



NSW NATIONAL PARKS & WILDLIFE SERVICE

Crookwell Reserves Plan of Management

**Incorporating Thalaba Nature Reserve,
Gillindich Nature Reserve, Burwood Creek
Nature Reserve, Nuggetty State Conservation
Area and Mount Davies Nature Reserve**



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This plan of management was adopted by the Minister for Environment on 23 September 2020.

Published by:

Environment, Energy and Science
Department of Planning, Industry and Environment
Locked Bag 5022, Parramatta NSW 2124
Phone: +61 2 9995 5000 (switchboard)
Phone: 1300 361 967 (Environment, Energy and Science enquiries)
TTY users: phone 133 677, then ask for 1300 361 967
Speak and listen users: phone 1300 555 727, then ask for 1300 361 967
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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ISBN 978-1-922493-27-9
EES 2020/0447
November 2020

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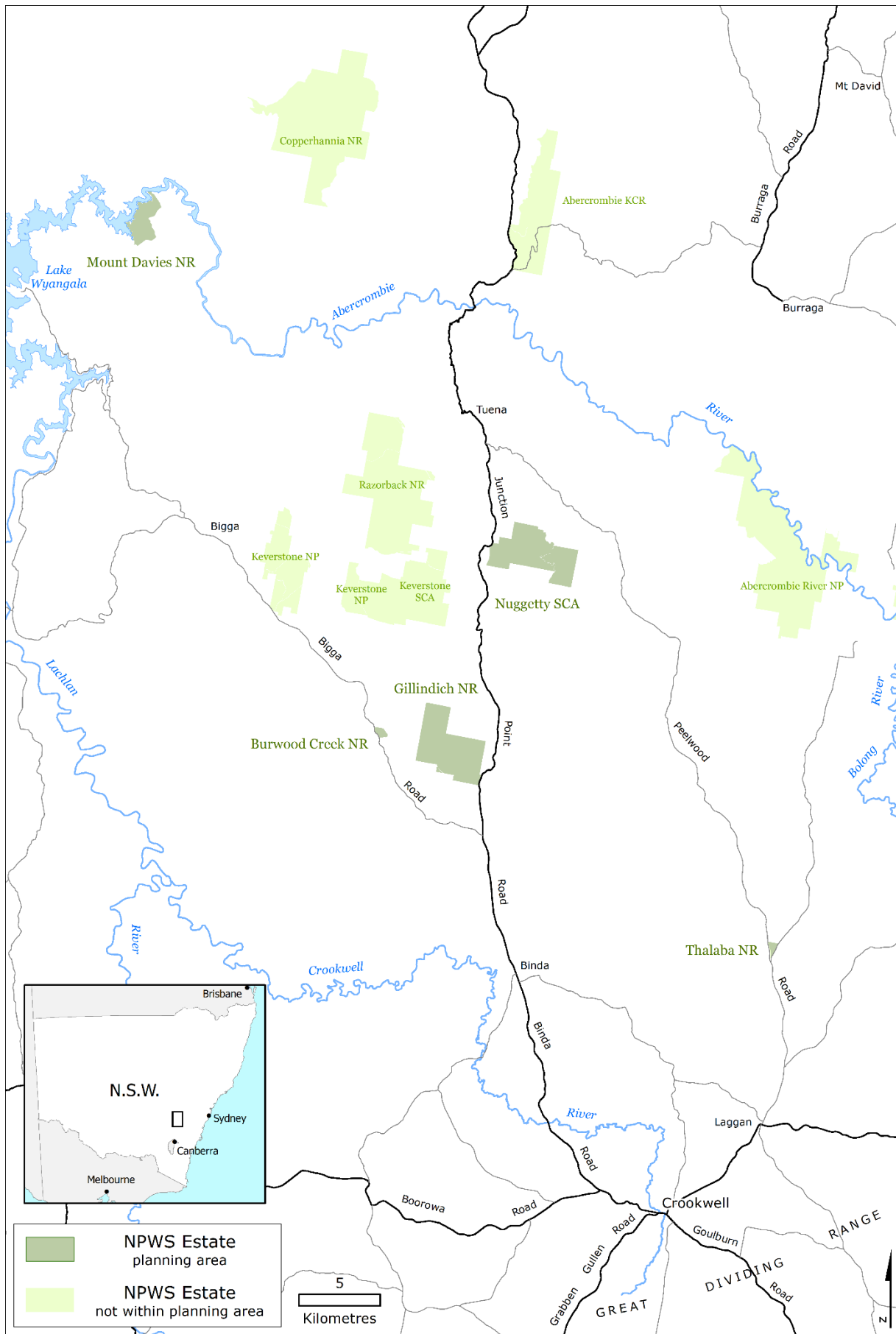


Figure 1 Regional locality and planning area map

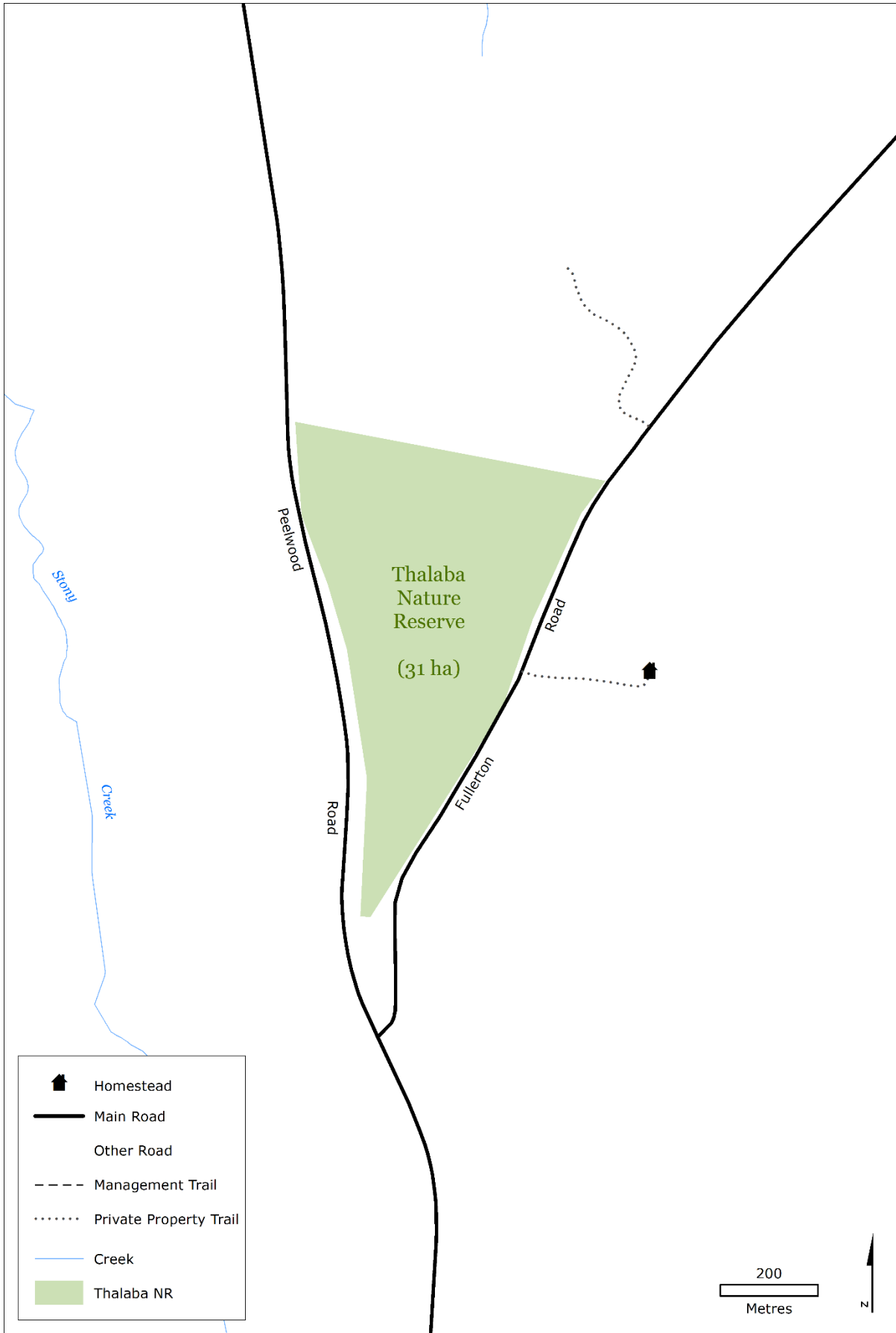


Figure 2 Thalaba Nature Reserve map

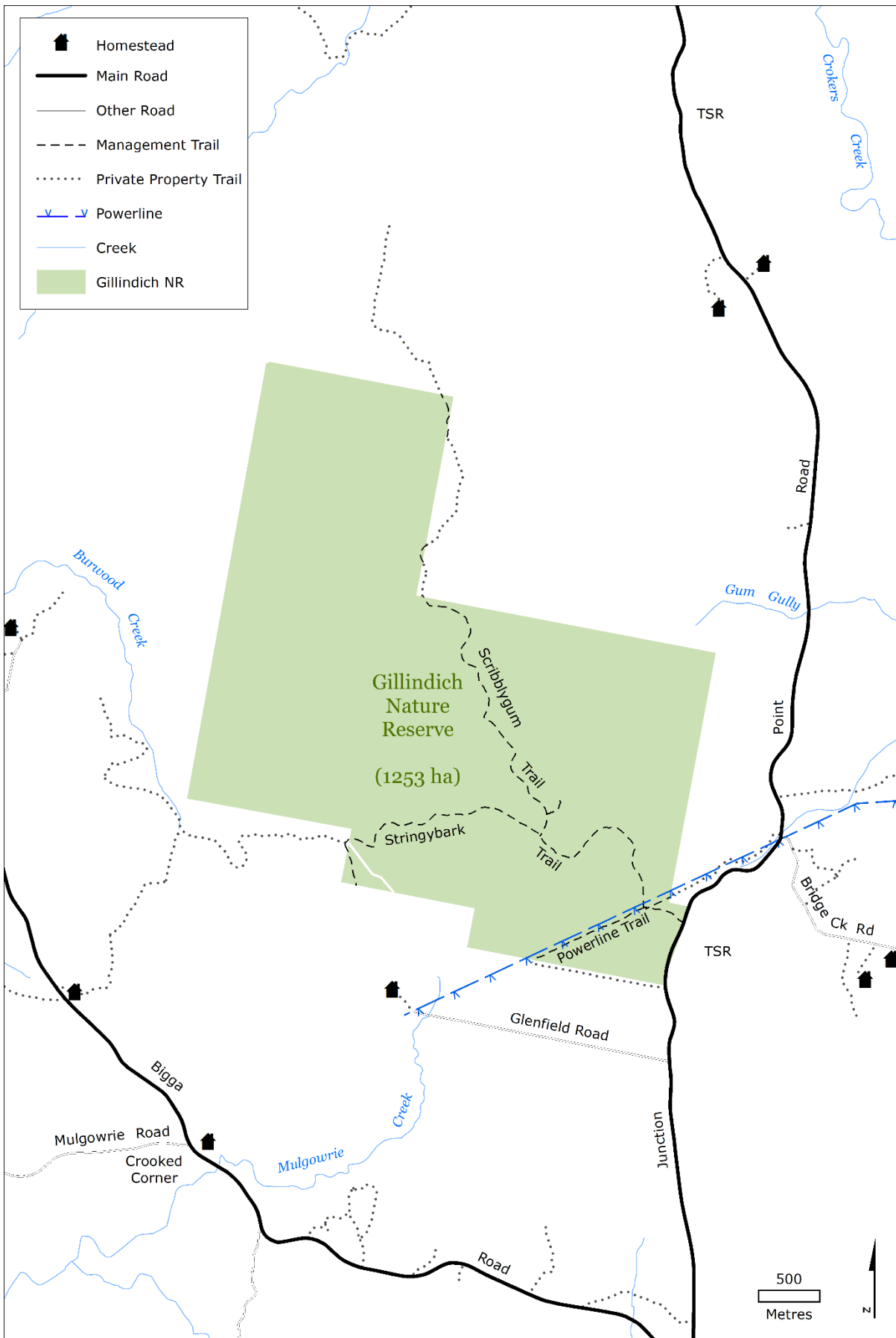


Figure 3 Gillindich Nature Reserve map

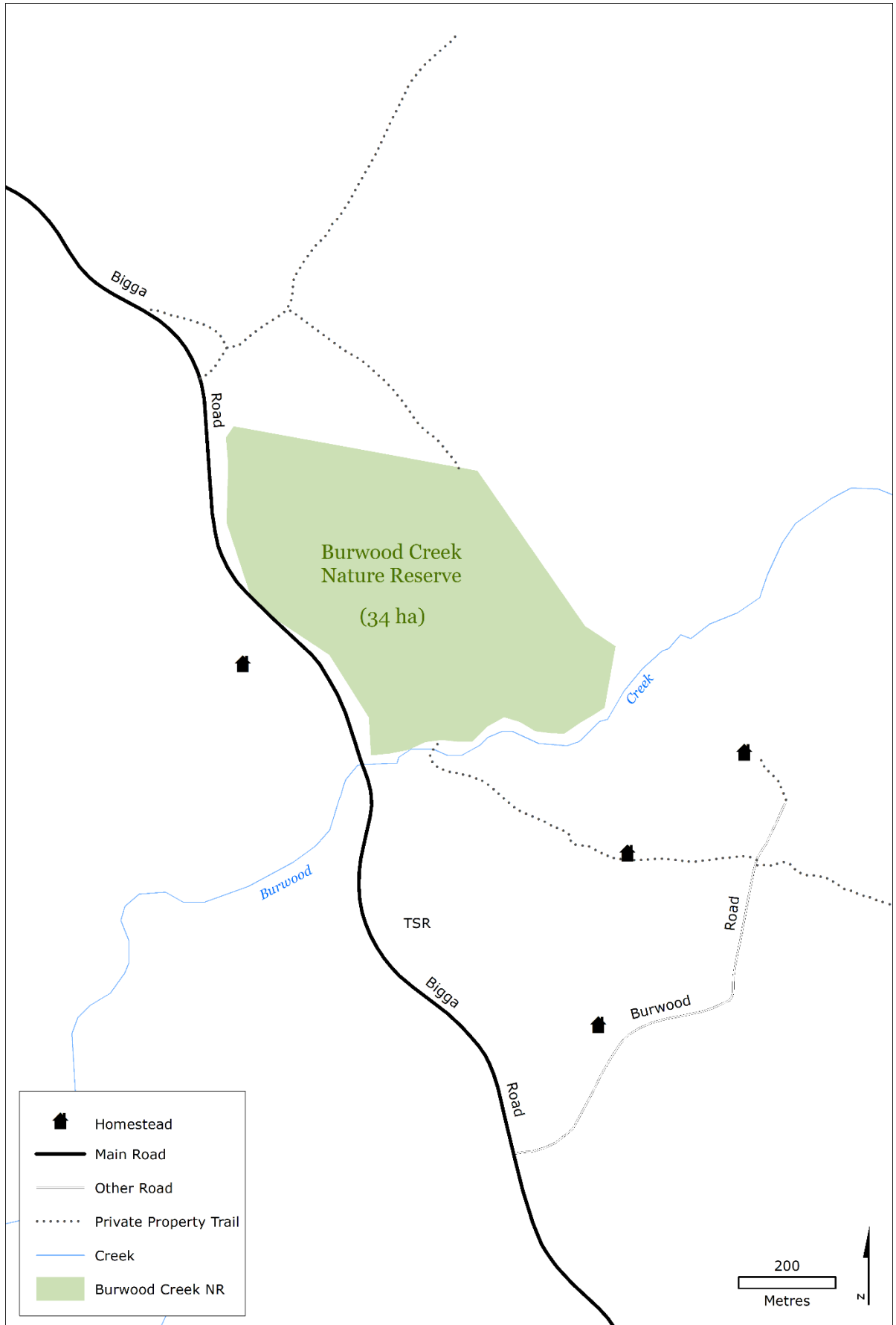


Figure 4 Burwood Creek Nature Reserve map

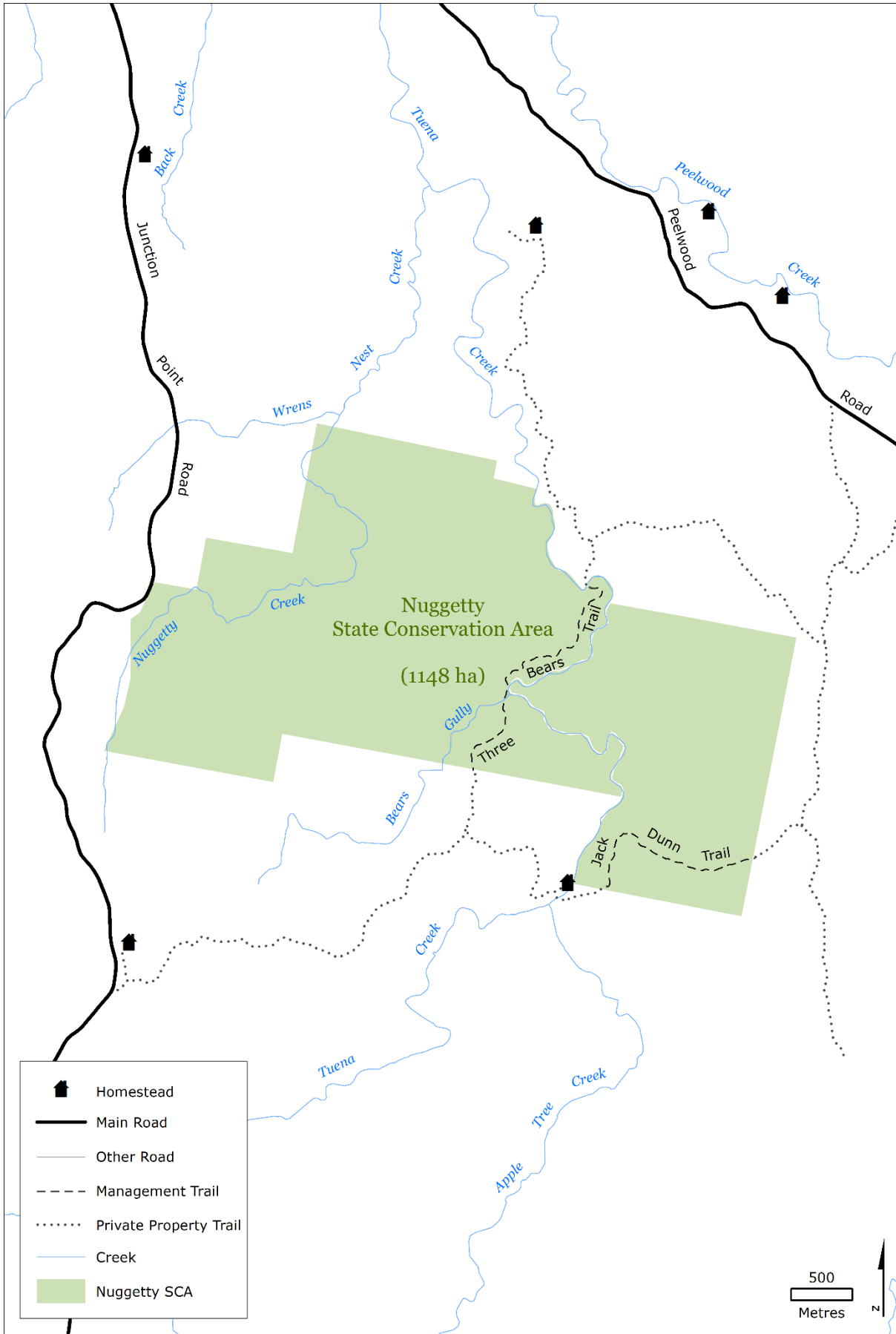


Figure 5 Nuggetty State Conservation Area map

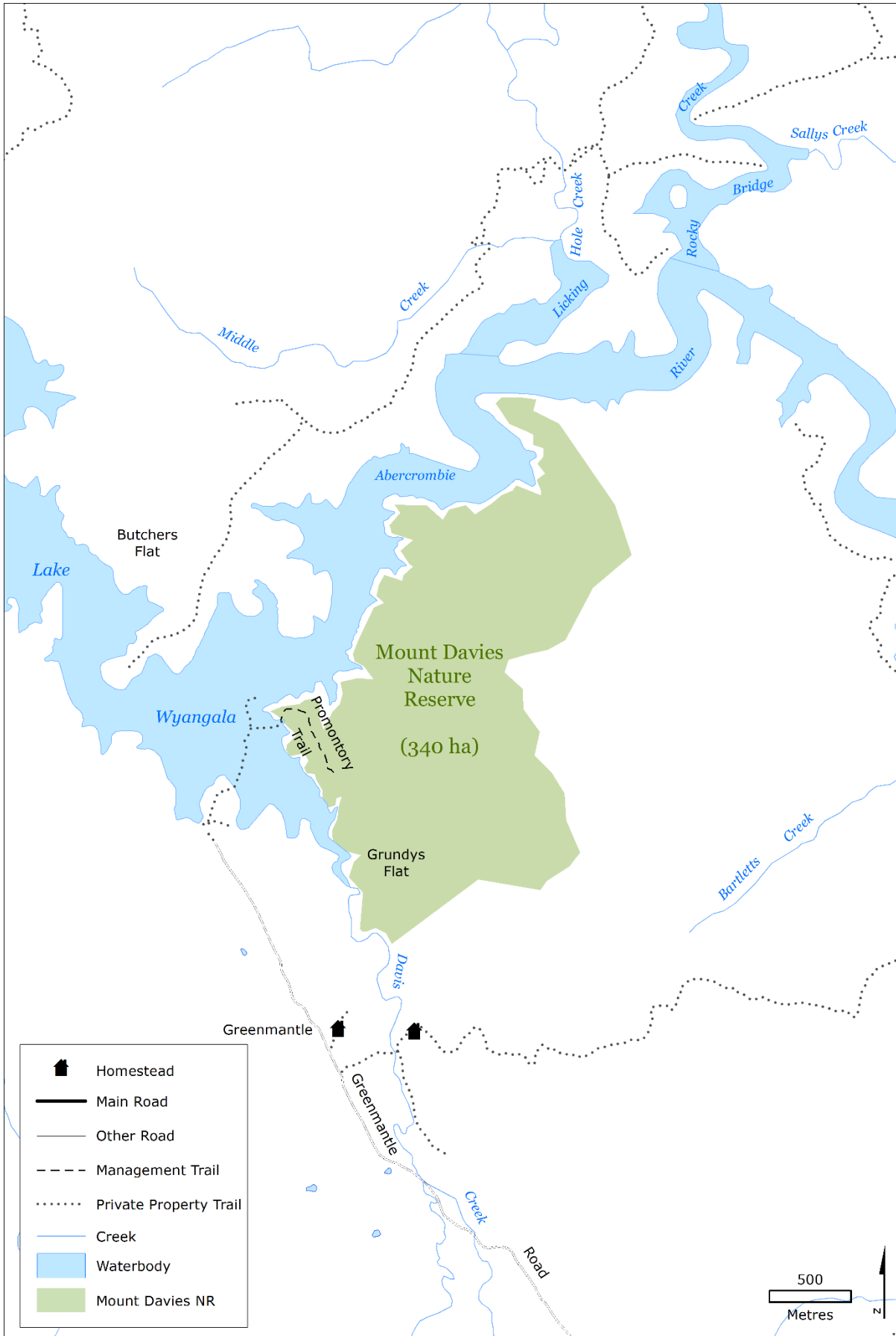


Figure 6 Mount Davies Nature Reserve map

1. Introduction

1.1 Location, reservation and regional setting

The Crookwell Reserves are a complex of five reserves located north of Crookwell in the NSW Southern Tablelands (Maps 1 to 6). They are, in a general progression from south to north: Thalaba Nature Reserve, Gillindich Nature Reserve, Burwood Creek Nature Reserve, Nuggetty State Conservation Area and Mount Davies Nature Reserve. They cover a combined area of 2806 hectares. They are collectively referred to as 'the reserves' in this plan of management.

Gillindich Nature Reserve (1253 hectares), Burwood Creek Nature Reserve (34 hectares) and Nuggetty State Conservation Area (1148 hectares) were reserved in August 2010. Thalaba Nature Reserve (31 hectares) and Mount Davies Nature Reserve (340 hectares) were reserved as state conservation areas in August 2010 and reclassified as nature reserves in November 2014.

All of the reserves were previously areas of Crown land that were recommended for addition to the protected area system as a result of the Goulburn Comprehensive Regional Assessment. These additions enhance the protection of a number of key vegetation communities and improve habitat connectivity in this fragmented and poorly conserved region.

The reserves, excluding Mount Davies Nature Reserve, lie within the South Eastern Highlands Bioregion, one of the 85 bioregions defined in Australia on the basis of common vegetation and land systems. Over 58% of the South Eastern Highlands Bioregion has been cleared for agriculture and development, and less than 10% of the bioregion is within conservation reserves. Mount Davies Nature Reserve and 15% of Nuggetty State Conservation Area lie within the NSW South Western Slopes Bioregion. Over 84% of this bioregion has been cleared and less than 3% is within conservation reserves (NPWS 2008).

The reserves are separated by up to 60 kilometres. They are clustered around a group of older parks, namely Keverstone National Park and State Conservation Area, and Razorback Nature Reserve. Other large parks in the vicinity include Copperhania Nature Reserve and Abercrombie River National Park and State Conservation Area.

The reserves are within the Upper Lachlan Shire Council Local Government Area, and the South East Local Land Services region.

The reserves lie within the boundaries of the Pejar Local Aboriginal Land Council, except Mount Davies Nature Reserve which is in the Cowra Local Aboriginal Land Council area. The Crookwell Reserves border onto or are within the traditional Country of the Wiradjuri, Gundungurra and Ngannawal peoples.

2. Management context

2.1 Legislative and policy framework

The management of nature reserves and state conservation areas in New South Wales is in the context of a legislative and policy framework, primarily the *National Parks and Wildlife Act 1974* and Regulation, the *Biodiversity Conservation Act 2016* and the policies of the National Parks and Wildlife Service (NPWS).

Other legislation, international agreements and charters may also apply to management of the area. In particular, the *Environmental Planning and Assessment Act 1979* may require the assessment and mitigation of the environmental impacts of any works proposed in this plan. The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 also applies in relation to actions that may impact migratory and threatened species listed under that Act. The *NSW Heritage Act 1977* may apply to the excavation of known archaeological sites or sites with potential to contain historical archaeological relics.

A plan of management is a statutory document under the National Parks and Wildlife Act. Once the Minister has adopted the plan, no operations may be undertaken within Thalaba Nature Reserve, Gillindich Nature Reserve, Burwood Creek Nature Reserve, Nuggetty State Conservation Area or Mount Davies Nature Reserve except in accordance with the plan. This plan will also apply to any future additions to these reserves. Should management strategies or works be proposed for these reserves or any additions that are not consistent with the plan, an amendment to this plan or a new plan will be prepared and exhibited for public comment.

2.2 Management purposes and principles

2.2.1 Nature reserves

Nature reserves are reserved under the National Parks and Wildlife Act to protect and conserve areas containing outstanding, unique or representative ecosystems, species, communities or natural phenomena.

Under section 30J of the Act, nature reserves are managed to:

- conserve biodiversity, maintain ecosystem functions, and protect geological and geomorphological features and natural phenomena
- conserve places, objects, features and landscapes of cultural value
- promote public appreciation, enjoyment and understanding of the reserve's natural and cultural values
- provide for appropriate research and monitoring.

Nature reserves differ from national parks in that they do not have the provision of recreation as a management principle.

2.2.2 State conservation areas

State conservation areas are reserved under the National Parks and Wildlife Act to protect and conserve areas that contain significant or representative ecosystems, landforms or natural phenomena or places of cultural significance; that are capable of providing opportunities for sustainable visitor or tourist use and enjoyment, the sustainable use of

buildings and structures, or research; and that are capable of providing opportunities for uses permitted under other provisions of the Act.

Under section 30G the Act, state conservation areas are managed to:

- conserve biodiversity, maintain ecosystem functions, protect natural phenomena and maintain natural landscapes
- conserve places, objects and features of cultural value
- provide for the undertaking of uses permitted under other provisions of the Act (including uses permitted under section 47J such as mineral exploration and mining), having regard to the conservation of the natural and cultural values of the state conservation area
- provide for sustainable visitor or tourist use and enjoyment that is compatible with conservation of the area's natural and cultural values and with uses permitted in the area
- provide for sustainable use (including adaptive re-use) of any buildings or structures or modified natural areas having regard to conservation of the area's natural and cultural values and with other uses permitted in the area
- provide for appropriate research and monitoring.

The National Parks and Wildlife Act requires a review of the classification of state conservation areas every 5 years in consultation with the Minister administering the *Mining Act 1992*. In the long term it is intended for Nuggetty State Conservation Area to become a nature reserve.

2.3 Statement of significance

The Crookwell Reserves are considered to be of significance for:

- **Biological values:** The reserves protect a number of key vegetation communities in this poorly conserved region, including an area of the White Box – Yellow Box – Blakely's Red Gum Woodland endangered ecological community. Nine animal species listed under the Biodiversity Conservation Act have been recorded in the reserves. The reserves also provide suitable habitat for several other threatened species, and support a large variety of native fauna and flora.
- **Landscape/Catchment values:** The reserves are important vegetated remnants within a landscape that has been extensively cleared for agriculture.
- **Historic heritage values:** Excavation diggings occur on the banks and flats of Tuena Creek in Nuggetty State Conservation Area and provide evidence of previous mining activity. A small section of rock wall located in Mount Davies Nature Reserve may be a remnant of a bridle path.

2.4 Specific management directions

In addition to the general principles for the management of nature reserves and state conservation areas, management of the Crookwell Reserves will focus on:

- protection of the range of plant and animal communities within the reserves, with particular attention to minimising further fragmentation, enhancing connectivity to other remnants, and the maintenance of populations of threatened or regionally significant species and communities
- protection of Aboriginal cultural values in consultation with the local Aboriginal community

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- cooperation with the NSW Rural Fire Service and the local community regarding fire management activities and fire suppression in the reserves
- control of introduced plant and animal species, including through cooperative programs with neighbours and Local Land Services
- encouragement of appropriate use of the reserves.

3. Values

The location, landforms and plant and animal communities of an area have determined how it has been used and valued. Both Aboriginal and non-Aboriginal people place values on natural areas, including aesthetic, social, spiritual and recreational values. These values may be attached to the landscape as a whole or to individual components, for example to plant and animal species used by Aboriginal people. This plan of management aims to conserve both natural and cultural values. To make the document clear and easy to use, various aspects of natural heritage, cultural heritage, threats and ongoing use are dealt with individually, but their interrelationships are recognised.

3.1 Geology, landscape and hydrology

The reserves lie in central eastern New South Wales. The landscape of the reserves was formed by uplifting associated with the underlying Lachlan Fold Belt. The Lachlan Fold Belt covers most of New South Wales and Victoria and also extends to other eastern states and territories. It is a geological zone of folded and faulted rocks formed in the Middle Paleozoic between 450 and 340 million years ago. It consists of sandstones, shales and volcanic rocks which have been intruded by numerous granite bodies and deformed by four episodes of folding, faulting and uplift.

The area consists of Paleozoic sedimentary sequences (Ordovician to Permian) overlain in part by Cenozoic volcanic rocks such as basalts. The general structural trend in this region is north–south and the undulating topography of the reserves strongly reflects this (NPWS 2003).

All of the reserves contain a mix of sedimentary and volcanic rocks. A widespread band of older marine sediments called the Adaminaby Group underlies all of the reserves. These sediments formed in the Ordovician period (488 to 443 million years ago). These sedimentary deposits are known as turbidites (in this case deposited from massive submarine landslides) and comprise sandstones, mudstones, shales, chert and quartzite.

In Nuggetty State Conservation Area (SCA) and Gillindich, Burwood Creek and Thalaba nature reserves (NR) the Adaminaby Group sediments are interspersed with extrusive volcanic rocks.

In Mt Davies NR the Adaminaby Group sediments were intruded by a biotite granite intrusion (the Bartletts Creek granite) in the late Silurian period (443 million years ago). Similarly, in Burwood Creek NR the western portion of the reserve is intruded by granite of the late Silurian period (the Yarra Aplite) and the eastern portion of the reserve is based on the Adaminaby Group and undifferentiated volcanics.

Thalaba NR and Nuggetty SCA form part of a plateau surface which is generally characterised by low rolling hills referred to as the Rockley Plains Landscape (DECC 2008), although Nuggetty SCA does contain linear ranges steeper than the surrounding landscape. The soils derived from this landscape contain red and yellow texture-contrast soils often with prominent bleached A2 horizons (DECC 2008). Texture-contrast soils have an abrupt increase in clay content down the soil profile, which can restrict drainage and cause waterlogging, and are often erodible. Bleached A2 horizons can be associated with texture-contrast soils. They are lighter in colour because minerals have been washed out. Many of the slopes in Nuggetty SCA are steep and highly erodible, with skeletal soils.

Nuggetty SCA has a history of gold mining, particularly along the Tuena Creek. The Peelwood Silver, Copper and Lead Mine was located approximately 16 kilometres south-west of Tuena (Hogan 1993).

Gillindich and Burwood Creek NRs contain soils which are yellow, hard setting texture-contrast soils with distinct bleached A2 horizons. Burwood Creek NR also contains the linear ranges and rounded hills on lower Silurian gneissic and foliated granite, of the Gunning Hills Landscape (DECC 2008). The soil consists of siliceous uniform sands, red earths and yellow texture-contrast soils, and provides the underlying substrate for the endangered White Box – Yellow Box – Blakely's Red Gum Woodland ecological community.

Mt Davies NR forms part of the westerly facing slope draining towards Wyangala Dam. The soils derived from the rocky outcrops of granite are thin loamy sands between outcrops, red texture-contrast soils on upper slopes grading to yellow texture-contrast soils on lower slopes and there is an accumulation of siliceous coarse sands along streams, characteristic of the Wyangala Hills Landscape (DECC 2008). Black cypress pine (*Callitris endlicheri*) are found in the infertile soils of the rocky outcrops which dominate the reserve.

Soil erosion is present in the reserves, particularly within gully systems and areas of disturbance, such as the trail network. The drainage lines in Burwood Creek NR are actively eroding, resulting in gullies that are several metres deep.

There are few watercourses in the reserves. Nuggetty SCA contains Tuena Creek, which forms the major tributary through the reserve and drains into the Abercrombie River. Gillindich NR contains unnamed tributaries that drain into Tuena Creek. Burwood Creek forms the southern boundary of Burwood Creek NR. Tuena Creek is the only perennial watercourse within the reserves.

3.2 Native plants

The region is characterised by a pattern of extensively cleared forest and woodland. Much of the remaining vegetation occurs in very small patches or as scattered trees. This fragmentation is largely the result of past clearing for agricultural purposes (RACAC 2002).

The reserves contain some of the only substantial vegetated areas remaining in the region, protecting a number of key vegetation communities that are underrepresented within the reserve system.

The vegetation communities in the Crookwell Reserves are shown in Table 1.

Burwood Creek NR contains White Box – Yellow Box – Blakely's Red Gum Woodland (referred to as Box Gum Woodland) which is listed as an endangered ecological community (EEC) under both the NSW Biodiversity Conservation Act and the Commonwealth Environment Protection and Biodiversity Conservation Act. Although locations are not currently known, there is the potential for this EEC to also occur in Gillindich and Mount Davies NRs and Nuggetty SCA, particularly on the lower slopes or in drainage lines. Flora species located in these areas may meet the definition of the EEC, however, it is questionable whether the areas containing this suite of species would be recognised as a distinct vegetation community or whether they are an ecotonal part of the broader vegetation mosaic, which would not be recognised as the EEC.

The threatened Yass daisy (*Ammobium craspedioides*) has been recorded in Burwood Creek NR and the endangered aromatic peppergrass (*Lepidium hyssopifolium*) is known from Burwood Creek NR.

The *Biodiversity Conservation Program* contains strategies for the recovery of threatened ecological communities and species. Actions to recover this community include pest and weed control using methods that do not disturb native species within the remnant, and the retention of fallen timber. A national recovery plan is available for this community (DECCW 2011).

The most significant threats to ecological values in the reserves include burning of drought-stressed vegetation, competition from weeds, and impacts from feral animals, particularly goats.

Table 1 Summary of vegetation communities located within the Crookwell Reserves
(from Gellie 2005 and Miles 2010)

Reserve and vegetation community	Dominant species	Structure	Geomorphology
Thalaba Nature Reserve			
Central Northern Tablelands Dry Shrub / Grass Forest	<p>Main canopy: <i>Eucalyptus dalrympleana</i>, <i>E. dives</i>, <i>E. bridgesiana</i>, <i>E. macrorhyncha</i>, <i>E. goniocalyx</i></p> <p>Shrub layer: <i>Acacia dealbata</i>, <i>Cassinia</i> sp., <i>Exocarpus strictus</i></p> <p>Understorey: <i>Poa sieberiana</i> var. <i>sieberiana</i>, <i>Rytidosperma pallidum</i>, <i>Rytidosperma racemosa</i> var. <i>racemosa</i>, <i>Microlaena stipoides</i>, <i>Themeda triandra</i></p>	Moderately tall forest with shrub/tussock grass understorey	Rolling hills
Gillindich Nature Reserve			
Widespread Tablelands Dry Shrub / Tussock Grass Forest	<p>Main canopy: <i>Eucalyptus macrorhyncha</i>, <i>E. dives</i>, <i>E. mannifera</i></p> <p>Shrub layer: <i>Daviesia leptophylla</i>, <i>Acacia falciformis</i>, <i>A. gunnii</i>, <i>Brachyloma daphnoides</i>.</p> <p>Understorey: <i>Rytidosperma pallidum</i>, <i>Poa sieberiana</i></p>	Moderately tall forest with shrub/tussock grass understorey	Slopes with southerly aspect at southern end of reserve, and on lower slopes of central creek line
Tablelands Dry Shrub / Tussock Grass Forest	<p>Main canopy: <i>Eucalyptus rossii</i>, <i>E. macrorhyncha</i>, <i>E. dives</i></p> <p>Sub-canopy: <i>E. goniocalyx</i>, <i>Acacia falciformis</i></p> <p>Understorey: <i>Rytidosperma pallidum</i>, <i>Daviesia leptophylla</i>, <i>Acacia gunnii</i>, <i>Brachyloma daphnoides</i>, <i>Poa sieberiana</i>, <i>Lomandra</i> sp.</p>	Moderately tall forest with shrub/tussock grass understorey	Exposed slopes and ridges
Tableland Dry Grassy Woodland	<p>Main canopy: <i>Eucalyptus melliodora</i>, <i>E. bridgesiana</i></p> <p>Shrub layer: <i>Acacia dealbata</i></p>	Grassy woodland	Major creek lines

Reserve and vegetation community	Dominant species	Structure	Geomorphology
Understorey: <i>Microlaena stipoides</i> , <i>Pteridium esculentum</i>			
Burwood Creek Nature Reserve			
Tableland Dry Grassy Woodland (includes White Box – Yellow Box – Blakely's Red Gum Woodland EEC)	Main canopy: <i>Eucalyptus melliodora</i> , <i>E. bridgesiana</i> Understorey: <i>Themeda australis</i> , <i>Rytidosperma</i> sp., <i>Aristida</i> sp.	Grassy woodland	Rolling hills
Nuggetty State Conservation Area			
Tablelands Dry Shrub / Tussock Grass Forest	Main canopy: <i>Eucalyptus rossii</i> , <i>E. macrorrhyncha</i> , <i>E. polyanthemos</i> , <i>E. mannifera</i> Understorey: <i>Rytidosperma pallidum</i> , <i>Brachyloma daphnoides</i> , <i>Poa sieberiana</i> , <i>Lomandra</i> sp., <i>Xanthorrhoea glauca</i>	Moderately tall forest with shrub/tussock grass understorey	Exposed slopes and ridges
Tableland Dry Grassy Woodland	Main canopy: <i>Eucalyptus melliodora</i> , <i>E. bridgesiana</i> Shrub layer: <i>Acacia dealbata</i> Understorey: <i>Themeda australis</i> , <i>Rytidosperma</i> sp., <i>Microlaena stipoides</i>	Grassy woodland	Sheltered slopes
Riparian Acacia Shrub / Grass / Herb Forest	Main canopy: <i>Casuarina cunninghamiana</i> Shrub layer: <i>Acacia mearnsii</i> Understorey: <i>Microlaena stipoides</i> , <i>Lomandra</i> sp., <i>Pteridium esculentum</i>	Tall forest	Tuena Creek
Mount Davies Nature Reserve			
South West Slopes Tall Shrubland Low Forest	Main canopy: <i>Callitris endlicheri</i> , <i>Eucalyptus sideroxylon</i> , <i>E. dealbata</i> , <i>E. polyanthemos</i> Shrub layer: <i>Acacia doratoxylon</i> Understorey: <i>Gonocarpus elatus</i>	Low forest	Exposed slopes and ridges

Reserve and vegetation community	Dominant species	Structure	Geomorphology
Western Slopes Shrub / Herb / Grass Dry Forest	Main canopy: <i>E. goniocalyx</i> , <i>E. albens</i> Understorey: <i>Poa sieberiana</i> , <i>Cassinia quinquefaria</i>	Moderately tall forest with shrub/tussock grass understorey	Lower slopes

3.3 Native animals

Preliminary surveys (Mills & Robertson 2010) suggest that the reserves support a large variety of native fauna including 80 species of birds, 23 mammal species, 20 species of reptile, and nine species of frogs. Mammals found on the reserves include the eastern grey kangaroo (*Macropus giganteus*), red-necked wallaby (*Macropus rufogriseus*), swamp wallaby (*Wallabia bicolor*), wallaroo (*Macropus robustus*), brushtail possum (*Trichosurus vulpecula*), ringtail possum (*Pseudocheirus peregrinus*), greater glider (*Petauroides volans*), sugar glider (*Petaurus breviceps*), wombat (*Vombatus ursinus*), echidna (*Tachyglossus aculeatus*), agile antechinus (*Antechinus agilis*), water rat (*Hydromys chrysogaster*) and 11 species of bat.

Table 2 details the nine threatened fauna species that are known to occur within the reserves. The presence of threatened species identified during the surveys indicates the reserves are valuable as habitat.

The presence of powerful owls and the identification of a high density of prey species (greater gliders) and roost trees signal that the Gillindich and Burwood Creek NRs are likely to be significant habitat for powerful owls (Mills & Robertson 2010).

There is potential for koalas (*Phascolarctos cinereus*) to occur within gullies containing ribbon gum (*Eucalyptus viminalis*) in Gillindich NR. Also, although the glossy black-cockatoo (*Calyptorhynchus lathamii*) is currently not known to occur within the reserves, the river sheoak (*Casuarina cunninghamiana*) that lines Tuena Creek in Nuggetty SCA is known to be prime foraging habitat for this species (Mills & Robertson 2010). Boorolong frog have been recorded in Tuena Creek in Nuggetty SCA (Mills & Robertson 2010).

The *Biodiversity Conservation Program* and national recovery plans contain strategies for the recovery of threatened animal species. A recovery plan has been prepared for the large forest owls, which includes the powerful owl (DEC 2006). Continued management of habitat values, such as hollow bearing trees, structural complexity of some habitats and open understorey vegetation of other habitats; and weed and feral animal control are required to limit further decline of threatened species.

Table 2 Threatened fauna species known to occur within the reserves

(Mills & Robertson 2010)

Common name	Scientific name	Status under BC Act					
			Thalaba NR	Gillindich NR	Burwood Ck NR	Nuggetty SCA	Mt Davies NR
Frogs:							
Booroolong frog	<i>Litoria booroolongensis</i>	Endangered				✓	
Birds:							
Gang-gang cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable		✓	✓		
Powerful owl	<i>Ninox strenua</i>	Vulnerable		✓	✓		
Scarlet robin	<i>Petroica boodang</i>	Vulnerable		✓		✓	
Speckled warbler	<i>Chthonicola sagittata</i>	Vulnerable				✓	
Varied sittella	<i>Daphoenositta chrysoptera</i>	Vulnerable		✓			
Mammals:							
Eastern false pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable		✓			
Southern myotis (fishing bat)	<i>Myotis macropus</i>	Vulnerable				✓	
Spotted-tailed quoll	<i>Dasyurus maculatus</i>	Vulnerable		✓			

3.4 Aboriginal heritage

Aboriginal communities have an association and connection to the land. The land and water within a landscape are central to Aboriginal spirituality and contribute to Aboriginal identity. Aboriginal communities associate natural resources with the use and enjoyment of foods and medicines, caring for the land, passing on cultural knowledge, kinship systems and strengthening social bonds. Aboriginal heritage and connection to nature are inseparable from each other and need to be managed in an integrated manner across the landscape.

The reserves lie within or border onto the traditional Country of the Wiradjuri, Gundungurra and Ngannawal peoples. The reserves lie within the boundaries of the Pejar Local Aboriginal Land Council, apart from Mount Davies NR which is in the Cowra Local Aboriginal Land Council area.

The Onerwal and Pejar local Aboriginal land councils were consulted during the Goulburn Comprehensive Regional Assessment process, to explain the objectives and intended outcomes of the assessment and to seek their consideration and input (RACAC 2002).

Aboriginal sites recorded in the local region include open campsites, shelters with art/deposits, and modified trees. An art site is located on private land within close proximity to Bigga. Given this, it is likely that other sites exist on the reserves. An Aboriginal site survey of Gillindich NR was conducted by NPWS staff in April 2011. The survey was conducted along the trail network, as it provided disturbed areas with suitable visibility. Approximately 6.5 kilometres of trail was surveyed, which traversed ridgelines. No cultural

material was found within Gillindich NR during the survey. Aboriginal site surveys have not been conducted in any of the other reserves.

The key threats to the potential Aboriginal sites are fire and fire management operations (see section 4.2).

3.5 Shared heritage

Cultural heritage comprises places and items that may have historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance. Prior to gazettal, the reserves were Crown lands mostly held under lease or permissive occupancy. Evidence of past grazing use in the reserves includes old fence lines. Gillindich NR and Nuggetty SCA are located in rugged country and were at best marginal areas for pastoral and agricultural activities.

There is evidence of past mining activity in Nuggetty SCA. Excavation pits and diggings, approximately half a metre deep, occur adjacent to Tuena Creek. The operational details of these particular diggings are not known. Two historic, underground gold mines, the Nuggetty Gully Reef Workings and the Red Flag Mine, are located in the west of Nuggetty SCA, and shafts associated with the Dog Trap mining complex are recorded in, or near to, Gillindich NR. It is not known if any physical evidence of these mines exists. The remains of a smelter at the closed Cordillera Mine occur on private land to the north-east of the reserve.

In the main gully north of the promontory in Mount Davies NR, a metre-wide section of path (possibly an old bridle trail) has been constructed across the steep slope by building up a rock retaining wall. It starts at the foot of a steep cascade on the southern slopes of the gully, traverses the slope in a north-westerly direction and ends approximately 50 metres on (Miles 2010).

Hut ruins are located in the north-east section of Thalaba NR. Neighbours suggest the hut was built by the previous lessee to use as weekend accommodation.

3.6 Recreation, education and research

The current level of use of the reserves is low and there are no visitor facilities in the reserves. The reserves are not considered a priority for development of visitor facilities due to their management objectives as nature reserves, their small size, and their lack of proximity to population centres and major travel routes.

Gillindich, Burwood Creek and Thalaba NRs and Nuggetty SCA each have at least one frontage to a minor public road. There is no public road frontage to Mount Davies NR. There are no trails in Burwood Creek or Thalaba NRs and access to the trails in Nuggetty SCA are through private property.

Tuena Creek passes through Nuggetty SCA and is largely within a Crown waterway reserve, excised from park. Fossicking is permissible in all areas of Nuggetty SCA except for in the banks and alluvial flats adjoining Tuena Creek, due to risks posed to Aboriginal and historic heritage. Fossicking must comply with relevant legislation, policy and minimal impact guidelines, such as the Mining Regulation 2016, NPWS *Fossicking Policy* (NPWS 2018) and *Fossicking: A guide to fossicking in NSW* (NSW Resources Regulator 2010).

There is evidence that some illegal use of the reserves occurs, such as hunting and timber collecting.

Research into the natural and cultural features of the reserves and their maintenance requirements is important as it provides an effective framework for making informed management decisions. Research to date has included flora and fauna surveys, preliminary surveys for cultural heritage, and assessments of fire fuel levels in the reserves.

4. Threats

4.1 Weeds and pest animals

Pest species are plants, animals and pathogens that have negative environmental, economic and social impacts and are most commonly introduced species. Pests can have impacts across the range of park values, including impacts on biodiversity, cultural heritage, catchment and scenic values.

The *Biosecurity Act 2015* and its regulations provide specific legal requirements for the response, management and control of biosecurity risks, including weeds and pest animals. These requirements apply equally to public land and privately owned land. Under this framework, Local Land Services has prepared regional strategic weed management plans and regional strategic pest animal management plans for each of its 11 regions, including the South East Region (South East LLS 2017 and South East LLS 2018).

The Local Land Services plans identify priority weeds and pest animals in each of the regions, plus the appropriate management response for the region (i.e. prevention/alert, eradication, containment or asset protection).

NPWS prepares regional pest management strategies which identify the operations and control actions undertaken by NPWS to meet the priorities from regional strategic pest and weed management plans. This also includes other important programs such as the *Biodiversity Conservation Program*.

The overriding objective of the NPWS regional pest management strategies is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. These strategies are regularly updated. Reactive programs may also be undertaken in cooperation with neighbouring land managers, for example, in response to emerging issues.

A weed is defined in this plan as any plant species not native to the reserves. Consistent with the *South East Local Land Services Regional Strategic Weed Management Plan* (South East LLS 2017) and NPWS regional pest management strategies control programs in the reserves will target:

- serrated tussock (*Nassella trichotoma*)
- blackberry (*Rubus fruticosus*)
- sweet briar (*Rosa rubiginosa*)
- St John's wort (*Hypericum perforatum*).

These species generally exist in low to medium numbers in the reserves, and occur in areas of disturbance such as old sheep camps and trails, or productive areas such as creek lines. Dense serrated tussock infestations exist within the main drainage line in Gillindich NR and along Nuggety Creek and adjacent spur lines in Nuggety SCA. Serrated tussock and blackberry are declared Weeds of National Significance.

A pest animal is defined in this plan as any animal species not native to the reserves. Pest animals within the reserves and on adjoining land are of concern because they have the potential to have detrimental effects on native animal communities through competition for resources, predation, disturbance and transmission of diseases. Pest animals can also impact native vegetation and have the potential to have an adverse economic impact on neighbouring properties.

Table 3 details the pest species that are known to occur within the reserves.

Table 3 Pest species known to occur within the reserves (Mills & Robertson 2010)

Common name	Scientific name					
		Thalaba NR	Gillindich NR	Burwood Ck NR	Nuggetty SCA	Mt Davies NR
Cat	<i>Felis catus</i>	✓	✓	✓	✓	✓
Dog	<i>Canis familiaris</i>		✓		✓	
Fallow deer	<i>Dama dama</i>				✓	
Goat	<i>Capra hircus</i>				✓	✓
Hare	<i>Lepus capensis</i>	✓				
Pig	<i>Sus scrofa</i>		✓		✓	
Rabbit	<i>Oryctolagus cuniculus</i>	✓	✓		✓	✓
Red fox	<i>Vulpes vulpes</i>	✓	✓	✓	✓	✓
Sheep/Cattle	<i>Ovus aries / Bos taurus</i>		✓			

All species identified in Table 3, excluding sheep/cattle and hares, have been listed as a key threatening process under the Biodiversity Conservation Act and a threat abatement plan has been endorsed for foxes. Rabbits, goats, foxes, cats and pigs are also listed as key threatening processes under the Environment Protection and Biodiversity Conservation Act.

There is frequent evidence of pig digging along the banks of Tuena Creek and adjoining flats in Nuggetty SCA. This has the potential to significantly degrade habitat quality for fauna species associated with the riparian habitat, including two threatened species: the Booroolong frog and southern myotis bat.

Goats also have the potential to significantly degrade the habitat of native species. Small patches of heath occurring in Nuggetty SCA provide good quality habitat for small mammals, however, almost all of this heath appears to be affected by grazing, most likely by goats. Feral goats may account for the low diversity of shrubs detected and lack of recruitment of black cypress pine and currawang (*Acacia doratoxylon*) in Mount Davies NR (Miles 2010).

Control programs for these species are implemented as needed in line with the NPWS regional pest management strategy.

The reserves are primarily surrounded by cattle and sheep properties. There is some evidence of stock occasionally straying into the reserves.

4.2 Fire

The primary objectives of NPWS fire management are to protect life, property, community assets and cultural heritage from the adverse impacts of fire, while also managing fire regimes in parks to maintain and enhance biodiversity. NPWS also assists in developing fire management practices that contribute to conserving biodiversity and cultural heritage across the landscape, and implements cooperative and coordinated fire management arrangements with other fire authorities, neighbours and the community (OEH 2013).

Little information is available about the fire history of the reserves. Anecdotal reports indicate the reserves have been subject to some fires started by lightning, but these have been quickly extinguished and there is little evidence of recent fires in the reserves.

The reserves generally contain dry sclerophyll forest in undulating country.

There are few assets that are vulnerable to fire within the reserves, but all the reserves adjoin areas of private grazing land with associated houses and outbuildings. A campus of Trinity Grammar School is located adjacent to Mount Davies NR.

The greatest fire threats are from lightning, arson, escaped hazard reduction burning and accidental ignitions on the reserves, nearby properties or public roads.

Fire management strategies, which define the fire management approach for the park, are in development. The strategies will outline the recent fire history of the reserves, key assets within and adjoining the reserves including sites of natural and cultural heritage value, fire management zones, and fire control advantages such as management trails and water supply points.

Fuel monitoring sites are being established in the reserves to provide baseline information to monitor fire fuel levels.

NPWS maintains cooperative arrangements with surrounding landowners and Rural Fire Service brigades and is an active participant in the Southern Tablelands Bush Fire Management Committee. Cooperative arrangements include trail maintenance, asset protection, fuel management, support for neighbour fire management efforts and information sharing.

4.3 Isolation and fragmentation

The area surrounding each of the reserves has been extensively cleared, which has resulted in a high loss of biodiversity and fragmentation of habitat in the region. Long-term conservation of biodiversity depends on the protection, enhancement and connection of remaining habitat across the landscape, incorporating vegetation remnants on both public and private lands. Nearby vegetated areas contribute to the habitat values of the reserves and provide ecological corridors to other vegetated areas. Maintaining the integrity of the remaining habitat within the reserves and, where possible, linking this to adjacent vegetated areas to facilitate wildlife corridors, or increasing the size of protected areas of remnant vegetation, is important in ensuring long-term viability of the reserves' biological values.

4.4 Soils

The drainage lines in Burwood Creek NR are actively eroding. Erosion within this reserve is resulting in gullies that are several metres deep. The movement of soil in the eroded gullies is resulting in a decline in water quality due to sedimentation.

4.5 Climate change

Human-induced climate change is listed as a key threatening process under the Biodiversity Conservation Act and habitat loss caused by human-induced greenhouse gas emissions is listed under the Environment Protection and Biodiversity Conservation Act.

The latest information on projected changes to climate are from the NSW and ACT Regional Climate Modelling ('NARClm') project. The climate projections for 2020–2039 are described as 'near future' (or as 2030); and projections for 2060–2079 are described as 'far future'. The snapshot shown in Table 4 is for the South East and Tablelands Region which covers the Crookwell Reserves (OEH 2014).

Table 4 South East and Tablelands region climate change snapshot

(OEH 2014)

Projected temperature changes	
Maximum temperatures are projected to increase in the near future (2020–2039) by 0.5–1.0°C	Maximum temperatures are projected to increase in the far future (2060–2079) by 1.8–2.5°C
Minimum temperatures are projected to increase in the near future by 0.4–0.7°C	Minimum temperatures are projected to increase in the far future by 1.4–2.3°C
The number of hot days will increase	The number of cold nights will decrease
Projected rainfall changes	
Rainfall is projected to decrease in spring and winter	Rainfall is projected to increase in summer and autumn
Projected forest fire danger index changes	
Average fire weather is projected to increase in summer and spring	Number of days with severe fire weather is projected to increase in summer and spring

Many parts of the Southern Tablelands are likely to become significantly drier than in the past, especially during the winter. Water stress, particularly during drought years, is likely to kill many trees in woodlands, and stressed trees are also likely to die from additional pressure from insect attack and disease. Such impacts are likely to be most severe for resident species or those with low dispersal capacity including many threatened woodland birds such as scarlet robins, and small mammals. The seasonality of growth in the tablelands is likely to intensify. This change is likely to increase the browsing and grazing of herbivores on grasslands and grassy woodlands during drier winter periods. Summer-growing grasses such as wallaby grass (*Microlaena* sp.), red grass (*Bothriochloa macra*) and weeds such as St John's wort are likely to expand and displace other native species such as Poa tussocks (DECCW 2010). It is predicted that fire frequency and intensity will increase.

Programs to reduce the pressures arising from other threats, such as habitat fragmentation, weeds and pest animal species and fire, will help reduce the severity of the effects of climate change.

5. Implementation

Current situation	Desired outcomes	Management response	Priority
1 On-park ecological conservation			
<p>The Crookwell Reserves will enhance the protection of a number of key vegetation communities, including the White Box – Yellow Box – Blakely’s Red Gum Woodland endangered ecological community.</p>	<p>Landscape and catchment values are protected.</p>	<p>1.1 Undertake fire, pest and weed management programs to maintain and enhance the natural biodiversity values, reduce threats to existing threatened species populations and to increase the reserves’ ability to cope with future disturbances, including climate change.</p>	Ongoing
<p>The reserves contain one animal species listed as endangered and eight animal species listed as vulnerable under the Biodiversity Conservation Act. The reserves provide suitable habitat for several other threatened species.</p>	<p>Native plant and animal species and communities are conserved.</p>	<p>1.2 Protect threatened ecological communities and threatened species through implementing relevant strategies in the Biodiversity Conservation Strategy and recovery plans.</p>	Ongoing
<p>The drainage lines in Burwood Creek NR are actively eroding, resulting in gullies that are several metres deep.</p>	<p>Negative impacts on threatened taxa are stable or diminishing.</p>	<p>1.3 Assess stability of erosion gullies. Obtain specialist advice and undertake remedial actions.</p>	
<p>Research to date provides a good basis for management, however further research will expand the knowledge base.</p>	<p>Research enables improved management decisions to be made.</p>	<p>1.4 Encourage further survey work of plant and animal species targeting threatened species, such as koalas in Gillindich NR, glossy black-cockatoos and Boorolong frog in Nuggetty SCA, and aromatic peppercreep in Burwood Creek NR.</p>	<p>Low</p> <p>Low</p>
2 Cultural heritage			
	<p>Aboriginal and historic places and values are</p>		Ongoing

Current situation	Desired outcomes	Management response	Priority
The reserves are located within the area of the Pejar and Cowra local Aboriginal land councils.	identified and protected.	2.1 Consult and involve relevant Aboriginal community members and organisations in the research into and management of Aboriginal sites, places and values, including interpretation of places or values.	
Preliminary survey work for Aboriginal sites has been conducted on the trail network in Gillindich NR. No sites were identified.	Aboriginal people are involved in management of the Aboriginal cultural values of the reserves.	2.2 Liaise with tertiary institutions and funding bodies to encourage further research into the Aboriginal heritage values of the reserves, such as predictive models of Aboriginal values, literature reviews and oral histories.	Ongoing
Excavation diggings occur on the banks and alluvial flats of Tuena Creek in Nuggetty SCA and provide evidence of previous mining activity. Fossicking occurs along Tuena Creek.	Negative impacts on Aboriginal and historic heritage values are stable or diminishing.	2.3 Assess potential impacts on Aboriginal or historic sites prior to all works.	Ongoing
Aboriginal sites are likely to occur in and on the banks and alluvial flats of Tuena Creek in Nuggetty SCA.	Understanding of the cultural values of the reserves is improved.	2.4 Determine the history and heritage significance of the excavation diggings in Nuggetty SCA.	Low
A small section of rock wall in Mount Davies NR may have heritage significance.	Understanding of the cultural values of the reserves is improved.	2.5 Fossicking is prohibited within historic diggings along Tuena Creek.	Ongoing
Hut ruins are located in the north-east section of Thalaba NR.	Understanding of the cultural values of the reserves is improved.	2.6 Fossicking is prohibited in the banks and alluvial flats along Tuena Creek.	Ongoing
Hut ruins are located in the north-east section of Thalaba NR.	Understanding of the cultural values of the reserves is improved.	2.7 Determine the history and heritage significance of the rock wall in Mount Davies NR. Protect the rock wall and retain in situ.	Low
Hut ruins are located in the north-east section of Thalaba NR.	Understanding of the cultural values of the reserves is improved.	2.8 Investigate safety issues associated with the diggings in Nuggetty SCA.	
Hut ruins are located in the north-east section of Thalaba NR.	Understanding of the cultural values of the reserves is improved.	2.9 Brief staff involved in management and fire suppression operations on the potential for mine (shaft) sites within	High

Current situation	Desired outcomes	Management response	Priority
		<p>Nuggetty SCA and the required management strategies for staff safety and site protection.</p> <p>2.10 Remove hut ruins located within Thalaba NR, subject to heritage assessment and environmental impacts associated with the removal.</p>	<p>High</p> <p>Low</p>
3 Visitor use			
<p>The reserves have little public use. Gillindich, Burwood Creek and Thalaba NRs and Nuggetty SCA each have at least one frontage to a minor public road.</p>	<p>Visitor use is appropriate and ecologically sustainable.</p>	<p>3.1 Allow day walks, picnics (no facilities will be provided, and no fires permitted) and educational visits, subject to limits on numbers and other conditions as necessary to minimise impacts.</p>	<p>Ongoing</p>
<p>There are no visitor facilities in the reserves and no public vehicular access will be provided due to the limited number of formed trails, access trails where available are through private property and the limited size of the reserves.</p>	<p>Negative impacts of visitors on reserve values are stable or diminishing.</p>	<p>3.2 Allow bush camping in Mount Davies and Gillindich NRs and Nuggetty SCA. Camping will not be promoted, no facilities will be provided and no fires permitted. Limits and other conditions may be instituted as necessary to minimise impacts. Camping will not be permitted in Burwood Creek NR to protect the threatened ecological community and Thalaba NR due to its limited size.</p>	<p>Ongoing</p>
<p>Some illegal use of the reserves is evident, such as hunting and timber collecting.</p>		<p>3.3 There will be no public vehicular access within the reserves due to the limited number of formed trails and their limited size.</p>	
		<p>3.4 Allow cycling in Gillindich NR on signposted management trails. Cycling will not be permitted in Mount Davies, Burwood Creek or Thalaba NRs due to the lack of formed trails. Cycling is not permitted in Nuggetty SCA as</p>	<p>Ongoing</p>

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Current situation	Desired outcomes	Management response	Priority
		access to the reserve's trail network is through private property.	Ongoing
		3.5 Allow fossicking in Nuggety SCA in line with legislation, NPWS policy and minimum impact guidelines. Limits and other conditions may be instituted as necessary to minimise impacts.	
		3.6 Fossicking will not be permitted in Thalaba NR, Gillindich NR, Burwood Creek NR and Mount Davies NR.	Ongoing
		3.7 Horse riding will not be permitted in the reserves, due to the limited number of formed trails, their limited size, the erodibility of the soils and their status as nature reserves.	Ongoing
		3.8 Install interpretative signage to raise community awareness of the reserves' significance and management programs.	Ongoing
		3.9 Monitor levels and impacts of visitor use.	
		3.10 Continue to undertake law enforcement patrols and to work with neighbours and law enforcement agencies to control illegal activities.	Low
			Low
			Low

Current situation	Desired outcomes	Management response	Priority
4 Community programs and education			
<p>The areas surrounding the reserves have been extensively cleared, which has resulted in a high loss of biodiversity and fragmentation of habitat in the region. Maintaining the integrity of the remaining habitat within the reserves and, where possible, linking this to adjacent areas of bushland to facilitate wildlife corridors is important in ensuring long-term viability of the reserves' biological values.</p>	<p>Neighbours support conservation of native vegetation near the reserves.</p>	<p>4.1 Identify key areas for connectivity into the reserves and prioritise their importance to the reserve.</p>	<p>Medium</p>
<p>Promotion of visitor understanding and appreciation of the values of the reserves is important for minimising damaging activities and maximising visitor enjoyment.</p>	<p>Visitors and the local community are aware of the significance of the reserves and of management programs.</p>	<p>4.2 Liaise with neighbours to encourage the retention and appropriate management of key habitats and corridors adjacent to the reserves.</p>	<p>Low</p>
		<p>4.3 Foster community engagement to build community pride in the reserves and provide information on the natural and cultural values (in consultation with the Aboriginal community) of the reserves via the internet.</p>	<p>Low</p>
5 Weeds and pest animals			
<p>Weeds present in the reserves include serrated tussock, sweet briar rose, St John's wort, blackberry, horehound and thistle. These occur in areas associated with disturbance such as old sheep camps and trails, or productive areas such as creek lines. There is also a large infestation of blackberry, tussock and St John's wort in the north-west of Nuggetty SCA.</p>	<p>Introduced plants and animals are controlled and where possible eliminated.</p>	<p>5.1 Manage introduced species in accordance with relevant pest management strategies. Priority will be given to control of serrated tussock, St John's wort, blackberry, pigs and goats, particularly where they threaten threatened ecological communities and species, the integrity of native communities, and have the potential to spread rapidly.</p>	<p>Ongoing</p>
<p>Feral animals recorded in the reserves to date include foxes, rabbits, cats, goats, pigs, dogs and deer. The presence and density of pest animal species in the reserves is currently unknown.</p>	<p>Negative impacts of weeds and pest animals on reserve values and neighbouring lands are minimised.</p>	<p>5.2 Prepare a weed map for each reserve to determine presence and extent of weeds, and to provide baseline comparative data for monitoring success of treatment programs.</p>	<p>Low</p>

Current situation	Desired outcomes	Management response	Priority
<p>Pig diggings along the banks of Tuena Creek in Nuggetty SCA has the potential to significantly degrade habitat quality for native fauna and flora, including threatened species.</p>	<p>Weed and pest control programs are undertaken where appropriate in consultation with neighbours.</p>	<p>5.3 Survey the reserves, e.g. establish sand plots or remote cameras, to determine the presence and extent of introduced animals in the reserves. Implement appropriate control strategies.</p>	<p>Low</p>
<p>Grazing by goats is likely to degrade small mammal habitat in Nuggetty SCA and shrub diversity and shrub recruitment in Mount Davies NR.</p>		<p>5.4 Treat new occurrences of highly invasive weed species with the potential for significant impacts on the reserves.</p>	<p>Ongoing</p>
<p>Stock occasionally enter the reserves.</p>		<p>5.5 Seek the cooperation of neighbours and relevant authorities in implementing weed and pest control programs.</p>	<p>Medium</p>
		<p>5.6 Plant canopy species in disturbed areas where canopy previously existed and serrated tussock is present to assist with weed control in these areas.</p>	<p>Low</p>
		<p>5.7 Undertake construction and maintenance of boundary fences with neighbours to exclude stock from the reserves. Fencing assistance may be provided in accordance with NPWS policy.</p>	<p>Low</p>
<p>6 Fire management</p>		<p>Life, property and natural and cultural</p>	

Current situation	Desired outcomes	Management response	Priority
Fire management strategies are currently being prepared for the reserves.	values are protected from fire.	6.1 Finalise and implement the fire management strategies for the reserves.	High
Fire is a natural feature of many environments but inappropriate fire regimes can lead to loss of particular plant and animal communities. High frequency fires have been listed as a key threatening process under the Biodiversity Conservation Act.	Fire regimes are appropriate for conservation of native plant and animal communities.	6.2 Participate in the Southern Tablelands Zone Bush Fire Management Committee. Maintain cooperative arrangements with local Rural Fire Service brigades and surrounding landowners in regard to fuel management and fire suppression.	Ongoing
Several private assets are located within close proximity to the reserves' boundary, including a campus of the Trinity Grammar School. Assets within the reserves include cultural heritage sites, gates and fences.	Negative impacts of fire on natural and cultural heritage values are stable or diminishing.	6.3 Respond to all unplanned fires in the reserves as quickly as possible.	Ongoing
The fire history of the reserves is unknown. However, it is presumed that the vegetation communities have not been affected by a significant fire for several decades. Ecological burns should only be introduced into the reserves if there is a demonstrated biodiversity decline. One way to determine if senescence is an issue is to permit experimental burns over small areas. Long-unburnt areas are ecologically significant as they are rare.	Negative impacts of fire on natural and cultural heritage values are stable or diminishing.	6.5 Establish a monitoring program to identify areas where vegetation communities are senescing due to lack of fire. Use of experimental burns over small areas is permitted.	Low
The reserves are located within the area of the Southern Tablelands Zone Bush Fire Management Committee.		6.6 Encourage research into improving understanding of the influence of fires on the diversity of tableland dry sclerophyll forest, particularly focussing on senescent vegetation due to lack of fire.	Ongoing
7 Infrastructure and maintenance			
Most management trails are suitable for four-wheel-drive vehicles only.	Management facilities and operations adequately serve management	7.1 Gate and signpost management trails to restrict unauthorised access.	High
			Ongoing

Current situation	Desired outcomes	Management response	Priority
	<p>needs and have minimal impact.</p> <p>Infrastructure and assets are routinely maintained.</p>	<p>7.2 Maintain all management trails in a manner that minimises erosion and water pollution, in accordance with NPWS policy.</p>	

High priority activities are those imperative to achievement of the objectives and desired outcomes. They must be undertaken in the near future to avoid significant deterioration in natural, cultural or management resources.

Medium priority activities are those that are necessary to achieve the objectives and desired outcomes, but are not urgent.

Low priority activities are desirable to achieve management objectives and desired outcomes, but can wait until resources become available.

Ongoing is for activities that are undertaken on an annual basis or statements of management intent that will direct the management response if an issue arises.

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