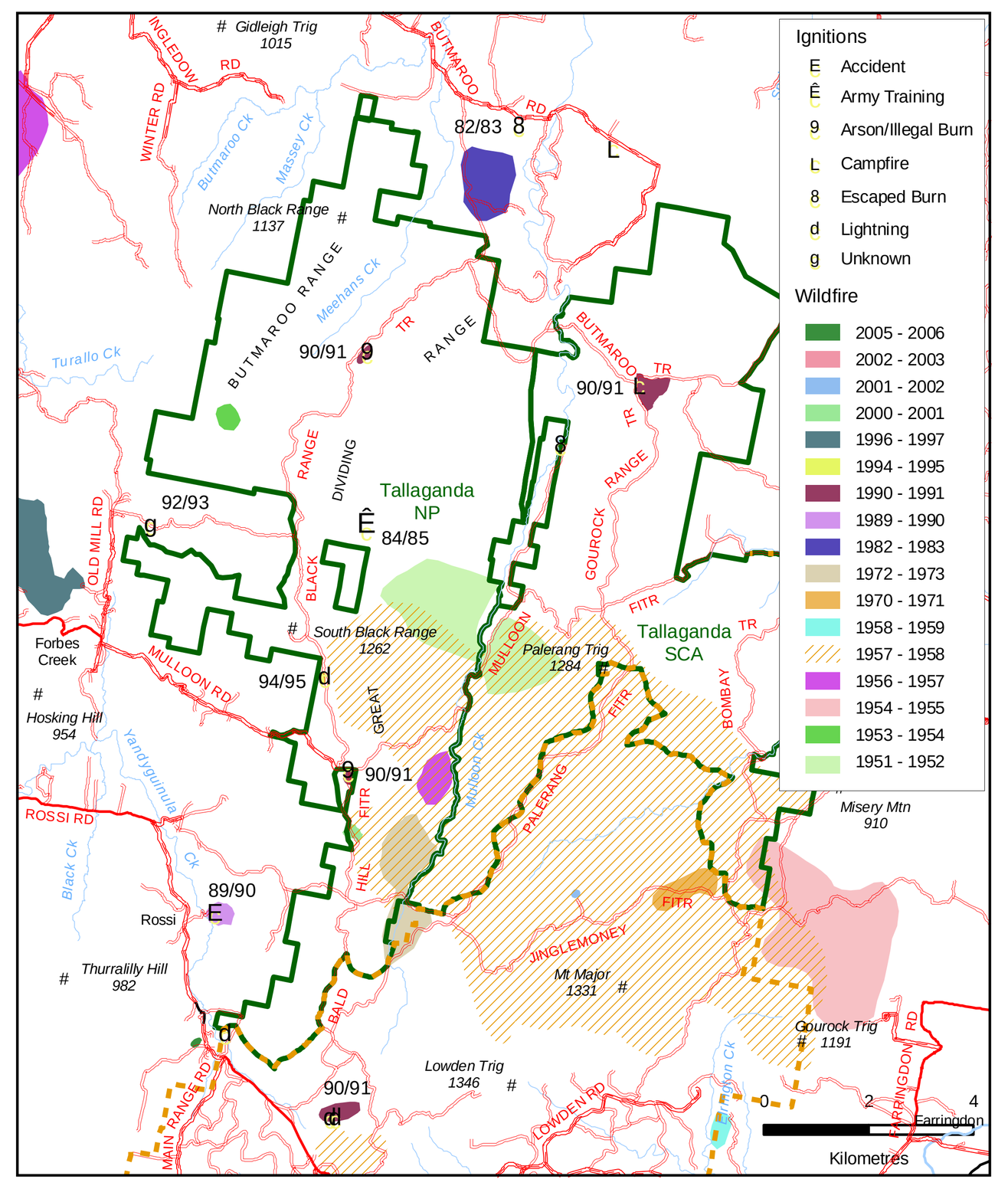
South West Slopes Region
Tallaganda National Park (North) & State Conservation Area
Fire Management Strategy 2006

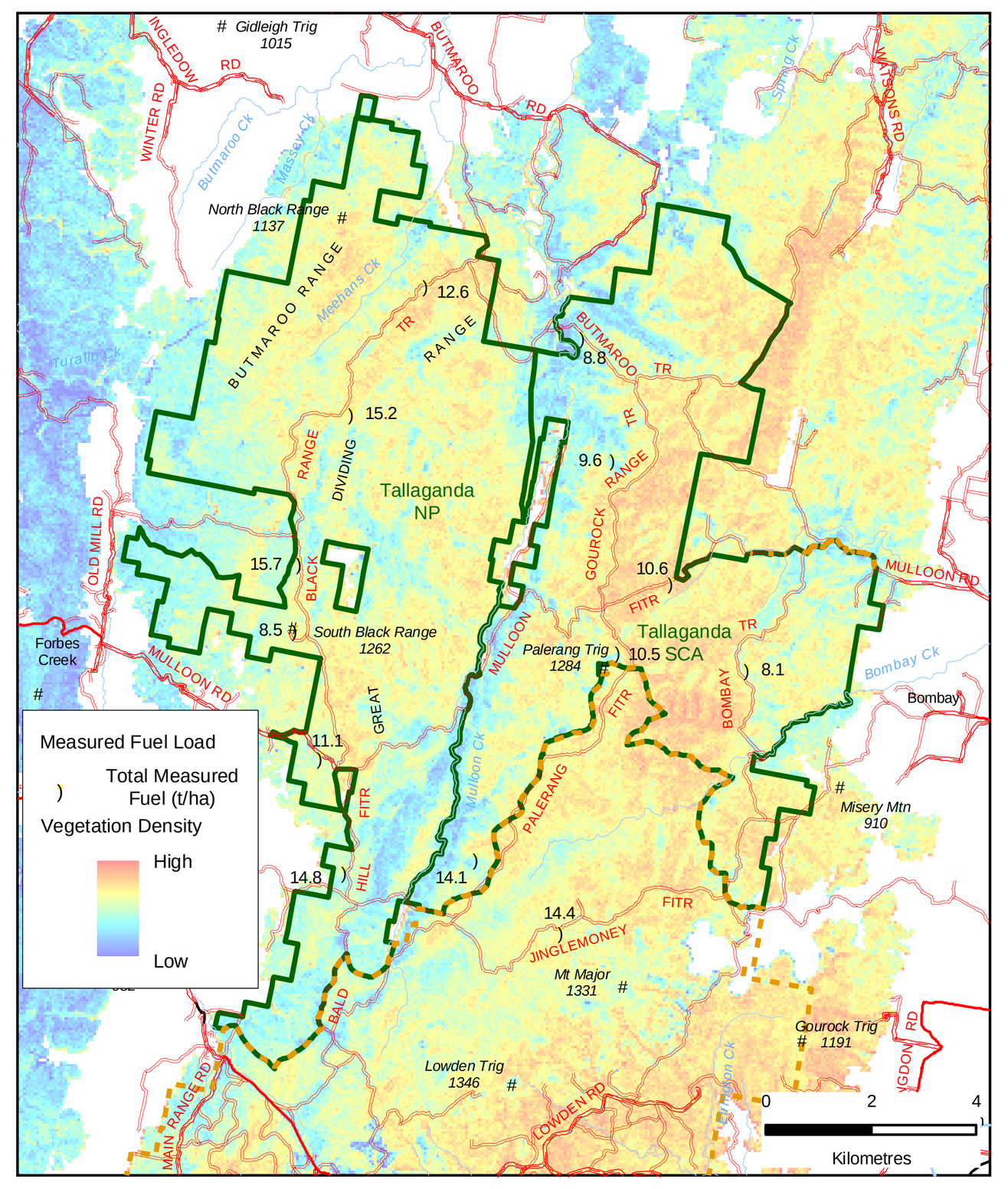
Scale: Works Programme map 1:100000, Location map 1:500000, other maps 1:130000
Version: November 2006 ISBN: 1 74137 288 7 DEC: 2006/438

This Map should be used in conjunction with air photos and ground reconnaissance during incidents and the development of incident action plans.

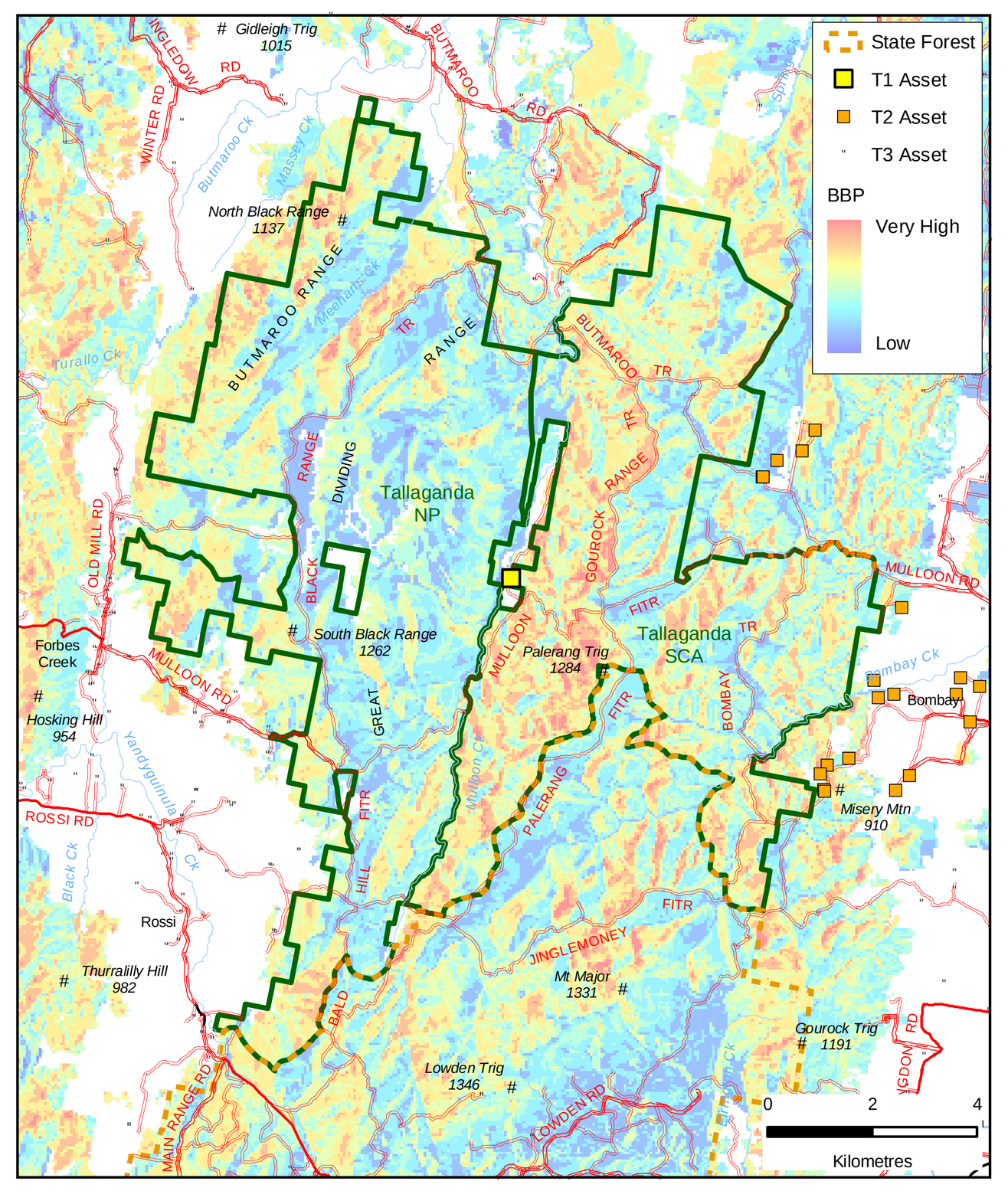
Fire History - Wildfire



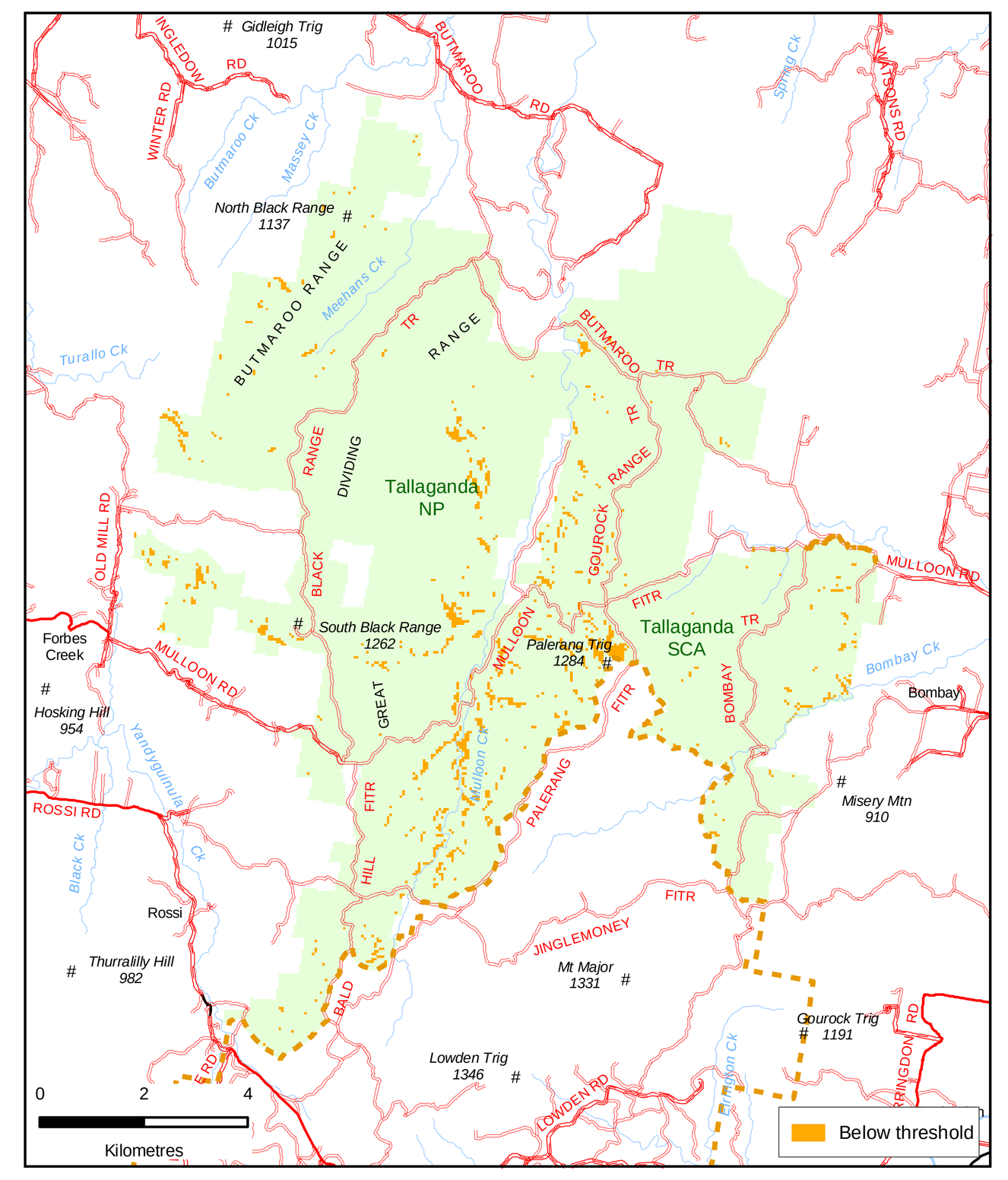
Landscape Fuels



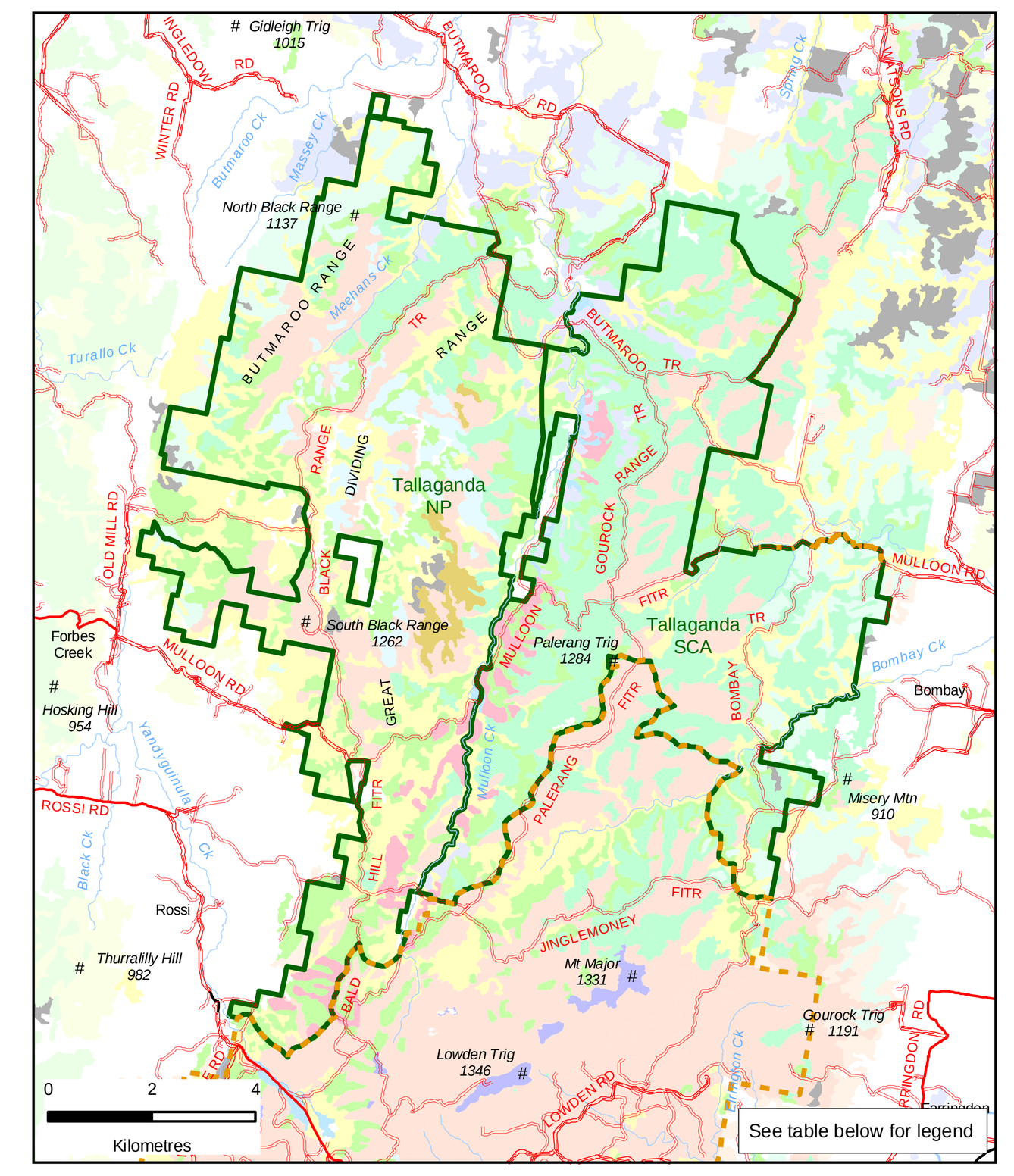
Bushfire Behaviour Potential & Assets at Risk



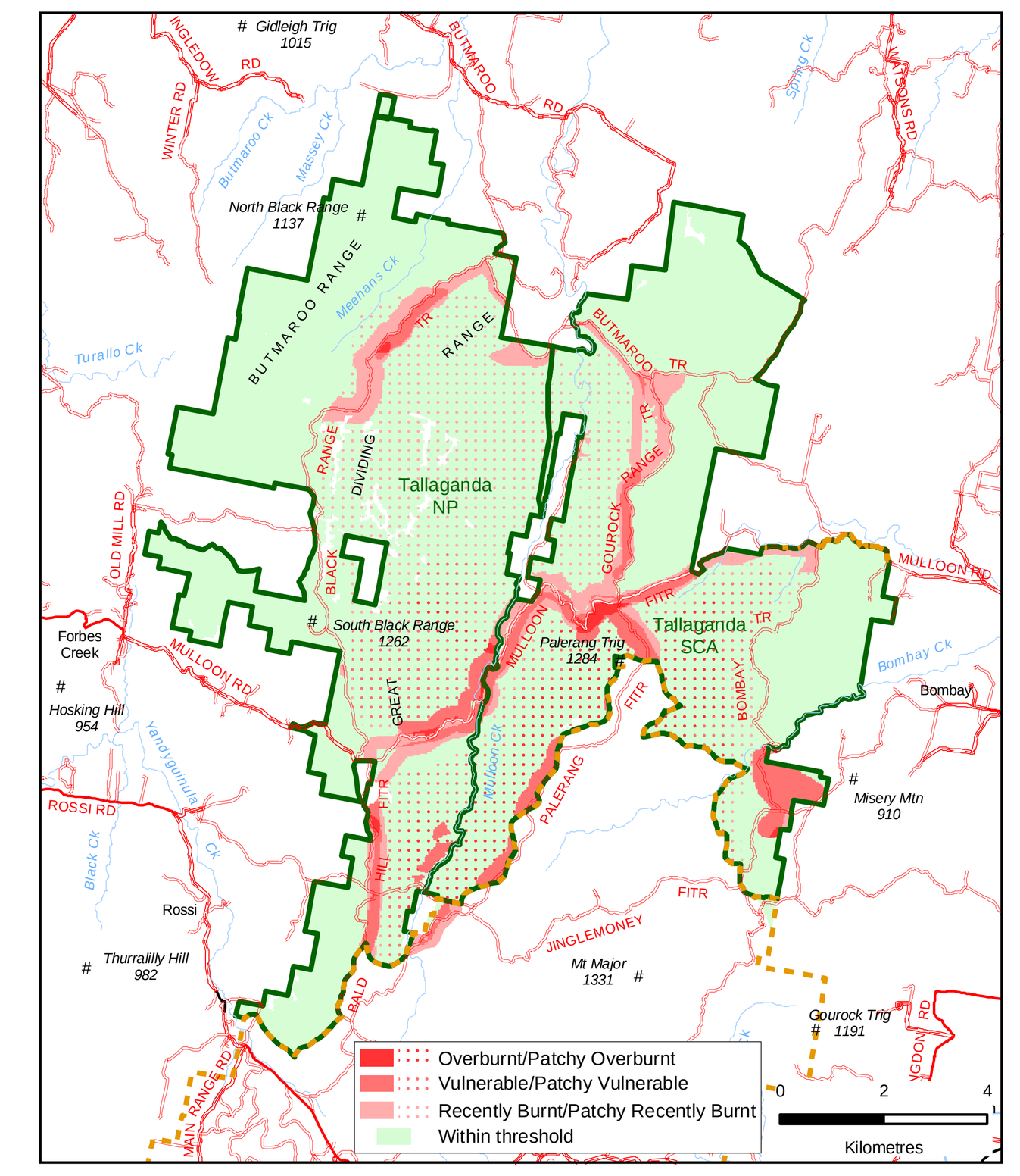
Soil Stability



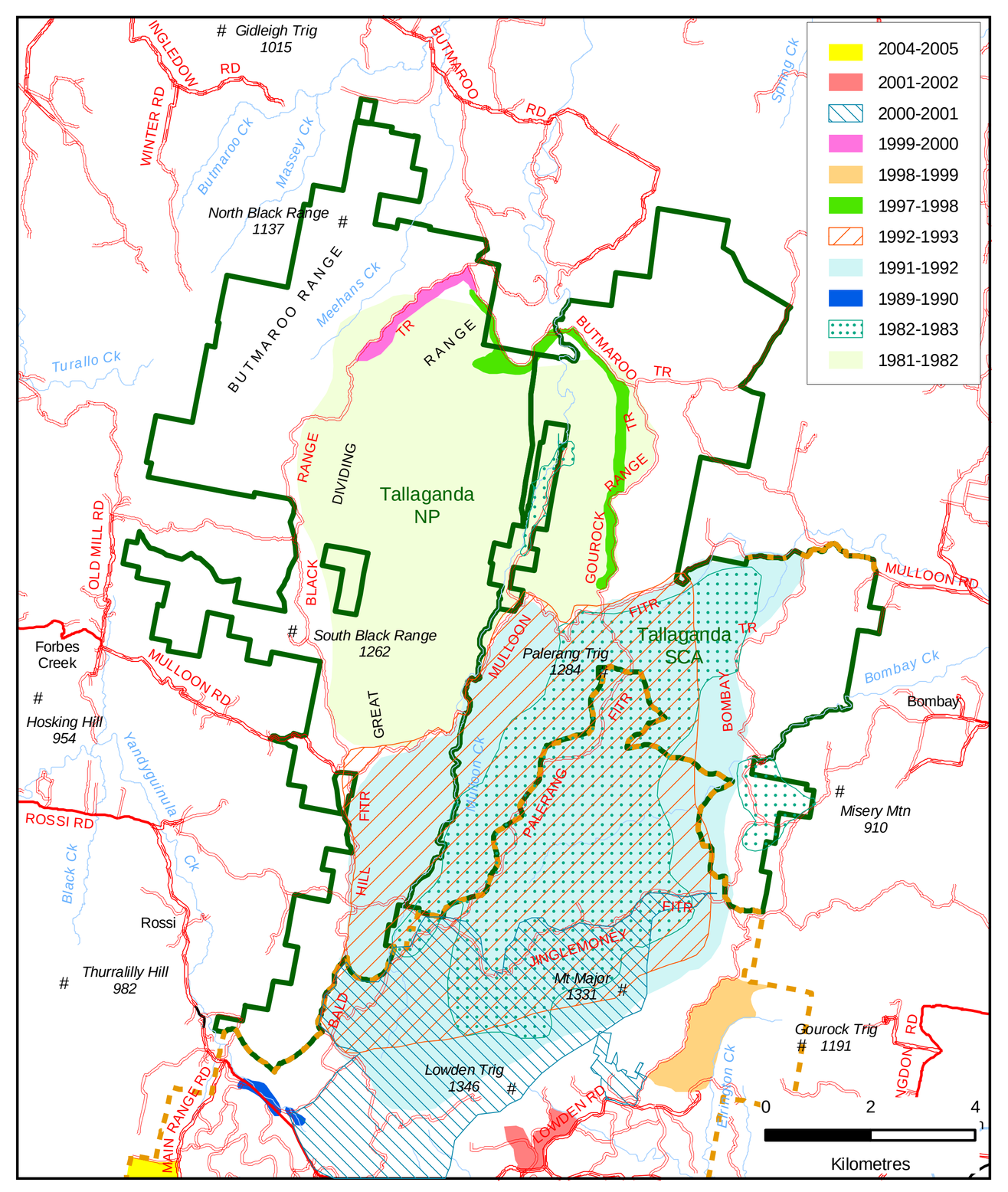
Vegetation Communities



Vegetation Threshold Analysis



Fire History - Prescribed Burns



FIRE HISTORY

Wildfire	There have been 12 recorded wildfires within the planning area between 1950 and 2001, under the reserves' previous tenure as Tallaganda State Forest. Five of these fires occurred in the 1950s and burnt a total of 6623 ha. Of this, 5531 ha burnt in the 1957-58 fire season, including 2485 ha within the current reserves. A wildfire in 1972-73 burnt 178 ha, while two fires in the early 1980s burnt a further 38 ha. Four fires in the 1990s burnt a total of 43 ha. Records prior to the 1980's held by State Forest do not include the 'cause' of fire. Since the 1980's, where recording fire ignition type/cause data is required, four fires have been accidental, one was caused by an arsonist and one caused by lightning.
Prescribed burns	Six fuel reduction burns have been recorded since 1957 in the reserve areas during previous land management. Of these, one burn conducted in the 1981-82 season burnt within a boundary covering 3837 ha, north of the Mulloon Trail (see map). A strip burn conducted in 2000-01 re-burnt the northern boundary of this block along the Butmaroo Trail, burning 225 ha. In 1982-83, 3042 ha of the area between the Mulloon, Jinglemoney and Bombay trails were treated, though it is unknown how patchy this burn was. In 1991-92 a block of 5761 ha was burnt in this area. However, it seems this burn was ineffective, as 4717 ha of this block was retreated the following season. No prescribed burns for fuel reduction or biodiversity management have been implemented since gazettal in 2001.
Ignitions	There have been 23 recorded ignitions in the area since 1950 (see map), including five caused by lightning, four accidentally lit and one by arson. Cause of ignition was not recorded prior to the late 1980s.
Fire Frequency	Fire frequency in the reserves is generally low, with much of the park not having been burnt since records commenced in 1950. North of the Mulloon Fire Trail, one section was burnt in a prescribed burn 24 years after wildfire. South of the Mulloon Fire Trail a larger block was prescribe burnt 25 years after wildfire, then reburnt 10 years later.

RESOURCE INFORMATON

The northern section of Tallaganda National Park comprising 6 342 ha (total size 16 658 ha) and the adjoining State Conservation Area (5 222 ha) are located on the Great Dividing Range in the area between Hoskinstown and Braidwood. The reserves were gazetted on 1st January 2001, and are located within a largely rural community with some rural residential development.

The reserves form part of the Shoalhaven and Murrumbidgee River catchments. Primary access is from the Mulloon Fire Trail, between Hoskinstown and Braidwood. The reserves lie within the area of Hoskinstown, Bombay, Mulloon and Bungendore Volunteer Bushfire Brigades.

Department of Environment and Conservation	Queanbeyan Area, South West Slopes Region, Parks and Wildlife Division	Government Areas	Eden-Monaro Federal Electorate Monaro State Electorate Palerang Council
Rural Fire Service	Lake George Bush Fire Management Committee	Other Organisations	Ngunnawal Local Aboriginal Land Council Buru Ngunawal Aboriginal Corporation Batemans Bay Local Aboriginal Land Council Murrumbidgee Catchment Management Authority Southern Rivers Catchment Management Authority

FUEL LANDSCAPE

MEASURED FUEL DATA - April 2004

	Vegetation type	Average t/ha	Fuel Ranges (number of sites assessed)
55	Brown barrel fern/herb/grass moist forest	10.5	Fine fuels (litter, grass <6mm thick and shrub<6mm thick, <1.5m high) ranged between 8.5 and 14.4 t/ha (n=4)
56	Narrow-leaved peppermint - ribbon gum herb/fern moist forest	14.8	Fine fuels ranged between 13.9 and 15.7 t/ha (n=2).
59	Narrow-leaved peppermint - silvertop ash shrub/fern dry forest	11.6	Fine fuels ranged between 10.5 and12.6 t/ha (n=2)
61	White ash moist shrub forest	15.2	N/a (n=1)
89	Mountain gum - ribbon gum - acacia herb/grass forest	13.1	Fine fuels ranged between 8.1 and 17.6 t/ha (n=5.
113	Brittle gum - broad-leaved peppermint dry shrub/grass forest	9.2	Fine fuels ranged from 8.8 and 9.6 t/ha (n=2)

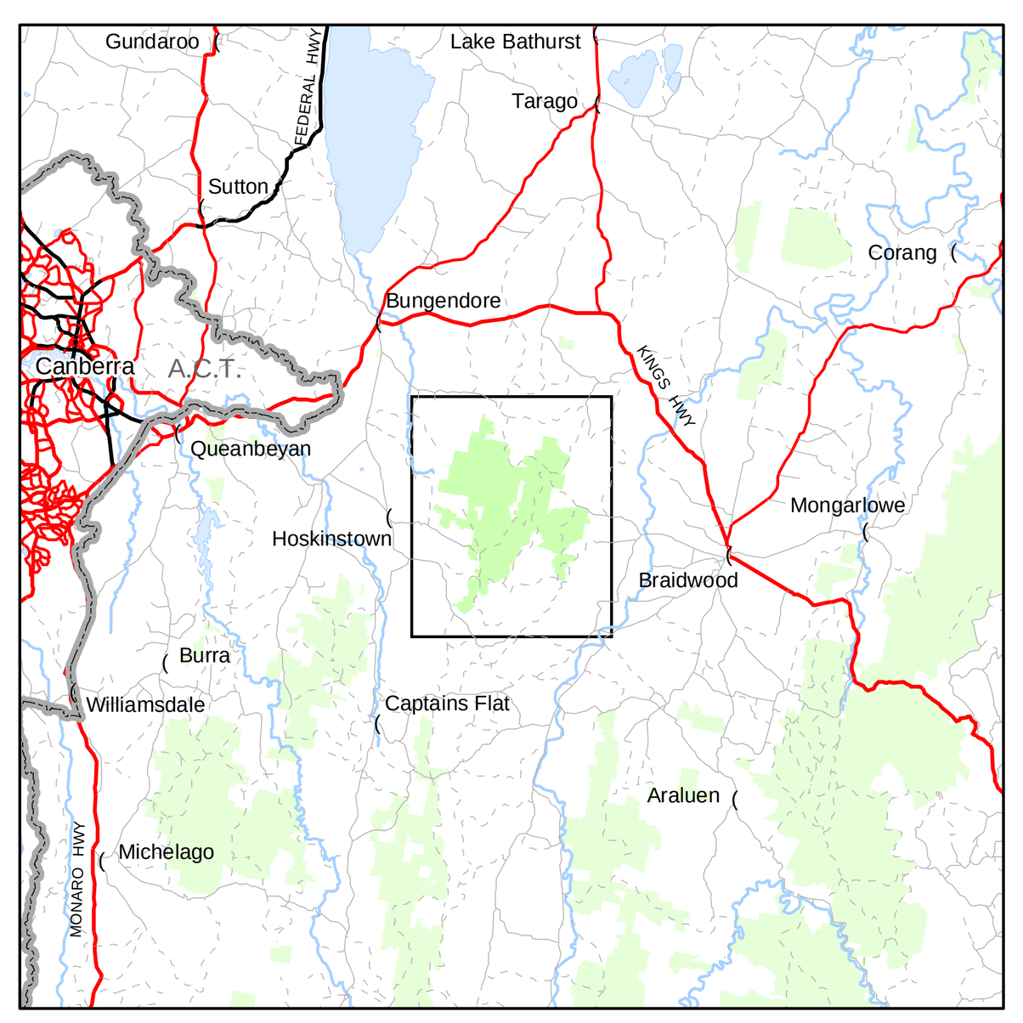
ANALYSIS OF LANDSCAPE FUELS

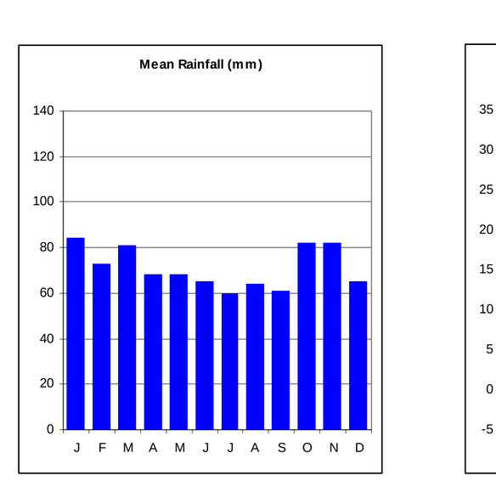
Fuel loadings are variable across the planning area. The fuel levels recorded above are likely to represent peak loadings as they were recorded after successive years of drought and after a dry late summer and autumn. Extended dry periods increase leaf drop and inhibit decomposition of fuels. Lower fuel loads could be expected after periods of higher rainfall enabling decomposition of leaf litter. The above map displays measured fuel loads combined with vegetation density *(satellite image December 2003 & January 2004 - quantitative & visual sampling March-April 2004)* to indicate fuel level variability across timbered areas in the landscape.

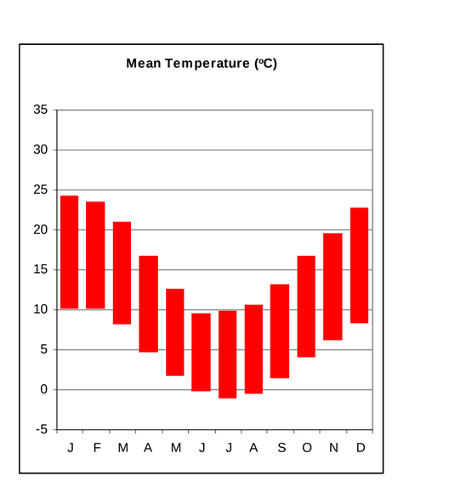
Much of the planning area supports tall moist forests dominated by brown barrel, ribbon gum, mountain gum and narrow leaved peppermint. These forests have heavy fine fuels, partly due to the contribution of fallen bark ribbons. More exposed slopes in the SCA support a lower, dry forest dominated by narrow-leaved peppermint and silvertop ash, with a scattered shrub layer and ground layer of mat rush and bracken. This vegetation supports fuel loads of about 11.6 t/ha. On the eastern side of the reserve in the Bombay area shallower soils support a dry shrub forest of silvertop ash and broad leaved peppermint, with scattered brittle gum and narrow-leaved peppermint, and a sparse shrub layer. Similar dry forest of brittle gum and broad-leaved peppermint in the north of the planning area also support relatively low fuel levels.

The above data demonstrate that fine fuel loads measured across the reserves generally conform with the levels prescribed for strategic wildfire management zones (8-15t/ha for 60-80% of zone) and are thus at an appropriate level. However, the contribution of bark fuels to fire behaviour will be high with the ribbon-barked trees in the area, thus increasing spotting potential.

Location







BUSHFIRE BEHAVIOUR POTENTIAL CLASSES

Bushfire Behaviour Potential is modelled for Tallaganda National Park, Tallaganda State Conservation Area and surrounding timbered lands using vegetation, aspect and slope ratings, as shown below. Ratings apply to the entire planning area, and thus bushfire behaviour potential can be directly compared between the northern and southern sections of this reserve system (displayed on two separate posters). However, comparisons cannot be made with models displayed in other fire management strategies.

Vegetation Fuel Hazard Rating
(under moderate weather conditions and fire danger indices)

Rating	Vegetation Type	% of Reserve
Low	Cleared (with patches of native vegetation)	1.7
Medium	55: Brown barrel fern/herb/grass moist forest 62: White ash - monkey gum moist shrub/fern forest 56: Narrow-leaved peppermint - ribbon gum herb/fern moist forest 61: White ash moist shrub forest 89: Mountain gum - ribbon gum - acacia herb/grass forest 95: Snow gum - mountain gum - acacia moist herb forest Unmapped vegetation types	61.3
High	59: Narrow-leaved peppermint - silvertop ash shrub/fern dry forest 66: Mountain gum - narrow-leaved peppermint shrub/grass forest 73: Snow gum - ribbon gum dry shrub/grass forest 74: Apple box - snow gum - candlebark dry shrub/grass/herb forest 107: Mountain gum - broad-leaved peppermint dry shrub forest 109: Brittle gum - broad-leaved peppermint - red stringybark dry shrub/ tussock forest 112: Silvertop ash - broad-leaved peppermint dry shrub forest 113: Brittle gum - broad-leaved peppermint dry shrub/grass forest	37.0

Topographic Hazard Rating

Aspect Behaviour Rating *(reflects likely aspect dryness and fire wind direction)*		Slope Behaviour Rating		
Rating	Aspect (°)	Rating	Slope (°)	% of Reserve
Low	65 - 190°	Low	0 - 10°	43.9
Medium	10 - 65°	Medium	10 - 20°	45.6
High	190 - 250° and 340 - 10°	High	20 -30°	10.0
Very High	250 - 340°	Very High	>30°	0.5

ANALYSIS OF BUSHFIRE BEHAVIOUR POTENTIAL

Bushfire behaviour at any position on the landscape reflects

- site attributes such as vegetation type, slope, aspect (can affect fuel levels, structure and moisture content); and
- fire weather attributes such as temperature, relative humidity, wind direction and wind speed. While these characteristics are difficult to predict, analysis of local weather data shows that bad fire weather days are generally associated with winds from the north- west to west. These winds have thus been incorporated into the fire behaviour potential model.

The western slopes of the Butmaroo, Great Dividing and Gourock Ranges have the highest fire behaviour potential, due to their steepness and exposure to both afternoon sun and drying north-westerly to westerly winds through summer. Forests on these slopes contain a higher proportion of flammable shrubs than more protected forests and thus may support a high fire behaviour under moderate conditions. On more sheltered aspects, the shrub layer is not as volatile and the fuel moisture levels are generally higher, thus mitigating fire behaviour under moderate conditions. However, during extended drought periods or severe fire weather conditions, these forests will support extreme fire behaviour, exacerbated by the ribbony bark of many of the tree species.

Throughout the reserve, the fire behaviour will be further modified by the local structure of the vegetation. Due to past logging events along the Black and Gourock Ranges, some sections of dense regrowth timber, creating a mid-level vegetation layer, can be found. Fire behaviour is expected to be worse in these areas than in surrounding mature forests.

RISK ASSESSMENT - LIFE & PROPERTY

Assets	Vulnerability	Risk Mitigation
T1 Private properties within close proximity (100m) of reserve boundary	· One house is located within 100 m of the reserve, and thus is within the immediate area of influence of fire leaving the reserves (see bushfire behaviour potential map).	· Participate in the development and, where appropriate, implementation of fire management proposals for asset protection. The RFS and property owners have primary responsibility for asset protection off-park. · Maintain access trails within the reserves for use in fire fighting operations, particularly the Bombay, Gourock, Black Range and Butmaroo Trails (see bushfire management zones map and works programme). · Implement works identified for strategic zones to assist in fire management operations (see bushfire management zones map and works programme). · Contain all unplanned fire events as soon as possible by rapidly responding to reported ignitions.
T2 Private property east of reserve in the Bombay area	· Some of these assets are located in bushland and are thus vulnerable to fire. · Vulnerable to fire coming from the reserve under the influence of north-westerly to south-westerly winds.	
T2 Forests NSW hardwood forests	· Hardwood forests located to the east of the park are vulnerable to fire leaving the park.	
T3 Other private property in area	· Assets may be damaged by bushfire, particularly when located in bushland.	

CULTURAL HERITAGE

Key Management Guidelines

- Identified sites will be protected.
- DEC Databases for cultural heritage will be accessed during incidents, and in planning for prescribed burning or other works to ensure new records are considered. Aboriginal site information from AHIMS is sensitive and subject to a Memorandum of Understanding. Site data must be used appropriately.
- Protection measures will be addressed in a Review of Environmental Factors and burn plans for prescribed burns.
- Where possible, trained officers will provide advice on site protection measures.

Aboriginal Heritage	Numerous Aboriginal sites are recorded within northern Tallaganda NP & SCA, of which nearly all are artefact scatters. Some open campsites and scarred trees also have been recorded. Other unidentified sites may occur across the landscape, especially in riparian areas, broad valleys, and ridgelines. · The possible scarred tree should be protected from fire, if possible, in both wildfire and any prescribed burning operations. · Open campsites and other artefact scatters should be clearly identified and protected from damage from earth moving equipment during control line construction. · During wildfire operations, efforts will be made to survey for aboriginal sites ahead of earthmoving operations.
Historic Heritage	No significant historical places have been recorded within the planning area (23rd March 2005). However, there is old stone work on sections of the council - managed Mulloon Fire Trail. Remnants of a hut are located on the east side of the Bombay Trail just north of Bombay Creek. · Earthworks on the Mulloon Fire Trail should avoid damaging the stonework. · Efforts should be made to protect hut remains from fire. · Earth moving equipment should avoid any historic remains.

SOIL STABILITY THRESHOLDS

Slope class	Recommended fine fuel range (t/ha) *	Status of reserves & potential impacts
0-10°	3-5	· Based on modelling of fuel loads and slope classes, 3% (299 ha) of Tallaganda National Park (north) and State Conservation Area has fuel cover less than that required to maintain soil stability. · Fine fuel ranges below the recommended levels for each slope class are expected to decrease slope stability, increase erosion potential, reduce water quality and potentially reduce vegetation recovery.
10-15°	4-7	
15-20°	10-12	
20-25°	12-14	
25-30°	16-18	
>30°	>20	

Fire Management Guidelines

- Exclude fire from areas where the fine fuel range does not meet the slope class thresholds, if possible. However, as these areas are associated with steeper slopes, any fire on steeper slopes will create soil stability issues until fuel loads recover.
- Avoid trail construction on slopes >25 degrees.
- Ensure prescribed burns are small and disjunct across the landscape so that large areas and steeper slopes are not left exposed.
- Control lines constructed during an incident will include adequate drainage to prevent trail erosion, and will be rehabilitated immediately post-fire.

* Recommended fuel range based on Good, R.B. (1994). Fuel Dynamics, Preplan and Future Research Needs. Chapter 23 pp 253 - 266. In: *Fire and Biodiversity. The Effects and Effectiveness of Fire Management.* Biodiversity Series No 8. Dept of Environment, Sport and Territories, Canberra.

FAUNA MANAGEMENT CONSIDERATIONS

Species	TSC Act Schedule	Management Considerations
Spotted-tailed quoll ®	Vulnerable	Even low intensity burns may impact on use of den sites and fire should thus be excluded from large rock outcrops where possible, particularly during the May to August breeding period. Efforts should be made to increase patchiness and reduce intensity of wildfires in these areas. Frequent fire may reduce structural diversity of vegetation, diminishing habitat value for quolls. High intensity fires that limit food resources (mostly arboreal prey and carrion) are detrimental.
Barking owl®	Vulnerable	Inhabit eucalypt woodland and drier open forest, roosting along creek lines. Nest in hollows of large, old eucalypts between late winter and late spring, and disturbance should be avoided at this time. Feed on invertebrates, with birds and smaller gliders, possums, rodents and rabbits becoming important during breeding. High intensity fires that destroy nesting sites and reduce prey numbers are detrimental. Frequent low intensity fires that degrade understorey habitat for prey are also detrimental.
Powerful owl®	Vulnerable	Strongly associated with long unburnt forest. Widespread, high intensity fires that reduce prey (particularly greater gliders) and destroy the large, old eucalypts that provide nesting sites are detrimental (but may form new hollows). Powerful owls are highly sensitive to nest disturbance and will readily abandon the nest. Thus fires near known nesting trees should be avoided between mid - May and mid October.
Masked owl(SF)	Vulnerable	Live in dry eucalypt forests and woodlands, hunting on ecotones such as edges of forests, roadsides, or patchy areas within forests. Thus show a preference for more frequently burnt areas. Mosaic burning improves foraging opportunities. Feed primarily on rodents and other ground mammals. Widespread intense or frequent fires that reduce numbers of prey directly or through simplification of the understorey will be detrimental. Roosts and breeds in moist eucalypt forested gullies, using large tree hollows. Nests vulnerable between March and October when fledging occurs.
Olive whistler®	Vulnerable	Mostly inhabit wet forests above 500m. Forage in trees and shrubs and on the ground, feeding on berries and insects. Vulnerable to fire that is too intense, widespread or frequent, changing vegetation structure and composition. They nest in low forks of shrubs between September and January and are particularly vulnerable to fire at this time.
Eastern false pipestrelle ®	Vulnerable	Generally utilise moister gullies, roosting in eucalypt hollows and under bark. Hibernate in winter, females pregnant in late spring and summer, and are vulnerable to fire at these times. Higher intensity fires that burn moist gullies may destroy roosting sites.
Large-footed myotis ®	Vulnerable	Generally roost close to water in hollow-bearing trees and in dense foliage. Young born in November or December. Fires destroying roosting sites will be detrimental.
Koala	Vulnerable	Fires that result in crown scorch will harm koalas by injuring or killing individuals, by reducing food supplies and increasing opportunities for predation. Recolonisation after widespread high intensity, non-patchy fires will be slow.
Broad-toothed rat	Vulnerable	Live in runways through wet grass, sedge or heath environments. Sheltering nests of grass are built in the understorey or under logs, where two or three young are born in summer. The diet is comprised of grass and sedge stems, supplemented by seeds and moss spore cases. Thus widespread or repeated fires, particularly if followed by drought, may compromise population viability.
Eastern pygmy-possum	Vulnerable	Too frequent fires that reduce the abundance of flowering myrtaceous shrubs, particularly banksias, will be detrimental. Fires between late spring and early autumn that impact on nesting sites in tree hollows, under the bark of eucalypts and in tree forks are detrimental.
Glossy-black cockatoo	Vulnerable	Feed almost exclusively on the seeds of various she-oak and therefore frequent fire that reduces the abundance of she-oaks is detrimental. One study found that even 22 years post-fire, habitat not suitable for the species. High intensity fire that may destroy nest sites in large hollow-bearing eucalypts is detrimental.
Pink Robin(SF)	Vulnerable	Inhabit rainforest and tall, open eucalypt forest, especially densely vegetated gullies. Catch prey by the perch-and-pounce method, foraging on the ground for insects and spiders. Thus fires removing logs is detrimental. Breed between October and January in a moss nest in a fork from 30cm to 6m above the ground, in deep undergrowth. Vulnerable to fire at this time.
Invertebrates	N/a	The Tallaganda range supports relatively high densities of velvet worms, flatworms, funnel web spiders and springtails, which have evolved a high degree of species diversity and endemism through successive glaciation episodes along this comparatively isolated part of the Great Dividing Range (Garrick et al 2004). As different catchments and even sub-catchments contain genetically separate species of these invertebrate groups, it is important that disturbance events such as fire are kept to a small scale to avoid potential extinction of species within a separate catchment. For velvet worms, logs are capable of supporting large populations only after a minimum of 45 years of decay (Barclay et al 2000). Presence and abundance are positively linked to log moisture, thus repeated fires that cause drying are detrimental.

® indicates species recorded in reserve. (SF) indicates species recorded in adjoining State Forest
TSC Act = Threatened Species Conservation Act

Barclay S, Ash JE, Rowell DM (2000) Environmental factors influencing the presence and abundance of a log-dwelling invertebrate, *Euperipatoides rowelli* (Onychophora: Peripatopsidae). Journal of Zoology, 250, 425-436.

Garrick RC, Sands CJ, Rowell DM, Tait NN, Greenslade P & Sunnucks P. (2004) Phylogeography recapitulates topography: very fine-scale local endemism of a saproxylic 'giant' springtail at Tallaganda in the Great Dividing Range of south-east Australia. Molecular Ecology, 13, 3329-3344.

VEGETATION COMMUNITIES

Veg Group	Vegetation Description	Ha	% of Reserve
59	Narrow-leaved peppermint - silvertop ash shrub/fern dry forest	3041	26.3
89	Mountain gum - ribbon gum - acacia herb/grass forest	2287	19.8
55	Brown barrel fern/herb/grass moist forest	2190	18.9
56	Narrow-leaved peppermint - ribbon gum herb/fern moist forest	1982	17.2
112	Silvertop ash - broad-leaved peppermint dry shrub forest	582	5.0
61	White ash moist shrub forest	408	3.5
107	Mountain gum - broad-leaved peppermint dry shrub forest	362	3.1
113	Brittle gum - broad-leaved peppermint dry shrub/grass forest	254	2.2
62	White ash - monkey gum moist shrub/fern forest	157	1.4
66	Mountain gum - narrow-leaved peppermint shrub/grass forest	47	<1
74	Apple box - snow gum - candlebark dry shrub/grass/herb forest	10	<1
73	Snow gum - ribbon gum dry shrub/grass forest	1	<1
109	Brittle gum - broad-leaved peppermint - red stringybark dry shrub/ tussock forest	N/A	N/A
95	Snow gum - mountain gum - acacia moist herb forest	N/A	N/A
0	Cleared	259	1.6
999	Unmapped vegetation communities	64	<1

VEGETATION MANAGEMENT CONSIDERATIONS

This section of Tallaganda National Park & Tallaganda State Conservation Area mostly occupies the eastern fall of the range. Vegetation ranges from moist tall forests dominated by brown barrel and narrow-leaved peppermint through intermediate forests that include silvertop ash to drier low forests dominated by broad-leaved peppermint. Small patches of other vegetation communities occur and it is assumed their fire history and fire management guidelines are similar to the more extensive vegetation communities.

A high proportion of plant species in the reserves regenerate primarily through resprouting (from buds in the stem, trunk or roots), often combined with some seedling germination. A small number of plant species in the reserve are obligate seeders, which die after complete leaf scorch but regenerate from seed. These characteristics affect how the plants in the reserve respond to the different elements of a fire regime, as outlined below.

Response to aspect of fire regime	Impact
Repeated short interval fires · reduce the number of seeding species by killing the plants before seed set occurs. · deplete the energy in the buds of resprouting plants, leading to plant death.	Depending on the length of the interval, repeated fires might lead firstly to the loss of long-lived shrubs, short-lived shrubs and finally herbs and perennial grasses.
Long fire intervals · fail to provide fire as a trigger to stimulate resprouting, or germination of species - adult plants may then die of old age · however, germination and resprouting may be triggered by drought, frost and animal disturbance.	Long fire intervals may reduce biodiversity unless other triggers initiate germination and resprouting.
Moderate to high intensity fire · causes significant damage to resprouting plants, enabling the germination and establishment of seedlings. · White ash is killed by 100% canopy scorch, and as seed storage is only on the plant it is vulnerable to high intensity fire. An interval of at least 30 years is required after such a fire for new plants to mature and reproduce.	Moderate to high intensity fire may cause domination by seeder species.
Low intensity fire · causes little damage to resprouting species that then out-compete germinating seedlings for water and nutrients.	Low intensity fire may cause domination by resprouting shrub species.
Spring fire · may reduce germination due to moisture stress · may be followed by death of seedlings in the hot, dry summers experienced in the area.	Spring burning may lead to a dominance of resprouting species.
Autumn fire · moisture levels may be sufficient to enable successful resprouting and germination of plants. · Seedlings may be killed by subsequent frosts	Autumn prescribed burning may maintain a mix of seeder and resprouting species, depending on frost severity.
Drought · May delay germination of plants after a fire until over 50 mm of rainfall. · Recovery of resprouting plants will also be slowed.	Fire applied in a drought cycle may lead to local extinctions of seeders. Slower rates of germination and resprouting will also contribute to erosion and nutrient losses.
A small fire · may lead to selective overgrazing of plants by herbivores.	A small fire may lead to the local extinction of palatable species.

KEY BIODIVERSITY MANAGEMENT PROVISIONS

The various responses of reserve flora and fauna to fire suggest that, for biodiversity management;

- Wildfires should be kept as small as possible and managed to reduce fire intensity where possible to limit both direct and indirect impacts on threatened fauna.
- Fire should be excluded from the rocky outcrops along Black Range for protection of quoll habitat
- Fire intensity should be reduced where possible in patches of *Eucalyptus fraxinoides* to prevent tree death, particularly if it is less than 30 years since a previous high intensity fire.
- High intensity burns should be avoided closer than 45 years apart, allowing time for fallen logs to decay and provide habitat for velvet worms.
- Where possible, fire should be prevented from burning entire catchments or sub catchments to avoid potential extinction of geographically restricted species of invertebrates. As these log-dependent invertebrates are part of the system that creates soils, their presence is critical to enhancing the productivity of these forest systems through nutrient cycling.
- Patchiness in wildfires should be promoted to maintain prey numbers and diverse habitat for the range of owls, quoll and other threatened fauna.
- Frequent fires that dry out logs should be avoided as the presence and abundance of velvet worms are positively linked to log moisture.
- Frequent fires that reduce litter levels should be avoided, as litter beds assist the dispersal of these and other invertebrates. Litter beds also stabilise soils, reducing erosion.
- Infrequent fires may enhance understorey habitat complexity, providing habitat for a range of fauna for a minimum of 10-40 years post fire. Frequent fires that reduce structural diversity of habitat should be avoided.
- Monitoring of floristic and structural diversity should be conducted in the long-unburnt age classes to monitor changes in floristic diversity and habitat quality occurring with time since fire.
- Fire should only be applied in response to a demonstrated loss of biodiversity.
- Fire should not be introduced to the area south of the Mulloon Fire Trail that has burnt in successive prescribed burns.
- Any burns implemented for strategic purposes should be applied between mid March and late May, where possible, to minimise impacts on threatened species.
- Strategic burns should be restricted in area, low-moderate in intensity and at a low enough frequency to maintain understorey habitat components for the range of threatened fauna in the reserve.

VEGETATION MANAGEMENT THRESHOLDS & EVALUATION

Threshold	Definition
Overburnt	The last two consecutive inter-fire intervals have been too short. *· Protect from fire as far as possible.*
Vulnerable	The area will be overburnt if it burns this year. *· Protect from fire as far as possible.*
Recently Burnt	Time since fire is less than the optimum interval, but before that it was within threshold. *· Avoid fires if possible.*
Within Threshold	Fire history is within the threshold for vegetation in this area. *· A burn is neither required nor should one necessarily be avoided.*

Analysis of the fire responses (recorded in the NPWS fire response database) of key plant species in each vegetation community suggests that species decline may occur if fire is repeatedly applied to large proportions of each community outside the intervals detailed below.

Description		Vegetation Description	Fire Thresholds: Minimum interval (yrs)	Fire Thresholds: Maximum interval (yrs)	Fire history evaluation
Moist Forests	55	Brown Barrel - Fern, Herb, Grass Moist Forest	40	200	50 % is within threshold 40% may be within threshold, but may have burnt in patches* (20% frequently burnt, 20% recently burnt) 4 % is frequently burnt 6 % is recently burnt
Moist Forests	62	White Ash & Monkey Gum - Moist Shrub, Fern Forest	40	200	100% may be within threshold, but may have burnt in patches* (78% frequently burnt, 22% recently burnt)
Intermediate Moist Forests	56	Narrow-leaved Peppermint & Manna Gum - Herb, Fern Moist Forest	30	200	43 % is within threshold 43% may be within threshold, but may have burnt in patches* (15% frequently burnt, 27% recently burnt) 7 % is frequently burnt 8 % is recently burnt
Intermediate Moist Forests	61	White Ash - Moist Shrub Forest	30	150	19 % is within threshold 79% may be within threshold, but may have burnt in patches* (9% frequently burnt, 70% recently burnt) 2 % is recently burnt
Intermediate Moist Forests	89	Mountain Gum & Manna Gum - Acacia, Herb, Grass Forest	30	150	47 % is within threshold 44 % may be within threshold, but may have burnt in patches* (21% frequently burnt, 23% recently burnt) 5 % is frequently burnt 4 % is recently burnt
Intermediate Dry Forests	59	Narrow-leaved Peppermint & Silvertop Ash - Shrub, Fern Dry Forest	25	150	41 % is within threshold 44 % may be within threshold, but may have burnt in patches* (22% frequently burnt, 22% recently burnt) 7 % is frequently burnt 8 % is recently burnt
Dry Forests	107	Mountain Gum & Broad-leaved Peppermint - Dry shrub Forest	25	150	24 % is within threshold 53 % may be within threshold, but may have burnt in patches* (37% frequently burnt, 16% recently burnt) 11 % is frequently burnt 12 % is recently burnt
Dry Forests	112	Silvertop Ash & Broad-leaved Peppermint - Dry Shrub Forest	25	150	90 % is within threshold 5 % may be within threshold, but may have recently burnt in patches* 2 % is frequently burnt 3 % is recently burnt
Dry Forests	113	Brittle Gum - Broad-leaved Peppermint - Dry Shrub, Grass Forest	20	150	81 % is within threshold 12 % may be within threshold, but may have burnt in patches* (9% frequently burnt, 3% recently burnt) 7 % is frequently burnt

These thresholds provide a broad framework for assessing the biodiversity status of the reserve, as mapped above. However, these thresholds are based on life cycles of a limited number of species, and given the lack of knowledge on ecosystem functioning without fire, the upper limits are untested. Some variability in fire regimes may be desirable to allow for unconsidered needs of some species. The following guidelines provide additional detail.

*Data is unreliable for broad areas shown as having had prescribed burns implemented, as the depth of these burns from trail ignition points is unknown, and in moister forests likely to be narrow. Part of the area is shown as being burnt in two subsequent years, indicating either very limited burning, or possibly erroneous duplication of fires during mapping. It is therefore likely that large sections of these areas are still within threshold.

BIODIVERSITY MANAGEMENT GUIDELINES

Guideline 1: Consecutive fires should not generally be applied more frequently than the thresholds

- These minimum thresholds are based on the time required to allow the post-fire maturation and reproduction of most perennial components and obligate seed regenerators.
- Ensure post-fire maturity and reproduction of many fauna species.
- Ensures that much of the reserves' soil will have fully restored nutrient levels to sustain vegetation. In sub alpine areas 10-12 years post-fire is needed to restore nitrogen to pre-fire levels, and phosphorus replacement may take 20 years (Raison, Khanna and Woods, 1985). Doherty (1997) considered that these effects would be exaggerated on soils with a lower nutrient status, such as those in the northern section of the reserves. Frequent burns will thus constantly deplete nutrient levels, hindering regeneration of healthy vegetation and limiting food resources for herbivores.
- In the moister forests on Black Range, the presence of white ash indicates a historic relatively low occurrence of high intensity fires. White ash is killed by 100% canopy scorch, and as seed storage is only on the canopy it is vulnerable to high intensity fire.
- Presence and abundance of velvet worms are positively linked to log moisture, thus frequent fires that cause drying of the environment are detrimental.
- Dispersal of invertebrates such as funnel web spiders and velvet worms is linked to the presence of a litter layer, thus frequent fires are detrimental.

Guideline 2: A range of post- fire ages within the recommended fire intervals should be present in each of the reserves' vegetation types.

- Ensures a range of age classes for a diversity of flora and fauna species.

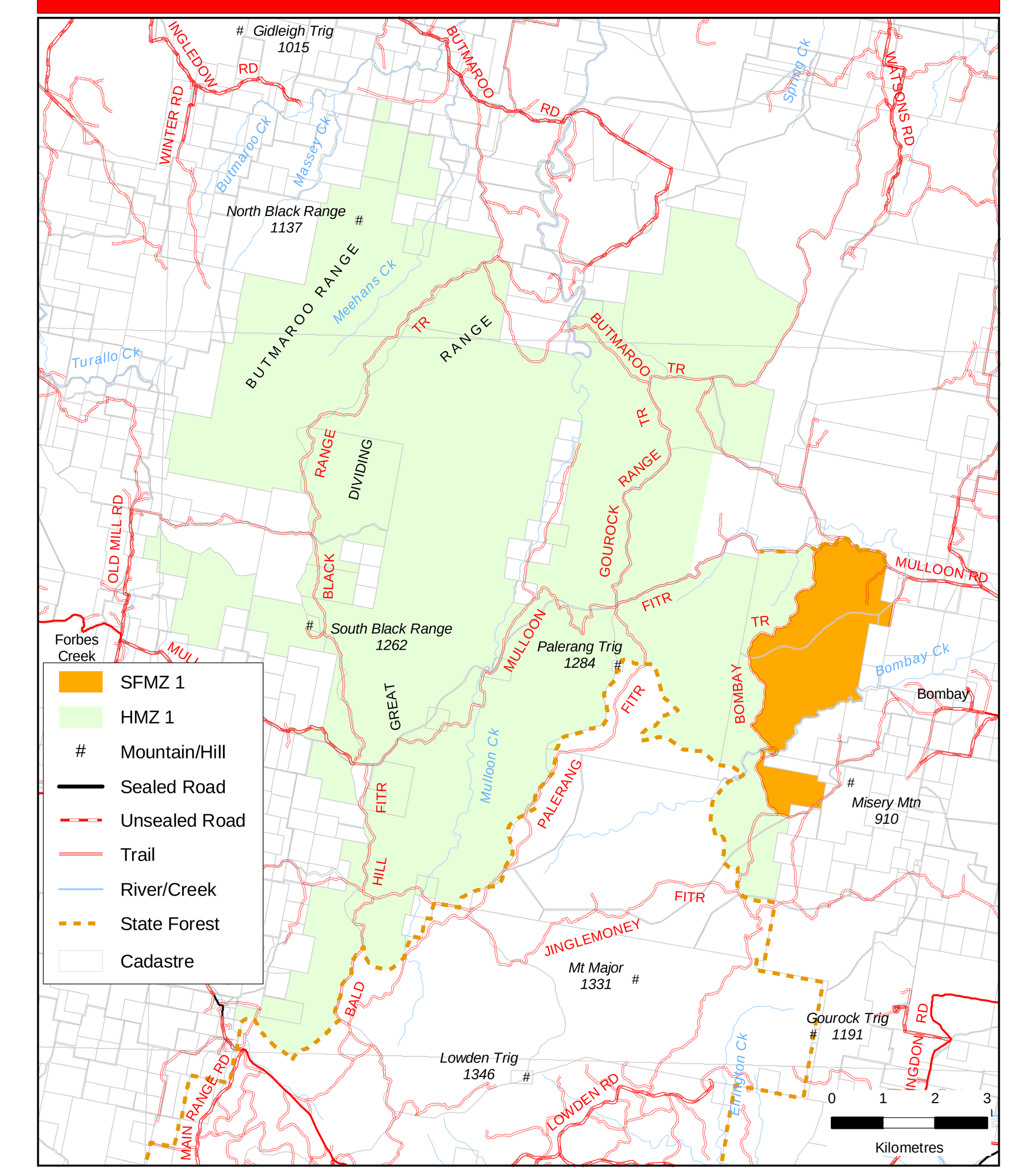
Guideline 3: At least 50% of the each of the reserves' vegetation types should be unburnt for more than 60 years.

- Extended period since fire enables development of a diversity of vegetation and habitat types for fauna.
- The moister communities are thought to experience infrequent, high intensity fire as the norm, possibly between 70 & 150 years apart (England et al 2004). Structural elements of these forests are slow growing and long-lived.

Guideline 4: Where prescribed burns are undertaken they should be at low frequencies, generally of low-moderate intensity and applied over comparatively small areas.

- The presence of some areas that have burnt more frequently than recommended may not be detrimental in the context of a widespread ecosystem, and may provide opportunities for disturbance loving species to germinate.
- Small, recently burnt patches may provide ecotonal areas that some fauna species prefer.
- High intensity fires < 45 years apart will reduce populations of velvet worms, which utilise fallen logs between 35 and 55 years of decay.

WORKS PROGRAMME



BUSH FIRE MANAGEMENT ZONES - DEFINITIONS

Asset Protection Zone (APZ)	Stringent fuel management standards are applied in areas immediately adjoining assets to protect life and property.
Strategic Fire Management Zone (SFMZ)	Fuel levels are controlled to reduce fire intensity, rate of spread & spotting distance. May be strategically placed areas in areas of high ignition potential, to consolidate asset management zones, to break up areas of higher bushfire behaviour potential or limit the spread of fire. Recommended fuel levels (BFCC) are between 8-15 t/ha for 60-80% of zone (except near a watercourse or in rainforest).
Heritage Management Zone (HMZ)	Defines management strategies for the protection of areas with important natural or cultural values. Focus on conserving biodiversity.

RESERVE BUSH FIRE MANAGEMENT ZONES

Zone	Strategy	Guidelines
SFMZ 1 East of Bombay Trail	· Enhance trail as fire advantage by removing adjoining shrubbery. · Undertake strategic burn in area north of Bombay Creek if prescriptions are exceeded for zone (8-15t/ha for 60-80% of zone). · Participate in strategic burns south of Bombay Creek as part of co-operative programme with RFS and landholders.	· Chemical control of shrub layer, removal of saplings and canopy to Cat 1 tanker height for a minimum of 1m each side of carriageway. · Apply low- moderate intensity burn. The zone is 699 ha in size (6% of area), and has not burnt in recent history. · Implement in autumn to early winter to ensure prescription and area not exceeded. · Divide strategic zone into 2-3 sub-zones and burn sequentially to maintain smaller recently burnt areas while meeting biodiversity thresholds. · Focus incendiaries along ridge systems to break run of fire, to retain a mosaic of fire frequency and intensity within zone and protect soils from erosion on the steeper slopes along Bombay Creek (refer to soil stability map).
HMZ 1 Rest of planning area	· Minimise size and intensity of wildfires. · Exclude fire from at least part of each vegetation type, where possible.	· Wildfires will be suppressed by effective means · Attempts will be made to increase burn patchiness by use of incendiaries, retardant, water bombing etc.

WORKS PROGRAMME

Activity	Category	Name	Proposed Works	Schedule
Prescribed Burning	SFMZ 1	East of Bombay Trail	· Implement prescribed burn if fuel levels exceed RFS guidelines for zone, and/or · Implement prescribed burn as part of larger cooperative burn with RFS	If fuels>8-15t/ha for 60-80% of zone, or as agreed no more often than 5-7 yrs apart
Reserve Trails Maintenance	Key management trails	Black Range Trail Butmaroo Trail East Butmaroo Trail Gourock Trail Bombay Trail Bald Hill Trail Jinglemoney Trail Palerang Trail	· Chemical fuel reduction 1m each side of trail · Removal of saplings and trimming of canopy of mature trees to Cat 1 tanker height for 1m each side of trail · Install track head and intersection signage · Install additional turning or passing bays · Maintain carriageways to RFS secondary trail standard	Ongoing Ongoing 2006-07 Ongoing Routine
Reserve Trails Maintenance	Other trails	Management trails	· Maintain as required for general management purposes - will potentially need touching up for fire activities	Routine
Research & Monitoring	Fuel monitoring	SFMZ	· Visual assessment of peak loadings · Quantitative assessment pre- and post -burning	Biennially As required
Research & Monitoring	Fuel monitoring	Long unburnt and any new fire age classes.	· Quantitative assessment of surface and elevated fuels, estimation of overall fuel hazard	Every 7-10 yrs & with change.
Research & Monitoring	Fire history	Dendrochronology	· Encourage continuing research by Monash University to assess the long-term fire history of the reserves	Ongoing
Cooperative Fire Management	Fire field days	Neighbour and volunteer orientation	· Reserve orientation, discussion re goals & strategies in conjunction with local RFS	Ongoing