formed an important route between the coast and the Western Plains. Middens, scarred trees, burial sites and rock art have been found within the park. Fire can be a problem for the protection of Aboriginal Heritage sites because of the inadvertent destruction of grinding grooves, stone arrangements and campsites by heavy plant; and the exfoliation and blackening of art sites by smoke and heat (NPWS, 1999). Scarred trees are susceptible to intense fires.

Due to the sensitive nature of issues surrounding the locations of these sites, a map is not provided within this public document. However a map for planning and incident response purposes has been provided to the NPWS Mudgee Area office.

2.4.2 Historic

It is the aim of NPWS to conserve as many of the reserves historic places as possible. Where appropriate these sites may be used for education and research.

Kelly's Gap in the Goulburn River National Park contains a historic roadway that was constructed in 1861 as a stock and coach route between Merriwa and Mudgee. Other historic heritage includes evidence of selective logging and mining that occurred in the park between 1800 and 1970, in the form of numerous disused trails and scantling dumps. Munghorn Gap area was historically used for grazing but there is little evidence of this activity today. The rugged topography of the reserves has meant that use of the area by Europeans has been limited.

2.5 Recreational use and facilities

The reserves exhibit low to moderate recreational use with Easter being identified as the peak period. The main camping area is within Goulburn River National Park at Spring Gully with limited facilities. This area is likely to be isolated by a fire moving in from the west, however, it would also provide a safe refuge and water access point during a fire incident. Low key camping and picnic areas are found at White Box and Big River. Honeyeater Flat provides the only camping area in Munghorn Gap Nature Reserve and has limited facilities. Picnic facilities are provided at Moolarben and a short walking track leads to Castle Rocks.

Due to the large variety of bird life, ornithology groups are frequent visitors to the reserves. Day use is common in the park particularly at Lees Pinch, where a lookout, walking track and interpretative signs are available for public use. The growth in vineyards in the Mudgee area has been paralleled by a growth in tourism, this is likely to increase future recreational use of the park.

3 Bushfire Environment

3.1 Fire history and frequency

The oldest wildfire mapped within the Service's GIS was in Goulburn River National Park during the 1984/1985-fire season. No spatial fire history information is available before this time. Anecdotal evidence suggests a fire regime of one major fire approximately every 40 years. No major fires have been recorded in Munghorn Gap Nature Reserve. The extent of all recorded fires is indicated by Map 5.

3.1.1 Wildfires

In the 17 years of recorded fire history, wildfires have occurred during 5 fire seasons. By far the most extensive of these was during the 1997/1998 fire season when 23 990 Hectares were burnt. Table 3 indicates the number of hectares burnt during the recorded fire history, map 5 identifies the extent of each fire.

Anecdotally, major wildfires are believed to occur approximately every 40 years, consistent with the account of the previous major fire being in 1954, 43 years prior to the most recent large scale wildfire.

The most common cause of ignition is by lightning strikes. Humans account for some ignitions, primarily from farming machinery and sparks from trains on the Ulan railway line. Arson is not considered to be a significant issue in the area.

Table 3: Wildfire History

Fire Season	Hectares Burnt
1984/85	89
1987/88	1309
1990/91	117
1993/94	326
1997/98	23990

3.1.2 Prescribed burning

Prescribed burns were carried out during 1993-94, 1995-96 and a recent burn in 2001 (see Map 3). Approximate areas burnt during each event are identified below.

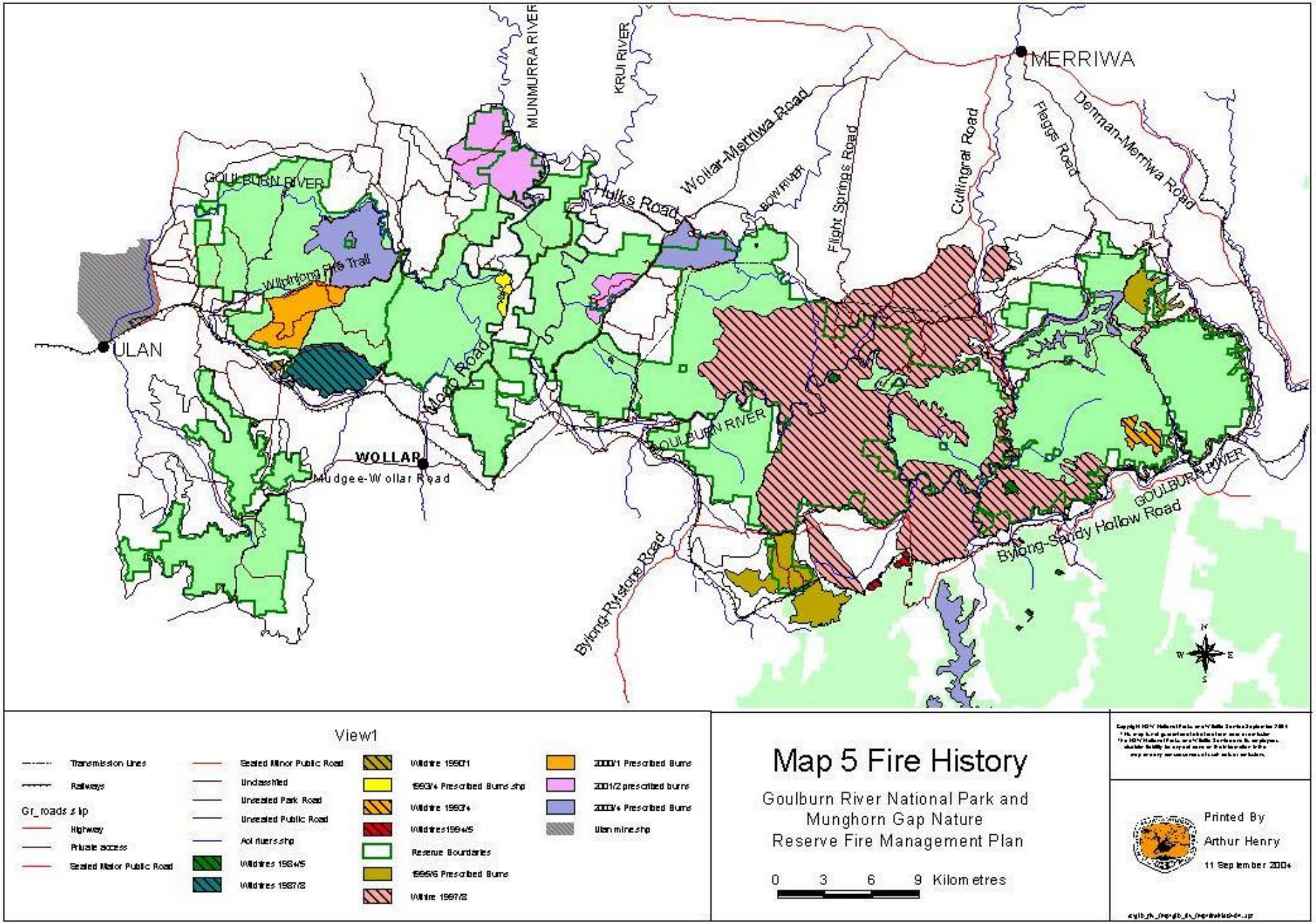

MERRIWA
MUNMURRA RIVER
KRUI RIVER
Wollar-Merriwa Road
Halks Road
BOW RIVER
Flight Springs Road
Cullingral Road
Flagge Road
Denman-Merriwa Road
GOULBURN RIVER
Wybong Fire Trail
ULAN
Moolarben Road
WOLLAR
Mudgee-Wollar Road
GOULBURN RIVER
GOULBURN RIVER
Bylong-Sandy Hollow Road
Bylong-Rylstone Road
N
W
E
S
View1
Transmission Lines
Railways
Gr_roads.shp
Highway
Private access
Sealed Minor Public Road
Sealed Minor Public Road
Unclassified
Unsealed Park Road
Unsealed Public Road
Act rivers.shp
Wildfires 1984/5
Wildfires 1987/8
Wildfire 1980/1
1993/4 Prescribed Burns.shp
Wildfire 1993/4
Wildfires1994/5
Reserve Boundaries
1995/6 Prescribed Burns
Wildfire 1997/8
2000/1 Prescribed Burns
2001/2 prescribed burns
2003/4 Prescribed Burns
Ulan mine.shp
Map 5 Fire History
Goulburn River National Park and
Munghorn Gap Nature
Reserve Fire Management Plan
0 3 6 9 Kilometres
Printed By
Arthur Henry
11 September 2004

Table 4: Prescribed Burning History

Fire Season	Hectares Burnt
1993/94	166
1995/96	2087
2000/01	1273
2001/02	3020
2002/03	40
2003/04	3050

3.1.3 Fire frequency (as at 28/8/02)

The majority of the park has not been burnt during recorded fire history. A large area of the park has been burnt once, with only two small areas having been burnt twice as shown in table 5.

Table 5: Fire Frequency Hectares

Area	No Recorded Burns (Ha)	1 Recorded Burn (Ha)	2 Recorded Burns (Ha)
Goulburn River NP	51838	18942	89
Munghorn Gap NR	6158	0	0
Inholdings	426	445	0
TOTAL	**58422**	**19387**	**89**

3.2 Fire weather

Weather appears to be the most significant factor in fire ignition and behaviour. Dry electrical storms are known to occur throughout the area at various times of the year. This provides many of the ignitions that occur throughout Goulburn River NP, Munghorn Gap NR and the nearby Wollemi NP. When such storms are preceded and followed by periods of dry hot weather the potential for wildfires increases.

Spring, summer and early autumn are known to be the most common times for the occurrence of these weather patterns.

3.2.1 Climate

Goulburn River NP experiences a climatic gradient along its east-west orientation, with Munghorn Gap NR experiencing a similar climate to that of the western end of Goulburn River NP. The eastern area of Goulburn River NP generally has a drier climate than the west, with higher monthly temperatures and greater seasonal variation in rainfall.

The western areas of Goulburn River NP and Munghorn Gap NR generally experience greater rainfall, as rainfall increases to the west due to an increase in elevation. The nearby town of Mudgee receives an average of 675.7 mm of rain each year, with the driest month of April receiving an average of 45.2 mm (BOM, 2001). Winter is the driest season in both reserves with late summer and autumn exhibiting the greatest variability in rainfall. Severe summer wildfire is of significant

concern in this area, as increased rainfall in the summer months may increase the erosion potential of the surrounding soils.

Figure 1: Mean Monthly Rainfall - Mudgee

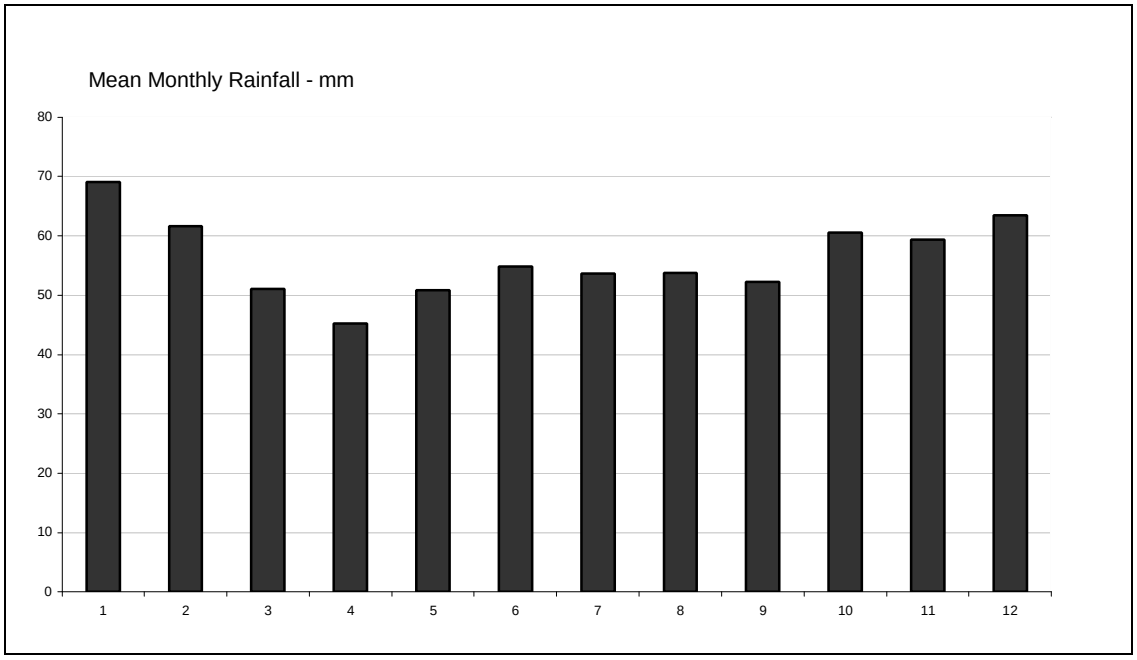
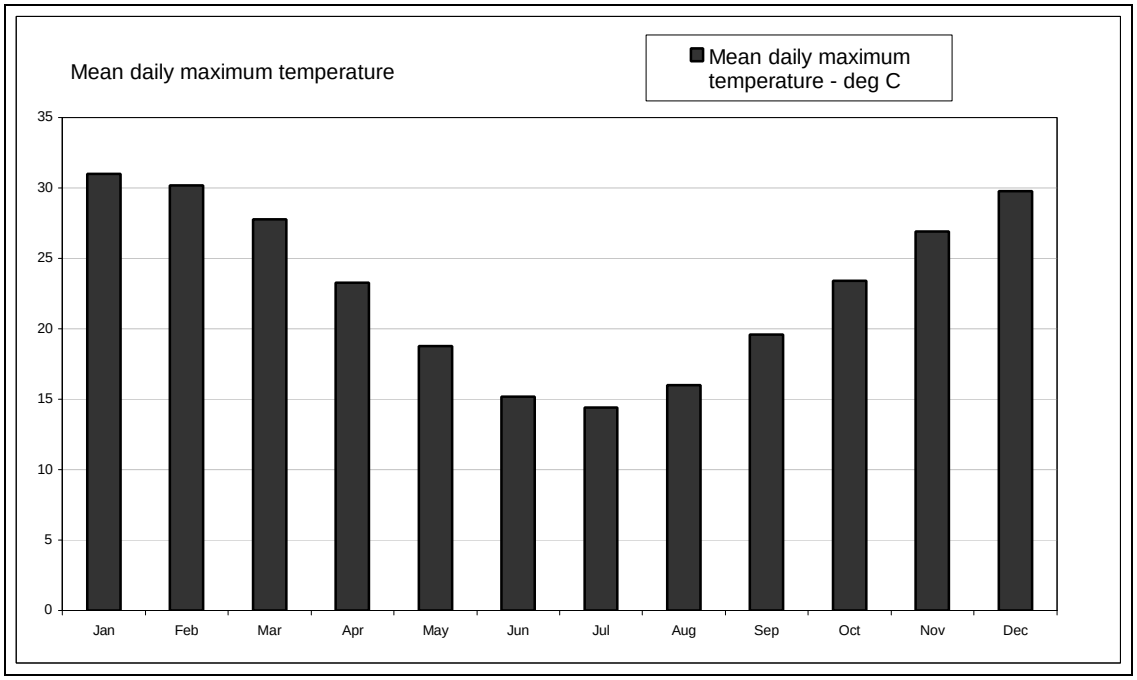


Figure 2: Mean Daily Maximum Temperature - Mudgee



3.2.2 Conditions associated with bush fires

Hot, dry weather with strong northwest winds are the conditions typically associated with bushfires within the reserves. These conditions are more common during the late spring and early summer months, particularly November and December. The nearby town of Mudgee records an average relative humidity of between 37% and 39% during these months, with wind speeds averaging 10-11km/h (BOM, 2001

figures at 1500 hrs). This time of year also coincides with periods of lowest soil moisture, as rainfall is dominant towards the end of summer.

3.2.3 Conditions suitable for prescribed burns

Generally low fuel loads within the reserves make effective prescribed burns difficult to achieve during periods of moderate fire danger. Consequently it is desirable to undertake prescribed burns during moderate to high fire danger conditions. These conditions usually occur during late spring and early autumn.

However, it is less desirable to burn during spring as this is the time of year most likely to be followed by periods of extreme fire weather and the risk of re-ignition from smouldering stags or wood dumps is high. Furthermore it is undesirable to burn during spring for ecological reasons, as it is prime breeding and nesting time for many animals and flowering time for many plants.

Early autumn burns have been recommended by Mudgee Area staff with the potential to burn as early as late February. Ideal conditions are dry and warm with winds below 20km/hr.

3.3 Fire behaviour potential

Pam O'Neill of the NPWS has modelled fire behaviour potential within the Arcview GIS system. The methodology and values assigned to input parameters are outlined below. It is important to note analysis of fire potential is a modelling process and therefore indicative only of relative fire behaviour characteristics. Map 6 identifies the relative fire potential within the reserves.

3.3.1 Introduction

The bush fire planning process requires bushfire behaviour models to be included in NPWS fire plans. Bush fire behaviour potential is a term used to describe the likely behaviour of any bushfire.

The model is based on factors known to affect bushfire intensity and rate of spread such as slope, aspect, fuel types, fuel arrangement and quantity, and weather conditions such as wind speed and humidity. The following bushfire behaviour potential model has been developed from the methodology used in "Improving Bushfire Management in Southern NSW" (Stephen Dovey, 1994, Southern Regional Fire Association).

The model is based on the probability of vegetation communities in specific terrain categories sustaining fire during a fire season (excluding extreme fire behaviour conditions).

It should be noted that the methods and classifications used for the Goulburn River NP model have been based on field observations and fire fighting experience in Goulburn River NP. The classifications should not be used as indicative classes for any other area (O'Neill, 2001).

Elevation, slope, aspect and vegetation were used as parameters to model bushfire behaviour potential. Individual parameters were numerically reclassified with higher values indicating more extreme behaviour. Reclassified GIS layers were then combined to produce a single model indicating bushfire behaviour potential.

3.3.2 Elevation

Elevation in Goulburn River National Park ranges from 144 - 674m whilst Munghorn Gap is somewhat higher ranging from 406 - 755m. For the purpose of the Wildfire Threat Analysis:

'The Digital Elevation Model (DEM) was reclassified (using the Analysis/reclassify menu) using the following classifications. A value was assigned on the basis that increasing height decreases the ability of vegetation to carry fire - moister generally.' (O'Neill, 2001).

Table 6: DEM Classification

Old Class (MSL)	New Class
0-200	2
200-400	1
400-755	0

3.3.3 Slope

'Slope was derived from the merged DEM using the Surface/derive slope function. The resulting grid was then reclassified into the following classes under the Analysis/reclassify menu. These standard classes were used to conform to the widely accepted Rural Fire Service Bushfire Risk planning process terminology (O'Neill, 2001).

Table 7: Slope

Old Class (degrees)	**New Class**	*RFS terms*
0	0	Flat
1-5	1	Level
6-15	2	Hilly
15>	3	Steep

3.3.4 Aspect

'The aspect grid was derived from the merged DEM (found under the Surface/Derive Aspect menu). The aspect was reclassified into 4 classes (under the Analysis/reclassify menu). The classes are chosen on the basis of field experience of wildfire behaviour in Goulburn River NP.

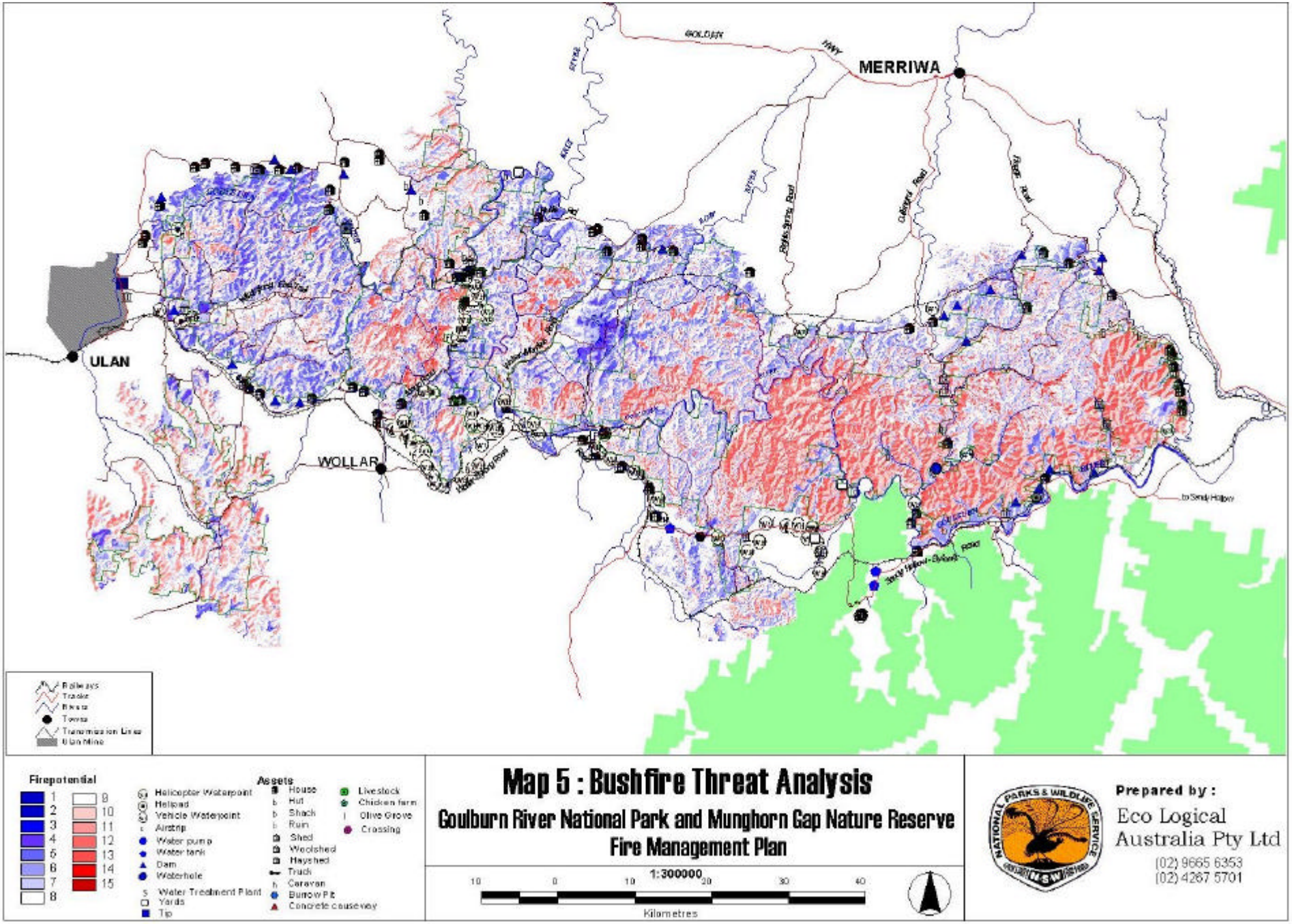

MERRIWA
ULAN
WOLLAR
Railways
Tracks
Rivers
Towns
Transmission Line
Ulan Mine
Firepotential
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Helicopter Waterpoint
Helipad
Vehicle Waterpoint
Airstrip
Water pump
Water tank
Dam
Waterhole
Water Treatment Plant
Yards
Tip
Assets
House
Hut
Shack
Ruin
Shed
Woolshed
Hayshed
Truck
Caravan
Burrow Pit
Concrete causeway
Livestock
Chicken farm
Olive Grove
Crossing
Map 5 : Bushfire Threat Analysis
Goulburn River National Park and Munghorn Gap Nature Reserve
Fire Management Plan
1:300000
10
0
10
20
30
40
Kilometres
Prepared by :
Eco Logical
Australia Pty Ltd
(02) 9665 6353
(02) 4267 5701

Table 8: Aspect

Old Class	New Class
-1	0
0	0
0-45	2
45-180	0
180-227	1
227-270	2
270-360	3

n.b: The aspect classification often requires two classifications to separate the 0, 360 and –1, as shown in the above table (O'Neill, 2001).

3.3.5 Fuel

In the absence of precise empirical data vegetation communities were used as surrogates for fuel loads.

Vegetation communities were classified into 7 classes for Goulburn River NP. Fire managers, using a visual appraisal of fuel loadings, structure, and the known volatility of differing species within a vegetation community completed the classification. This is a subjective process based on experience of fire behaviour gained in the field. Vegetation was classified into classes as follows (using the Analysis/reclassify function).

The vegetation communities were identified and described by Lisa Hill, The Vegetation of Goulburn River National Park and Munghorn Gap Nature Reserve, A Report on Vegetation Mapping and Survey for Fire Management Purposes (NPWS, 1999).

Table 9: Vegetation Communities

Code	Goulburn River NP & Munghorn Gap NR Vegetation Communities	New Value
	Urban	0
	Water	0
RPF1	River Oak Riparian Forest	1
RF1	Dry Rainforest in Sandstone Gorges	1
RF2	Dry Rainforest on Basalt	1
HF1	Herbfield on Basalt	2
RL1	Cumbungi Rushland	2
Ag	Agricultural	2
C	Cleared	2
Dist	Disturbed Lands	2
OF1	Ironbark Open Forest on Sandstone	3
AOF1	Apple Alluvial Open Forest	3
WL2	Box Woodland on Basalt	3
OF7	Callitris Open Forest	4
AOF5	Callitris Alluvial Open Forest	4
OF8	Spotted Gum Open Forest	5
WL1	Scribbly Gum Woodland	5
OF3	Slaty Gum Open Forest	5
OF4	Open Forest on Pilliga Sandstone	5
AOF2	Narrow Leaved Ironbark Alluvial Open Forest	5
OF5	Munghorn Stringbark Sheltered Open Forest	5
OF6	Munghorn Open Forest Complex	6
OF23	Exposed Open Forest on Sandstone Ridges	6
AOF3	Sheltered Open Forest Complex in Sandstone Gullies	6
AOF4	Munghorn Apple Alluvial Open Forest	6
MLF1	Mallee Open Forest on Narrabeen Conglomerate	7
HL2	Moist Heath on Perched Sands	7
HL1	Heathland on Sandstone	7
LOF1	Low Open Forest-Scrub Complex on Sandstone Plateau	7
HL3	Tea-tree Riparian Heathland	7
HL4	Pagoda Heath Complex	7

3.3.6 Analysis of likely Fire Behaviour

This analysis aims to derive a bushfire behaviour model for Goulburn River NP with the highest values in the model indicating the greatest potential to carry fire.

Aspect, slope, elevation, and vegetation were the environmental variables used to derive the bushfire behaviour model of Goulburn River NP. 25m grids were used in the modelling process. Aspect, slope, elevation and vegetation grids were reclassified and then added together to form the behaviour model. Arcview 3.2 was used for the model.

The Aspect (classes 0-3), slope (classes 0-3), elevation (classes 0-2) and vegetation (classes 0-7) were then added together using a specific mapping calculator.

The resulting Arcview theme as a 25m grid is the bushfire potential model.

The bushfire behaviour potential model is displayed on Map 6. Higher values indicate a likelihood of high intensity fires.

It is important to note that this model is indicative only and that during extreme fire events there is potential for areas that have received low values to carry extremely high intensity fires.

3.4 Damage potential

Damage potential relates to the ability of wildfire to cause damage to assets, be they structural, ecological, cultural or otherwise. Damage potential is highest where assets are in close proximity to areas of high bushfire behaviour potential, that is, areas where the most intense and least controllable fires are likely to occur. The locations of all assets within the GIS system are indicated on Map 6.

The potential for damage can be broken into three categories:

1. Damage to assets within the reserves
2. Damage to assets located in reserve 'inholdings'
3. Damage to property neighbouring the reserves

Potential for damage is discussed further in the following section.

3.4.1 Historical damage

During the 1997 fires approximately 6500 Ha of pasture was lost and 40km of fencing was destroyed. No information is available for damage caused by fire prior to this. No information is available for historical damage to natural cultural heritage assets.

Permanent vegetation monitoring sites have been established since the 1997 fires. No monitoring sites have been established for cultural heritage or threatened fauna or flora.

3.4.2 Economic

Structural assets within the reserves tend to be associated with camping and picnic grounds. Given the low number of such assets and their location within areas that have low fuel loads damage potential is considered to be low.

There are numerous in-holdings within the reserves external boundaries. Of particular concern are those within the 'No-Name' area along Mogo Road. There are dwellings and associated structures with high economic value that could be considerably damaged by wildfire. It is important to note that these areas are also the most vulnerable to loss of life. A community fire plan is in preparation for the

'No-Name' area. Infrastructure associated with the settlement including, telephone lines are particularly vulnerable to damage by fire.

Other areas of particular concern include properties along Cullingral Road and the Merriwa River. In many areas the reserves are surrounded by agricultural land. The risk of economic loss to areas neighbouring the reserves is considered to be high due to potential fire damage to fences, pasture, dwellings and other structures.

3.4.3 Natural heritage

As documented in previous sections the reserves exhibit high natural heritage values (section 2.3). The potential loss of natural heritage values and management implications are outlined in section 4.4.

3.4.4 Cultural heritage

As documented in previous sections the reserves exhibit high cultural heritage values (section 2.4). The potential loss of natural heritage values and management implications are outlined in section 4.5

4 Fire Management

4.1 Fire management zones

NPWS is currently implementing a system of land zoning based on fire management attributes. An example of an attribute that could be used is asset value, or fire hazard. Areas with similar attributes have been grouped together in zones, under the appropriate fire management regime. These zones will have stated management objectives, which can be measured over time. Management regimes can then be modified to meet targets for the zoned area to achieve effective fire management of the reserves.

4.1.1 Overview

Mudgee Area Staff have identified 2 types of zones within the reserves, see map 7. These may be added to or modified over the life of the plan.

- Strategic Fire Management Zone
- Land Management Zone

The following section identifies objectives, indicators, strategies and methods for each zone.

4.2 Standard Fire Management Objectives (ALL ZONES)

4.2.1 Performance indicators and notes:

Table 10: Standard Fire Management Objectives

Objective	Performance Indicator
1. To prevent the occurrence of human caused unplanned fire on the reserve.	There is no increase in ignitions caused by humans over the planning period.
2. To suppress unplanned fires occurring on the reserve.	Fires occurring on the reserves are suppressed within appropriate control lines on the reserves, safely, with minimum environmental damage and cost during the planning period.
3. To minimise the potential for spread of wildfires on, from or into the reserve.	Wildfires starting on the reserves are suppressed within the reserves and wildfires starting outside the reserves are prevented from entering the reserves, safely, with minimum environmental damage and cost during the planning period.
4. To protect from bushfires occurring on the reserve, person and property on, or immediately adjacent to, the reserve.	No death or injury to persons, or destruction of property, caused by on-park bushfires in the planning period.
5. To manage bushfires to avoid the extinction of all species which are known to occur naturally within the reserve.	Fire regimes are maintained within specified ecological thresholds across more than 50% of the area of each vegetation community on the reserve.
6. To protect from damage by fires all Aboriginal sites, historic places and culturally significant features know to exist within the reserve.	No damage caused to known Aboriginal sites, historic places and culturally significant features as a result of bushfires during the planning period.

In summary the achievement of life and property protection objectives will be evaluated by:

- Acceptance of the Plan by the respective Bush Fire Management Committees as complimenting their Bush Fire Management Plan.
- Provision of public education on fire prevention, preparedness and response for landowners of the study area to be undertaken in cooperation with the respective Bush Fire Management Committees.
- Maintenance of accurate fire history records and an evaluation of trends.
- Maintenance of the roads and trails within the Park to the identified standard.

The achievement of the biodiversity objectives will be evaluated by:

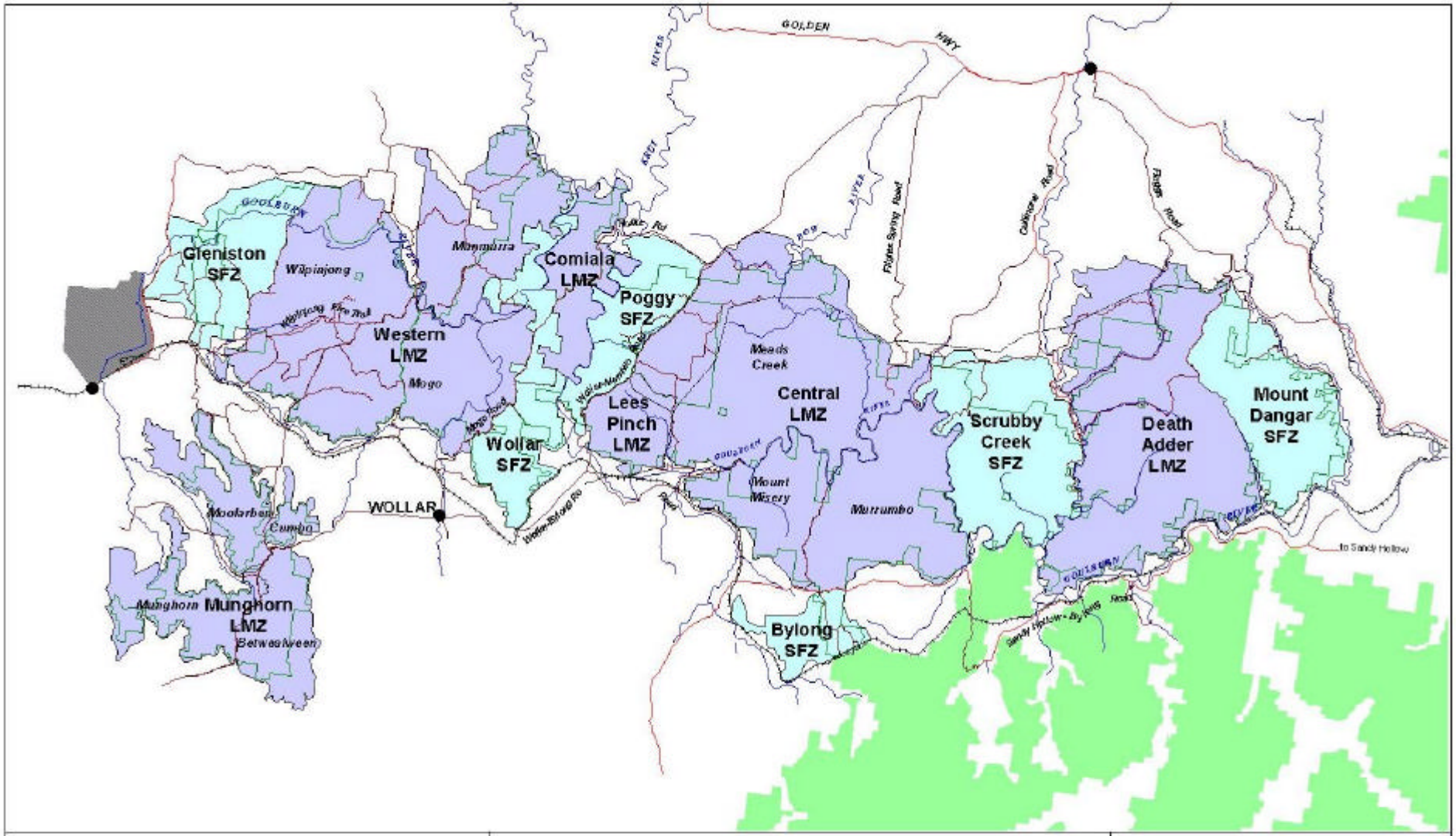
- Accurate recording of all prescribed burns and wildfires in the study area.
- Comparing fire history with the fire regime requirements identified for each zone.
- The incidence of fires in fire sensitive vegetation and locations.
- The enhancement of habitat for threatened species and an increase in the local population identified through follow up surveys.

4.3 Zone Specific Objectives and Strategies

4.3.1 SFZ - Strategic Fire Advantage Zone

Table 11: Strategic Fire Zone

Zone	Objectives	Strategies and Methods
Strategic Fire Advantage Zone	• To provide strategic areas of fire protection advantage which will reduce the speed and intensity of bushfires, and reduce the potential for spot fire development • To manage fuel levels adjacent to structures or areas used to assist fire operations. • To reduce wildfire intensity and spotting potential.	• Maintenance of tracks and trails. • Fuel managed by slashing, selective shrub clearing, and construction of radiation barriers, trail construction or burning. • Burning in areas likely to cause a breach in adjoining fire control line. • Suppress or contain wildfires inconsistent with the fire prescription/regime.


GOLDEN HWY
Gleniston SFZ
Wilpinjong
Mannamurra
Comiala LMZ
Poggy SFZ
Western LMZ
Mogo
Meads Creek
Central LMZ
Lees Pinch LMZ
Wollar SFZ
Scrubby Creek SFZ
Death Adder LMZ
Mount Dangar SFZ
Mount Misery
Murrumbo
WOLLAR
Moolarben
Cumbo
Munghorn LMZ
Bylong SFZ
Sandy Hollow - Bylong Road
to Sandy Hollow
LEGEND
Fire Management Zones
NPWS Estate
LMZ
SFZ
BYLONG SFZ - Group Zones
Mogo - Individual Zones
Towns
Ulan Mine
Rivers
Highway
Sealed Road
Unsealed Road
Railways
Transmission Lines
Map 8 : Fire Management Zones
Goulburn River National Park and Munghorn Gap Nature Reserve
Fire Management Plan
1:300000
10 0 10 20 30 40
Kilometres
Prepared by :
Eco Logical Australia Pty Ltd
(02) 9665 6353
(02) 4267 5701

4.3.2 LMZ Land Management Zone

Table 12: Land Management Zone

Zone	Objectives	Strategies and Methods
Land Management Zone	• To meet relevant land management objectives in areas where life and property are not directly at risk. • To apply fire prescriptions consistent with broad area objectives or relevant statutes • To prevent permanent damage or destruction of heritage items by an inappropriate fire regime. • To manage fire consistent with the objectives of this Plan and NPWS statutory obligations.	• Rapid detection and response by NPWS and Local Fire Brigades • Burning within vegetation community fire regime thresholds. • Suppress or contain wildfires inconsistent with the fire prescription/regime. • Maintenance of strategic tracks and trails.

4.4 Biodiversity conservation

The response of biota to fire is a key factor in managing fire within the reserves. The ecological principles that have been applied in this Fire Management Plan are outlined below, as well as an evaluation of current fire regimes, and strategies that will be applied to biodiversity conservation. It is important to note that maintaining biodiversity thresholds within the reserves is secondary to the protection of life and property. As a result there is potential for some areas to be burnt too frequently through hazard reduction burns or, in suppressing a wildfire the maximum interfire period for a vegetation community may be exceeded. These effects can be ameliorated through maintaining a mosaic of fire regimes across the distribution of a vegetation community.

4.4.1 Principles and thresholds

The aim of this plan from a biodiversity perspective is to ensure that fire is managed in a manner that prevents loss or degradation of biodiversity over time.

To achieve this the following ecological principles will be applied:

- Minimum and maximum inter-fire periods to ensure that species and communities are provided with an adequate inter-fire period to regenerate and to ensure biodiversity is not compromised through removing the regenerative stimulus provided by fire.
- Identification of habitat and communities requiring exclusion of fire (e.g. Basalt Dry Rainforest, Mallee Fowl Management Area).
- Maintenance of a diversity of fire regimes through a pattern of ‘mosaic burning’ where only a small proportion of any vegetation community is subject to the same fire regime. This ensures a variety of ages and lifecycles is present at any one time.
- Varying the inter-fire period within the minimum and maximum thresholds at any given point to ensure individual species are neither advantaged nor disadvantaged by a homogenous fire regime.
- Maintaining refuges, to aid in protecting fauna during and after fire.
- Application of the precautionary principle to prescribed burning and undertaking studies into the effects of fire on species and communities.

4.4.2 Vegetation Communities

Thresholds for minimum and maximum interfire periods were allocated to grouped vegetation communities based on recommendations by Hill (1999) and discussions with Ross Bradstock, Principal Research Scientist, Bushfire Research Unit, NPWS. These are outlined in Table 13.

Table 13: Acceptable fire regimes for vegetation communities

Fire Community	Threshold
Basalt Dry Rainforest	No fire acceptable
Basalt Woodland and Herbfield	Decline expected if successive fires occur less than 8 years apart. Decline expected if no fire occurs for more than 20 years. Vary fire regime within these thresholds across the communities' distribution.
Basalt Woodland and Herbfield - Mt Dangar and Merriwa River	Decline expected if successive fires occur less than 15 years apart. Decline expected if no fire occurs for more than 35 years. Vary fire regime within these thresholds across the communities' distribution.
Dry Sandstone Communities	Decline expected if successive fires occur less than 10 years apart. Decline expected if no fire occurs for more than 40 years. Vary fire regime within these thresholds across the communities' distribution.
Fire-Sensitive Communities	Decline expected if successive fires occur less than 50 years apart. Decline expected if no fire occurs for more than 100 years. Vary fire regime within these thresholds across the communities' distribution.
Permian Forest	Decline expected if successive fires occur less than 10 years apart. Decline expected if no fire occurs for more than 40 years. Vary fire regime within these thresholds across the communities' distribution.
Sandstone Dry Rainforest	Decline expected if successive fires occur less than 50 years apart. Decline expected if no fire occurs for more than 100 years. Vary fire regime within these thresholds across the communities' distribution.
Scrubby Complexes	Decline expected if successive fires occur less than 10 years apart. Decline expected if no fire occurs for more than 40 years. Vary fire regime within these thresholds across the communities' distribution.
Sheltered/Alluvial Sandstone Communities	Decline expected if successive fires occur less than 10 years apart. Decline expected if no fire occurs for more than 40 years. Vary fire regime within these thresholds across the communities' distribution.
Western Sandstone Woodland	Decline expected if successive fires occur less than 10 years apart. Decline expected if no fire occurs for more than 40 years. Vary fire regime within these thresholds across the communities' distribution.

4.4.3 Threatened Flora

Threatened flora species (listed in Table 1) known to occur within the parks, were assessed by Ross Bradstock. There is a lack of information relating to the response of individual species to fire. Maintaining fire regimes within the thresholds indicated for relevant vegetation communities is believed to be the most appropriate way to manage individual species, until further information is available. Research into the response of species to fire including mortality and regeneration in relation to different fire regimes is recommended.

4.4.4 Threatened Fauna

Threatened fauna species known to occur within the parks were assessed by Ross Bradstock, and fire management recommendations for key fauna species contained within the report 'The Fauna of Goulburn River National Park' (NPWS, 2001a) have been adopted. Where species specific information is not available the recommendation is to maintain fire thresholds as recommended for vegetation communities. Management recommendations are outlined in the table below.

Table 14: Fauna fire management Recommendations

Common Name	Vegetation Community	Recommendations
Mallee fowl	Ironbark Open Forest on Sandstone	**Exclude** fire within a 3km buffer of Mallee Fowl records.
Regent Honeyeater	River Oak Riparian Forest, Slaty Gum Open Forest, Low Open Forest-Scrub Complex, White and Grey Box Woodlands.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Swift Parrot	Sclerophyll forests and open woodlands.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Barking Owl	Ironbark Open Forest on Sandstone, Scribbly Gum Woodland	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Brush-tailed Rock-wallaby	Ironbark Open Forest on Sandstone	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Common Bent-wing Bat	Apple Alluvial Open Forest, Sheltered Open Forest Complex	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Eastern Cave Bat	Sheltered Open Forest Complex, Ironbark Open Forest on Sandstone	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Eastern False Pipistrelle	Tree Hollows in high Rainfall Forests, Caves.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Glossy Black-Cockatoo	Sheltered Open Forest Complex, Ironbark Open Forest on Sandstone, Exposed Open Woodland.	**Prescribed** burns should involve the investigation of areas of proposed burns to identify, map and exclude significant stands

		of *Allocasuarina.*
Greater Long-eared Bat	Apple Alluvial Open Forest, Sheltered Open Forest Complex, Ironbark Open Forest on Sandstone, Scribbly Gum Woodland	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Koala	Predominantly Dry Sclerophyll forest, Woodland.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Large-eared Pied Bat	Roosts in caves, mine tunnels and abandoned Fairy Martin nests in well wooded areas.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Masked Owl	Ironbark Open Forest on Sandstone	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Painted Honeyeater	Woodland and Open Forest.	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Pink-tailed Worm Lizard	Ironbark Open Forest on Sandstone	**Exclude** fire from recorded site until further investigations have been undertaken.
Powerful Owl	Sheltered Open Forest Complex, Ironbark Open Forest on Sandstone	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.
Square-tailed Kite	Sheltered Open Forest Complex, Ironbark Open Forest on Sandstone	Consider low-intensity hazard reduction burning to reduce fuel loadings adjacent to visitor facilities and avoid the risk of high intensity fire escapes near recorded sightings.
Squirrel Glider	Apple Alluvial Open Forest	One location within the reserves. Fire to be **excluded** from this location until further information becomes available.
Turquoise Parrot	Apple Alluvial Open Forest, Ironbark Open Forest on Sandstone, Slaty Gum Forest, White and Grey Box Woodland	Maintain recommended fire thresholds for vegetation communities. Vary fire regime within desirable thresholds across the distribution of each community.

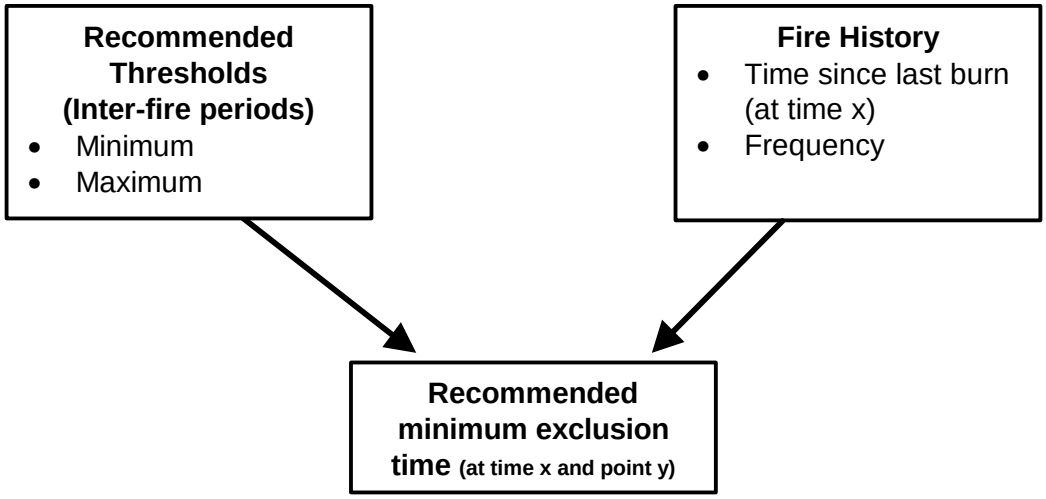
4.4.5 Evaluation of current fire regimes

An evaluation of fire history in relation to recommended vegetation community and individual species fire regimes indicates that all areas within the reserves are currently within preferred thresholds. Only two small areas have been burnt twice since records are available (1984), with the inter-fire period being within the thresholds for the vegetation communities. This information will need to be re-assessed annually as fire history is updated.

4.4.6 Fire regime strategies for biodiversity conservation

Analysis of fire history in relation to the recommended interfire periods for vegetation communities and significant fauna species was used to determine preferred fire regimes spatially across the reserves. This analysis provides a snapshot in time in relation to the preferred fire regime at the end of the 2000/2001 fire season. Clearly as fire history changes with time ie. additional areas are burnt or the interfire period increases through a lack of burning at any given location this analysis will need to be undertaken to reflect these changes. The following flowchart broadly identifies the relationship between recommended thresholds and fire history in determining the preferred fire regimes at any given location. The results of this analysis are presented in Map 8.

Flowchart 1: Assessment Method



The potential outcomes from this analysis can be summarised as follows:

1. The fire history is <u>currently</u> within the preferred thresholds
    - Exclude fire from locations where minimum interfire periods would be exceeded by burning.
    - Burn areas where maximum interfire periods are approaching.
    - Where burning or not burning would still remain within recommended thresholds consider initiating a program of mosaic management, burning a small proportion of the landscape and ensuring a variety of ages are present at any one time.

2. The minimum interfire period has been exceeded by burning too frequently
    - Exclude further fire from these locations, undertaking studies, rehabilitation if required

3. The maximum interfire period has been exceeded by not burning frequently enough.
    - Undertake a land management burn if deemed to be appropriate

The preferred fire regimes at the end of the 2000/01 fire season have been included in map 8.

4.5 Aboriginal heritage

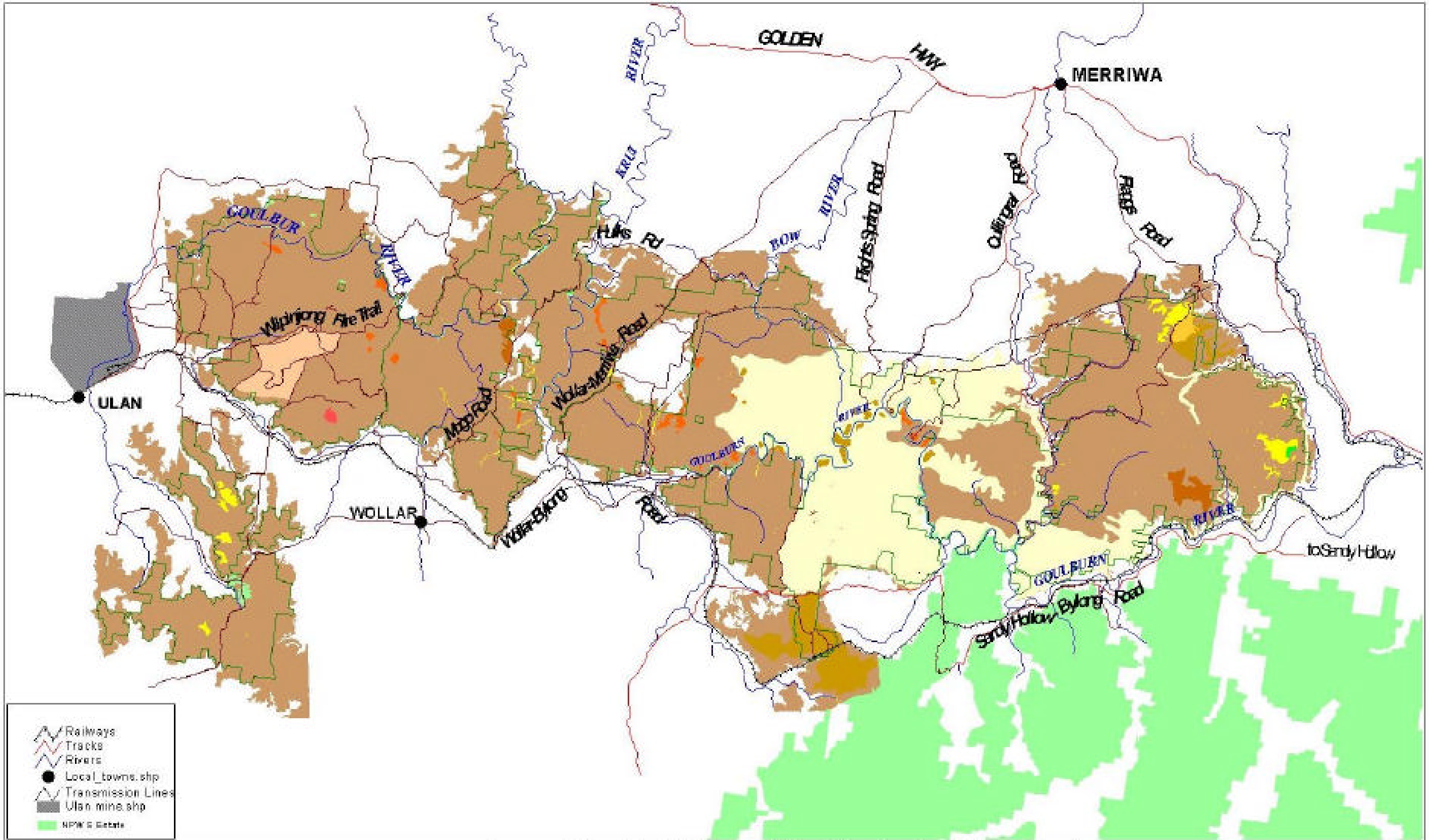
It is recognised that Aboriginal Heritage items may be affected by hazard reduction activities, wildfire and wildfire suppression activities. Table 15 outlines recommended strategies to minimise damage (NPWS, no date).

Table 15: Protection of Aboriginal Heritage sites

Heritage Item	Strategy
Scarred and carved trees.	All fuel should be cleared from around trees. Clearly mark trees prior to any control lines being placed.
Stone arrangements, ceremonial rings, rock engravings, rock art, grinding grooves.	Fuel must be cleared from in, on and around all identified stone/rock sites. Move fuel from rock shelters containing art.
Burials, artefact scatters, middens.	Clearly define and mark sites wherever possible. Control line planning must avoid (and attempt to protect) all Aboriginal sites whenever possible.
Flora of Cultural significance.	Consultation required.
Natural features of cultural significance.	Consultation required.

While the NPWS presently has legal responsibility for the protection of Aboriginal sites it acknowledges the right of Aboriginal people to make decisions about their own heritage. It is therefore policy that Aboriginal communities be consulted about decisions regarding the management of Aboriginal sites and related issues and how the Aboriginal culture and history of an area controlled by the NPWS will be promoted and presented.

Wildfire can permanently damage Aboriginal sites such as carved trees and art sites. Aboriginal sites can also be damaged by fire fighting equipment, particularly heavy earth moving equipment, burning itself and smoke. Procedures for the use of earth moving equipment are detailed in the NPWS Fire Management Manual. It states that, where possible, existing fire trails and/or control lines will be used during prescribed burning operations or wildfire suppression. Should construction works be required, the Aboriginal Sites Register maintained by NPWS will be used as a reference guide to avoid damage to any sites. Consultation will be undertaken with the Aboriginal Land Council prior to any hazard reduction activity.



Prescription
- Burn - by 2004
- Burn - by 2008
- Exclude - Always
- Exclude - until at least 2002
- Exclude - until at least 2004
- Exclude - until at least 2006
- Exclude - until at least 2008
- Exclude - until at least 2011
- Exclude - until at least 2046
- Exclude - until at least 2048
- Mosiac burning, 10 - 40 year c
- Mosiac burning, 15 - 35 year c

Map 7 : Minimum Fire Exclusion Time

Goulburn River National Park and Munghorn Gap Nature Reserve Fire Management Plan

1:300000

10 0 10 20 30 40

Kilometres

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Consultation should be considered for the following activities:

- Fire management planning
- Hazard reduction burn planning
- Identification of sites and places during fire fighting planning wherever possible
- Identification of Aboriginal Heritage that is present in the area under fire management planning

If possible, sites in HR burn areas should be inspected following a burn in order to analyse the effectiveness of the measures taken.

4.6 Historic heritage

NPWS aims to conserve as wide a range of historic places as possible within these reserves and to utilise those places and the relics within them for education and non-destructive research where appropriate.

Fire management burns will be planned having considered the conservation of any historic heritage values within the proposed burn area.

In particular, the Kellys Gap stock and coach route between Merriwa and Mudgee may be at risk from earthworks associated with placement of fire control lines or mechanical fire suppression, rather than from damage to the structure from fire itself.

Consideration will be given to protection of historic heritage items in the planning phase of all fire suppression and hazard reduction activities.

4.7 Operational guidelines

NPWS use the incident control system (ICS), which is based on the Australian Inter-Agency Incident Management System (AIIMS). This system ensures that there is a common method for developing and maintaining chains of command, spheres of responsibility and language usage across agencies prior to a fire incident occurring.

4.7.1 Unplanned Fires

The priorities of NPWS in wildfire suppression are:

- the safety of all incident personnel
- the effective protection of human life and community assets
- the conservation of biodiversity and cultural heritage
- the cost effectiveness of strategies
- the achievement of community support.

Wildfire suppression response will be determined via incident appreciation and situation analysis. Wildfire suppression strategies may include any combination of reconnaissance, direct - parallel - indirect attack, defence, mop-up and patrol appropriate to the situation and approved by the Incident Controller.

Wherever possible:

- existing built and natural fire advantages will be used instead of construction of new control lines
- existing tracks will be used for temporary access for firefighting vehicles and the construction of new trails avoided
- the use of heavy earthmoving equipment for construction of control lines will be avoided. Hand-tool lines, air blowers or slashers will be preferentially employed
- if the use of heavy earthmoving equipment is necessary, where-ever possible side cutting will be avoided. A NPWS approved operator should be used and construction work should be under the direct supervision of a NPWS officer at all times.
- trail routes for the construction of new access will be planned to avoid environmentally sensitive areas, visibility impacts and to minimise soil instability.
- access into remote areas for personnel and equipment will be by aircraft in preference to new fire trail construction.
- backburning and burning out will be the minimum necessary to achieve wildfire suppression objectives.
- backburning will be conducted in such a way that the danger of the fire escaping pre-determined boundaries is minimised and the safety of personnel is ensured.

During unplanned fire events, the NPWS will work with the Mudgee, Rylstone and Merriwa Bushfire Management Committees and Rural Fire Service, Police and other authorities, as well as neighbours to protect life and property. This may involve closing down of park use areas and facilities to park visitors, and may also include park evacuation and closure.

4.7.2 Hazard Reduction

Prescribed burns that will be undertaken within the reserves will require consultation with the community as well as with local rural fire service authorities. Once this has been achieved, the creation of a burn plan is necessary. This burn plan will outline the objectives for the prescribed burn, as well as the type of fire behaviour that will be required. Objectives should relate to biodiversity management as well as fuel management.

A burn plan should include the following:

- Identification of lines of command and responsibilities of individual personnel.
- Identification of dangers and hazards to personnel and actions to recognise, avoid and/or mitigate them.
- Identification of escape routes and refuge points should control of the fire be lost.
- Identification of communication resources and protocols.
- Identification of assets that will be affected by the burn.
- Strategies to protect assets.
- Identification of control strategies for any potential escapes that are identified.

- Identification of any other hazards that are present and outlining of mitigation measures.
- Identification prescriptions for hazard reduction. Prescriptions should include details of fine fuel moisture content, weather, fire behaviour, methods and patterns of ignition, forward rate of spread and nature of control lines.
- Time of year.

4.7.3 Public Welfare and Safety

Proper notification to the public must be given for any proposed hazard reduction burning activity. NPWS Fire Management policy requires that each region maintain a register of contact details for reserve neighbours. Direct notification should be provided to the landholders directly affected by the activity – i.e. neighbours adjacent to the part of the reserve that will be burnt. Furthermore, details of co-operative arrangements with neighbours and other agencies (including utility providers) should be listed in any incident procedure documentation (with neighbours' approval). Wherever possible the NPWS should keep neighbours well informed of the fire situation during fire suppression (NPWS, 2001b). Wider public notification should take place through local print media and NPWS offices, with regards to time, date, road closures and duration of the burn. All burn areas must be thoroughly inspected prior to ignition, and should include details such as locations of powerlines, railway lines etc. Post fire safety checks should be conducted during and after 'mop-up' and any closures that may be necessary should be approved and advertised *in situ* and through local media as soon as possible**.**

4.7.4 Smoke management

The EPA considers that any smoke that leaves the property of a landholder and causes annoyance to others to be pollution. However, smoke from hazard reduction burns is given exemption by the EPA. Smoke is likely to temporarily increase local air pollution, and create a visual impact. This is mitigated by choice of day with weather conditions that will minimize direction of smoke travel. During hazard reduction burning or wildfires, there may be a need to close roads or restrict traffic. This may require the involvement of the Police.

4.7.5 Guidelines for cooperative fire fighting arrangements

The NPWS is committed to cooperative fire fighting in order to maximise the effectiveness of the fire management resources within the area. The Service will actively participate in the Mudgee, Rylstone and Merriwa Bushfire Management Committees. Detailed policies and procedures are included in each BFMC's Operations Plan covering cooperative fire management and first response arrangements.

5 Fire management assets

5.1 Fire management access

The national park has an extensive network of trails that are used by the Service for fire management and other operational activities. The following criteria has been used as a basis for assessing the suitability of trails for fire management:

- Track orientation.
- Known fire paths.
- History of fire regime.
- Proximity to assets at risk.
- Potential effectiveness as a fire control line.

Table 16. Trail classification system.

Class	Type	Description
1	Road or trail with fire break	Existing formed road used for regular traffic; or a maintained trail which has slashed area alongside
2	Maintained trail	A trail regularly maintained for vehicular access
3	Non-maintained trail	A trail which is not maintained permitting 4wd vehicular access
4	Slashed route	A trail that is maintained by slashing only
5	Closed or rehabilitated trail, or previous control line	A trail not in use, but the line of the trail is distinguishable, and can be re-opened for fire control purposes
6	Maintained handtool line	A track maintained as a narrow fire break for fire management purposes only
7	Walking track	A track maintained for bushwalking only
8	Negotiable route	An uncleared route where a control line can be constructed for fire suppression operations

Table 17 details designated fire trails, as well as public roads that dissect the reserves. Some private roads that provide fire access to the Park are also included. Distances are for sections within or adjacent to the reserves

Table 17. Goulburn River and Munghorn Gap Trails

Name	Km	Class	FMU
Big River Track	2	2	Comiala
Bonnies FT	2	5	Munghorn
Bow River FT	5	5	Meads Creek
Bylong Sandy Hollow Rd	60	1	Bylong, Murrumbo
Castle Rocks FT	8	2	Betwealween
Comiala Property Track	4	3	Comiala
Cullingral Rd	10	1 & 3	Scrubby Creek, Death Adder
Death Adder Rock FT	17	2	Death Adder
Double Arrow Track	2	3	Wollar
Drummers Flat	2	3	Murrumbo
Duggans Track	5	3	Scrubby Creek
Durridgere Rd	5	1	Gleniston, Wilpinjong
Eckfords Crk Track	4	3	Mount Dangar, Death Adder
Flaggs Rd	15	1	Mount Dangar
Hopewood FT	3	2	Munmurra
Horse Gully FT	7	2	Mount Dangar
Hulks Rd	5	1	Poggy

Kelly's Gap FT	3	2	Comiala
Merriwa River FT	6	2/3	Scrubby Creek, Death Adder
Millers FT	10	2	Wilpinjong
Mogo Rd	17	1	Mogo, Mogo Road
Moolarben Rd	5	1	Munghorn
Morrisons Flat FT	8	2	Murrumbo
Mudgee - Casilis Rd	10	1	Gleniston
Mudgee - Wollar Rd	10	1	Munghorn, Cumbo, Moolarben, Betwealween
Munmurra Link Track	6	2	Munmurra
Oil Bore Track	3	3	Meads Creek
Parsons Gully FT	8	2	Scrubby Creek
Poggy South	4	3	Lees Pinch
Policemans FT	4	2	Scrubby Creek, Meads Creek
Sandy Hollow - Bylong Rd	30	1	Bylong, Murrumbo
Sleepers FT	6	2	Wilpinjong, Mogo
Spring Gully Rd	6	2	Comiala
Thompson Flat FT	4	2	Comiala
Trig Track	3	7	Munghorn
Railway Tunnel FT	4	2	Bylong
Ulan - Wollar Rd	22	1	Gleniston, Wilpinjong, Mogo
Valances Arm FT	10	2	Death Adder
White Box Camp Rd	1	2	Poggy
Wilpinjong FT	12	2	Wilpinjong
Wollar- Merriwa Rd	15	1	Lees Pinch, Poggy, Meads Creek
Worondi Creek Rd	11	1	Mount Dangar

A management road and fire trail database will also be maintained in order to keep track of location, condition and infrastructure available within the reserves. Inter agency access procedures for roads and trails are outlined in the *Road and Trail Access Conditions for other Agencies: Standard Operating Procedures*, and *Specifications for Fire Roads and Trails: Standard Operating Procedures* detailed in the NPWS Fire Management Manual.

5.2 Fire management utilities

Fire management utilities includes infrastructure that assists in the detection and control of wildfires, and assists in fire management operations. Utilities include fire towers, dams and maintained watering points, and helipads. Fire trails, roads, dams and helipads for management of the Park are displayed in Map 6.

Fire equipment is a NPWS shared resource across the state. The following table outlines the fire management utilities and equipment available to the Blue Mountains Region for fire management activities in the reserves. It should be noted that additional NPWS equipment can be sourced from across the state.

Table 18: Utilities and other equipment available for fire management in the reserves.

Infrastructure	No	Location
Control Centres	5	NPWS Mudgee Rural Fire Service Merriwa, Mudgee, Muswellbrook and Rylstone
AVIATION		
Heli Base Unit Trailer	2	Bulga Blackheath

BOUYWALLS	2	Rylstone Bulga
ARMS SOFTWARE		
(GPS and Laptop)	1	Mudgee
COMMUNICATIONS		
VHS Radio System		All vehicles and personal hand helds
AIRBAND VHF		Mudgee
	1	
EARTH MOVING EQUIPMENT		
Bulldozer Caterpillar D4H	1	NPWS works depots – Rylstone/Coolah (subject to availability)
Bogie Tipper	2	
Skid steer loader Mustang	1	
4WD Tractor Case with FEL	1	
INCENDIARY EQUIPMENT		
Min. 5000 stock	1	Mudgee, Rylstone
FIRE EQUIPMENT		
Tanker 1500 L	1	Coolah
Strikers - 450 l		Rylstone, Coolah, Mudgee
Tanker 3000l`	5	
		Rylstone
	1	

5.3 Fire management facilities

The Mudgee Area of the NPWS has a fire operations room at the Mudgee Office equipped with radio, remote weather monitoring equipment, telecommunications and maps. Fire management facilities are also available at RFS Control Centres in Merriwa, Mudgee and Rylstone. Other facilities are detailed in each districts Bush Fire Management Operations Plan and annual NPWS Regional Incident Procedures.

6 Works schedule

All works activities on NPWS parks and reserves outlined in this fire management plan will be subject to environmental assessment via a review of environmental factors (REF), where appropriate and as outlined by Part 5 of the *Environmental Planning and Assessment Act, 1979*.

6.1 Biodiversity works schedule

6.1.1 Fire management research

There is a need to continue further research to provide details where deficiencies in knowledge occur in understanding how to manage and conserve biodiversity within the reserves. Briefly these are:

1) Knowledge of animal fire responses, particularly the lower vertebrates and invertebrates, especially in relation to habitat characteristics.
2) A basis for classifying the responses of animals to fire as a function of life-history attributes.
3) A basis for predicting the long-term responses of animal populations to fire regimes, not just a single fire.
4) A better understanding of the requirements for refuge, post fire dispersal and recolonisation of animal species which are depleted by fires in the short-term with a view to defining the thresholds of fire size and shape needed for conservation.

Fire management research and monitoring requirements for consideration include:

- Establishment of permanent sites for the monitoring of the response of biota and landscape processes to the fire regimes of the reserves. The program should include the monitoring of ecotones so as to measure the rate of expansion or reduction of the size of vegetation communities. At least two sites are to be established per vegetation community per zone.

- On-going analysis of trends shown by fire ignition point data and wildfire paths to determine further site specific fire prevention and mitigation strategies.

- Compilation of locally prepared fuel accumulation curves for the major vegetation communities of the study area.

- Evaluation of the need to burn the localities where fire frequency appears to be less than the guidelines for fire regimes.

- Research into the life history and response to fire on individual species of flora and fauna.

- More detailed evaluation of the fire regime and recovery plan requirements of the threatened species identified within the reserves.

The National Parks and Wildlife Service Research Section will design an appropriate monitoring system to manage the above research projects. The Mudgee Area staff will assist by providing staff and resources to implement the projects.

6.1.2 Fire mapping and database management

Using a Geographical Information System (GIS), fires will be mapped as they occur within the reserves. This will allow large amounts of data related to fire regimes, including fire frequency and thresholds, to be processed quickly and made available for reporting. Where mapping of large areas is required, the use of remote sensing techniques may be utilised.

The database will also store information on assets, ecological and cultural heritage values. Fire regimes will be assessed before the beginning of each fire season.

6.1.3 Monitoring fuel

It is aimed to conduct pre and post fuel reduction activities using the visual assessment technique outlined in Morris (1997), and the eventual establishment of permanent fuel monitoring sites throughout the reserves.

It is intended that future fuel sampling in the reserves will follow the objectives listed below:

- Determine the accumulation rate and distribution of fuel in selected fuel types according to age since last fire.
- Allow the prioritisation of prescription burns.
- Measure the effectiveness of prescription burns.

6.1.4 Monitoring fire regimes and changes to biodiversity

To enable continued refinement and improvement of management guidelines for all zones a greater level of information is required. Research conducted in the following areas would assist in improving the management of fire and the natural and cultural values of the reserves:

- Development of models for predicting the long term responses of plant and animal populations to identified fire regimes.
- Improvement in knowledge of propagule longevity for plants especially obligate seed regenerators.
- Improvement in knowledge of animal refuge, post-fire dispersal and recolonisation requirements to determine the spatial patterns of fire required for conservation.
- Temporal vegetation regeneration following prescribed burns.
- Soil erosion following fires.
- Correlation of weather and fire behaviour.

The Area will aim to actively seek interest in the above research areas from scientists and tertiary students.

6.2 Operations Works Schedule

The operations work schedule consists of a prescribed burning schedule and a schedule for infrastructure works. Priorities for prescribed burning works are indicated on a Fire Management Unit basis. Actual boundaries for burn blocks will be determined by field inspection and consultation with neighbours, the Rural Fire Service and other relevant stakeholders. The timing is indicative only and will be dependant on a variety of factors including weather and seasonal conditions

6.2.1 Prescribed burning of bushfire zones

Table 19: Prescribed Burning of Bushfire Zones

Fire Management Unit / Zone	Priority	When	Completed
Bylong SFZ	Low	2007	
Wollar SFZ	Moderate	2006	
Gleniston SFZ	Moderate	2009	
Mount Dangar SFZ	Moderate	2006	
Mogo Road SFZ	High	2007	
Poggy SFZ	High	2002-4	Poggy & Tongo HRs 2002 & 2004
Scrubby Creek SFZ	Low	2009	
Mogo LMZ	Low	2009	
Wilpinjong LMZ	Low	2001-2005	Pear Hill east & Wilpinjong Hrs 2001 & 2004. Pear Hill West in 2005.
Munmurra LMZ	Low	2002	Munmurra Hr
Comiala LMZ	Low	2008	
Meads Creek LMZ	Very Low	Tba	
Lees Pinch LMZ	Low	2005	
Mount Misery LMZ	Very Low	2008	
Murrumbo LMZ	Very Low	Tba	
Death Adder LMZ	Low	2004-5	Death Adder HR edges completed 2004
Moolarben LMZ	Low	2010	
Cumbo LMZ	Low	Tba	
Munghorn LMZ	Low	2007	
Betwealween LMZ	Low	2009	

6.2.2 Infrastructure Works Schedule

Table 20: Infrastructure Works Schedule

Infrastructure, trail or area to be treated	Class	Works to be conducted	Scheduled completion period or maintanence period
Public access roads	1	Regular inspection, clear drains and fallen timber. Regular grading including attention to drainage and surface	Monthly Annual
Fire Trails	2	Regular inspection, clear timber and vegetation, check drainage. Grade and reform drainage	Bimonthly Biannual
Slashed routes	4	Slash and clear	6 months

Plan administration

6.3 Management of works

Works programmed for the next five years will be incorporated into regional operation plans, including those of the Bushfire Management Committees. This will include comprehensive risk assessment plans. An appointed fire management officer will be responsible for monitoring the performance of the works, and for producing an annual report on the works schedule, which will be submitted for review to the regional manager.

6.4 Plan review

This plan is designed to have a currency of 5 years. As scientific findings related to conservation values and response to fire are dynamic and ongoing, there may be a need to incorporate information and research findings into the management of the reserves. This will follow the necessary EIA procedures.

Plan review will include assessment of the following indicators:

- Loss of life and/or property attributable to on park fire or fire suppression work.
- Number of reported incidents of arson in the park.
- Fires occurring in the park are suppressed within existing control lines, in a safe manner and with minimum environmental damage and cost.
- Fires with ignition points within the reserves are contained within the boundaries of the reserve, and fires with ignition points outside the reserves are prevented from entering the reserve in a safe manner and with minimum environmental damage and cost.
- Fire regimes are maintained within specified ecological thresholds, across a specified percentage of area for each plant community in the park.
- No significant decline in species population occurs as a result of fire management activities or inappropriate fire regimes.
- There is no damage to sites of Aboriginal and historic significance as a result of fire management activities.

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Personal Comments

Stephen Dovey (1994), Southern Regional Fire Association.

APPENDIX 1

DEFINITIONS AND PRINCIPLES

Most definitions described below come from the Australian Fire Authorities Council (AFAC) ***Glossary of Rural Fire Terminology*** *(March 1996).*

Aerial Detection The discovering, locating and reporting of fires from aircraft.

Aerial Fuels The standing and supporting of combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, bark and creepers.

Aspect The direction towards which a slope faces, eg north-east. Slopes on a west to north-westerly aspect are the most hazardous during fire fighting operations.

Assets at Risk The natural resources or improvements that may be jeopardised if a fire occurs. Examples include: threatened species habitat, rainforests, forestry coups, human built structures or infrastructures, park information signs, transmission poles etc. and may also include scenic values. For the fire manager it may also include natural values that may be threatened by a fire (eg water catchment quality).

Backburning A fire started intentionally along the inner edge of a fireline to consume the fuel in the path of a wildfire.

Buffer A strip or block of land on which the fuels are reduced to provide protection to surrounding lands.

Burning Programme All the prescribed burns scheduled for a designated area over a nominated period of time.

Bush Fire Management Unit (FMU) Management areas of a variable size that define containment blocks in the event of a wildfire. Can also be designated as areas of specific ecosystem types defined by management authorities in order to monitor the long term effects of fire upon those areas.

Bush Fire Management Zone (BFMZ) Management areas where a specified fire management operational objective, strategy and performance indicator has been developed to mitigate against the threat of a wildfire.

Byram-Keetch Drought Index (BKDI) A numerical value reflecting the dryness of soils, deep forest litter, logs and living vegetation, and expressed as a scale from 0 - 200 points. When 100 points has been reached in an area, that area is said to be in drought.

Coarse Fuels Dead woody material, greater than 25mm in diameter, in contact with the soil surface (fallen trees and branches).

Controlled Burning *see Prescribed Burning*.

Crown Fire A fire burning in the crowns of trees and usually supported by fire in ground fuels. It is a fast travelling fire that usually consumes all available fuels in its path.

Drought Index A numerical value, such as the Byram-Keetch Drought Index, reflecting the dryness of soils, deep forest litter, logs and living vegetation.

Ecosystem The interacting system of a biological community, both plant and animal, and its non living surroundings.

Edge Burning A term used to describe perimeter burning of an area in mild conditions prior to large scale prescribed burning. This practice is used to strengthen buffers and to reduce mop-up operations.

Fine Fuels Grass, leaves, bark and twigs less than 6mm in diameter.

Fire The chemical reaction between fuel, oxygen and heat. Heat is necessary to start the reaction and once ignited, fire produces its own heat and becomes self-supporting. Removal of any one of the three elements of fuel, oxygen and heat will extinguish a fire.

Fire Behaviour The manner in which a fire reacts to the variables of fuel, weather and topography. Changes in any of these variables with result in a change in the fires behaviour.

Fire Break Any natural or constructed discontinuity in a fuel bed used to segregate, stop and control the spread of a wildfire, or to provide a fireline from which to suppress a fire.

Fire Extent The area burnt by a wildfire, measured in hectares. Within that area there will be "islands" of unburnt vegetation (these islands are generally included in the total fire extent).
NB: it is preferable that fire effect only part of a vegetation community at any one time so that nearby areas of more mature plants may provide a seed source for recolonisation and animals will have suitable unburnt habitat in order to seek shelter and to forage.

Fire Front The part of a fire where the rate of spread, flame height and intensity are greatest, usually when burning downwind or upslope.

Fire Intensity The rate of energy released per unit length of fire front. This is usually expressed as kilowatts per metre (kW/m).

Fire Management All activities associated with the management of fire-prone land, including the use of fire to meet land management goals and objectives.

Fire Perimeter The entire outer boundary of a fire area.

Fire Regime The history of fire in a particular vegetation type or area including the frequency, intensity and season of burning (season in this context refers to the time of the year in which the fire occurred). It may also include proposals for the use of fire in a given area.

Fire Season The period(s) of the year during which fires are likely to occur, spread and do sufficient damage to warrant organised fire control. In New

	South Wales the core fire season is from 1st October to the 31st March of the following year. *At the regional scale, the season may be introduced or extended by one month dependant upon the prevailing weather conditions, drought indexes and number of wildfire's that may already be burning within that area.*
Fire Storm	Violent convection caused by a large continuous area of intense fire; often characterised by destructively violent surface indrafts, a towering convection column, long distance spotting, and sometimes by tornado-like whirlwinds.
Flame Height	The vertical distance between the tip of the flame and ground level, excluding higher flame flashes. Expressed in vertical metres.
Fuel	Any material such as grass, bark, leaf litter and living vegetation, which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare of dry weight.
Fuel Arrangement	A general term referring to the spacing and arrangement of fuel in a given area.
Fuel Load	The oven dry weight of fuel per unit area. Commonly expressed as tonnes per hectare.
Fuel Bed	The arrangement and vertical profile of all readily combustible materials lying on the ground.
Fuel Management	Modification of fuels by prescribed burning, manual removal, slashing, grazing, or other means. The objective is to reduce the fuel thereby reducing the risk posed by wildfires.
Fuel Type	An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause predictable rate of spread or difficulty of control under specified weather conditions.
Habitat	A physical portion of the environment that is inhabited by an organism or population of organisms. A habitat is characterised by a relative uniformity of the physical environment and fairly close interaction of all the biological species involved. *Organisms within the given habitat will express a level of co-dependancy upon one-another. The loss of the physical characteristics of a given habitat can have sever and long term detrimental effects upon the organisms living in that habitat.*
Hazard Reduction	*see Fuel Management*
Island	An unburnt area within a fire perimeter. Islands are critical for species survival and recruitment after a wildfire event.
NPWS	The National Parks and Wildlife Service of New South Wales.
NSWFB	The New South Wales Fire Brigades.

Prescribed Burning The controlled application of fire under specified environmental and weather conditions to a predetermined area and at the time, intensity, and rate of spread required to attain planned resource management objectives.

RFS The Rural Fire Service.

Rate of Spread The forward progress per unit time of the head of the fire or another specified part of the fire perimeter.

Service, the The National Parks and Wildlife Service of New South Wales.

SF State Forests of New South Wales.

Scorch Height The height above ground level up to where foliage has been browned by a fire. This height is roughly ten times the actual flame height of the fire.

Slip-on Unit A fire fighting unit that can be placed on to the back of a four-wheel drive vehicle to convert it to a fire tanker.
Depending upon the unit's water carrying capacity, a four-wheel drive tray top vehicle could be converted to Category 2,7 or 9 fire tanker in a very short space of time.

Spot Fire Isolated fires started ahead of the main fire by sparks, embers or other ignited material, sometimes to a distance of several kilometres.

Striker A small four-wheel drive fire tanker capable of carrying from 400 to 600 litres of water for fire fighting purposes. Also known as a Category 9 Fire Tanker.

Structure Fire A fire burning part, or all of any building, shelter, or other human made construction.

Tanker A mobile firefighting vehicle equipped with a water tank, pump, and the necessary equipment for spraying water and/or foam on wildfires.
Under NSW Dept. of Rural Fire Service guidelines, bushfire fighting tankers have been designated into nine 'Categories' delineating water carrying capacity and whether the unit is two or four wheel drive capable.

Topography The surface features of a particular area or region, ie the lay of the land, and includes mountains, rivers etc.

Unplanned Fire *see Wildfire*

Urban/Rural Interface The line, area, or zone where structures and other human development adjoin or overlaps with undeveloped bushland. Also known as the urban/bush interface, urban interface or just the interface.

Wildfire An unplanned fire. A generic term which includes grass fires, forest fires and scrub fires.

APPENDIX 2 Fire Zone Specifications

Zone	Sub-Zone (if applicable)	Suppression Objective	Prevention & Mitigation Objectives	Strategies (Methods)	Width	Comments
Asset Protection	*at present no sub-zones*	to protect residential areas, crops, plantations, utilities, camping areas, day use areas, urban interface, cultural heritage assets, etc.	to instigate, where appropriate, community education and community fireguard programmes	el managed by slashing, selective shrub clearing, construction of radiation barriers, trail construction or burning	Use Planning for Bush Fire Protection (DBFS, 1991) as a guide	should operate in conjunction with Community Fireguard
Strategic Fire Management	Strategic Wildfire Control	to assist in the strategic control and containment o wildfires to reduce wildfire intensity and spotting intensity	promotion of the Services fire management and fuel management activities	burning suppress or contain fires inconsistent with the fire prescription fuel managed by slashing, selective shrub clearing, construction of radiation barriers, trail construction	100-3000 metres	
Heritage Area Fire Management (Land Management)	Special Area Management	to prevent permanent damage or destruction of natural or heritage items, areas or values by an inappropriate fire regime	promotion of awareness of the special values requiring protection in these areas	burning suppress or contain fires inconsistent with the fire prescription	appropriate for the protection of the heritage item	management of the heritage item may be subject to a plan of management, conservation plan or a species recovery plan the zone may be delineated where the surrounding area requires a different fire regime
	Heritage Area Management	to apply fire prescriptions consistent with broad area biodiversity objectives or relevant status	promotion of awareness of the special values requiring protection in these areas	burning suppress or contain fires inconsistent with the fire prescription	variable	
Fire Exclusion	at present no sub-zones	to rapidly suppress all fires that occur within this zone for the duration of the zones existence	promotion of awareness of the values threatened by any potential fire that will occur within the lifetime of the zones existence	rapid suppression of all fires	variable	

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