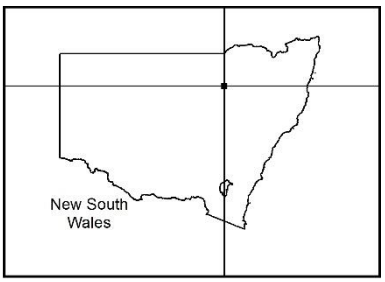
nationalparks.nsw.gov.au

Pilliga Outwash Parks Statement of Management Intent



Disclaimer: this is a statement of intent to guide the management of the parks prior to the development of a plan of management. Any statements made in this publication are made in good faith and do not render the Office of Environment and Heritage liable for any loss or damage. Provisions within the final plan of management may vary from those identified in this document as a result of new information and community consultation. The maps in this statement are intended to show the parks' location and basic features only, and are not suitable for use when navigating to or exploring within parks.

Photo on front cover: Outback landscape in Pilliga National Park. Photo credit: Rob Cleary.

Published by:
Office of Environment and Heritage
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: +61 2 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks, general environmental enquiries, and publications requests)
Fax: +61 2 9995 5999
TTY users: phone 133 677, then ask for 131 555
Speak and listen users: phone 1300 555 727, then ask for 131 555
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Report pollution and environmental incidents
Environment Line: 131 555 (NSW only) or info@environment.nsw.gov.au
See also www.environment.nsw.gov.au

ISBN 978-1-76039-973-3
OEH2017/0686

Pilliga Outwash Parks Statement of Management Intent, November 2017.

Printed on environmentally sustainable paper

About this document

This statement of management intent outlines the main values, issues, management directions and priorities of the National Parks and Wildlife Service (NPWS) for managing Pilliga National Park, Pilliga State Conservation Area, Pilliga West National Park, Pilliga West State Conservation Area and Merriwindi State Conservation Area. These parks are referred to collectively in this statement as 'the Pilliga Outwash parks' or 'the parks'.

This statement, together with relevant NPWS policies, will guide the management of the parks until a plan of management has been prepared in accordance with the *National Parks and Wildlife Act 1974*. The NPWS *Managing Parks Prior to a Plan of Management Policy* states that parks and reserves without a plan of management are to be managed in a manner consistent with the intent of the National Parks and Wildlife Act and the 'precautionary principle' (see Principle 15).

A plan of management will be prepared to set out the ongoing management objectives for the parks. The plan of management is a statutory document under the National Parks and Wildlife Act which will be available for public comment. NPWS will also encourage the community to contribute to the ongoing conservation of the parks by promoting and raising public awareness of their special values. The legislative and policy framework for plans of management is outlined in Appendix A.

Scientific names for common names mentioned in the text (as well as the status) are included in Appendix B.

This statement of management intent was approved by the Director, Northern Inland on 10 November 2017.

Acknowledgments

NPWS acknowledges the Pilliga Outwash parks are in the traditional Country of the Gamilaroi People (also known as the Gomeroi and Gamilaraay People).

This document was prepared by staff of NPWS, part of the Office of Environment and Heritage.

Contacting NPWS

For more information or any inquiries about this statement of management intent or the Pilliga Outwash parks, contact the NPWS Office at 50–58 Wellington Street, Baradine NSW 2396; by mail to PO Box 105, Baradine NSW 2396; or by telephone (02) 6843 4000.

Contents

1 Landscape setting and context 1

2 Protecting the natural environment 7

2.1 Geology and landform 7
2.2 Native plants 9
2.3 Fire 17
2.4 Native animals 20
2.5 Pest animals 27
2.6 Climate change 30

3 Looking after our culture and heritage 33

3.1 Aboriginal culture and heritage 33
3.2 Shared cultural heritage 35

4 Public use of the park 39

4.1 Recreation 39
4.2 Firewood collection 40
4.3 Illegal activities 40
4.4 Research 40

5 NPWS infrastructure and services 42

5.1 Park roads and management trails 42
5.2 Water supply infrastructure 42
5.3 Quarries 42
5.4 Etoo radio tower and bore 43
5.5 Fencing and other infrastructure for the Reintroduction of Locally Extinct Mammals project 43

6 Non-NPWS activities and infrastructure 45

6.1 Apiary sites 45
6.2 Transmission lines and telecommunications 45
6.3 Mining 45

Appendices 47

Appendix A Legislation and policy 47
Appendix B Scientific names 50
Appendix C Vegetation communities in the Pilliga Outwash parks 55
Appendix D Vegetation management guidelines by community type for fire 58

References 59

Tables

Table 1. The makeup of the Pilliga Outwash parks 1
Table 2. Vegetation communities occurring in the Pilliga Outwash parks 10
Table 3. Threatened ecological communities in the Pilliga Outwash parks 11
Table 4. Number and size of fires mapped on state forest and NPWS-managed lands in the Pilliga Outwash between 1950 and 2017 18
Table 5. Pest animals recorded in the Pilliga Outwash 27
Table 6. New England North West climate change snapshot 31

Figures

Figure 1. Overview of Pilliga Outwash parks vi
Figure 2. Pilliga north parks – Pilliga State Conservation Area and part Pilliga National Park (Gilgais) 3
Figure 3. Part Pilliga National Park (Etoo) 4
Figure 4. Pilliga West State Conservation Area and Pilliga West National Park 5
Figure 5. Merriwindi State Conservation Area 6

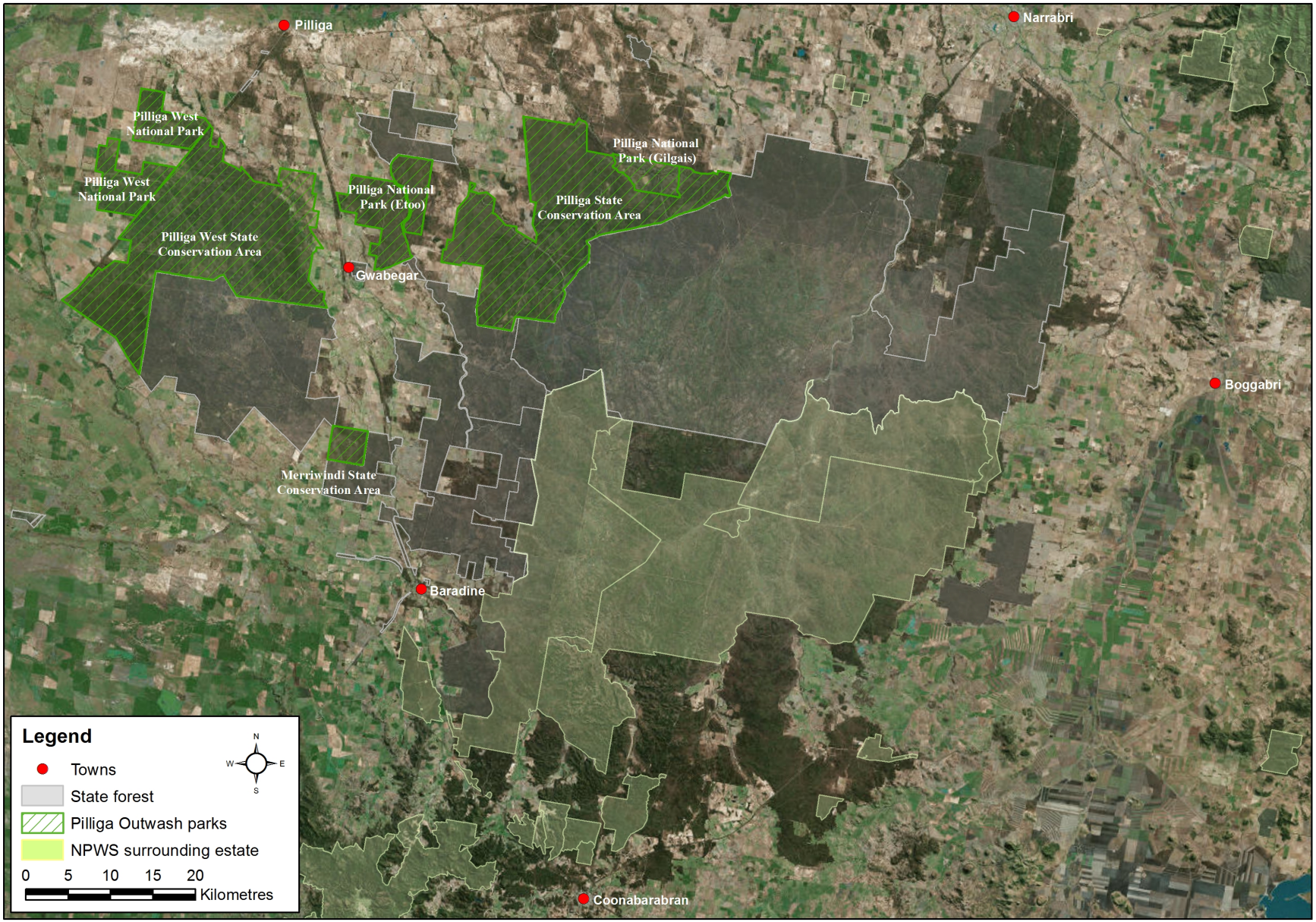


Figure 1. Overview of Pilliga Outwash parks

1 Landscape setting and context

Objective: The Pilliga Outwash parks retain an important place in the network of vegetated, conserved land in the Brigalow Belt South Bioregion.

The Pilliga Outwash is a broad alluvial province on the western slopes of the Great Dividing Range in northern inland New South Wales, 40 kilometres north of Baradine. It takes its name from the series of intersecting alluvial fans formed by creeks draining towards the Namoi River from the Pilliga Forest uplands in the south-east.

The Pilliga Outwash parks were gazetted in December 2005 as a result of the Brigalow Belt South and Nandewar bioregional assessment process and consequent decision to create new conservation reserves under the *Brigalow and Nandewar Community Conservation Area Act 2005*. Prior to 2005, the parks were state forests managed for the commercial production of cypress pine and ironbark.

There are five parks within the Pilliga Outwash group. Together they form the north-west section of the 500,000-hectare contiguous forest known as the Pilliga Forest (formerly known as the Pilliga Scrub) which occurs between Pilliga, Narrabri and Coonabarabran (see Figure 1). This expanse of forest is the largest surviving woodland remnant on the inland western slopes and is a key area for biodiversity conservation in inland New South Wales. Part of the Pilliga Forest continues to be managed for timber production within state forests. Land adjoining the Pilliga Forest is mostly used for grazing and dryland cropping.

The parks in the Pilliga Outwash cover 91,171 hectares. The areas and former names of the individual parks are shown in Table 1 and Figures 2 to 5. In this plan, 'Pilliga West parks' refers to the parks west of Cypress Way; namely Pilliga West State Conservation Area, Pilliga West National Park and Merriwindi State Conservation Area. 'Pilliga North parks' refers to Pilliga National Park (Etoo and Gilgais sections) and Pilliga State Conservation Area.

Table 1. The makeup of the Pilliga Outwash parks

Park (gazetted name)	Size (ha)	Previous name
Pilliga National Park (Pilliga Community Conservation Area Zone 1 National Park)	11,120	Gilgai Flora Reserve (Pilliga East State Forest) Etoo State Forest Quegobla State Forest
Pilliga State Conservation Area (Pilliga Community Conservation Area Zone 3 State Conservation Area)	33,386	Cubbo State Forest Euligal State Forest Pilliga East State Forest
Pilliga West National Park (Pilliga West Community Conservation Area Zone 1 National Park)	8,040	Pilliga West State Forest
Pilliga West State Conservation Area (Pilliga West Community Conservation Area Zone 3 State Conservation Area)	36,895	Pilliga West State Forest
Merriwindi State Conservation Area (Merriwindi Community Conservation Area Zone 3 State Conservation Area)	1,730	Merriwindi State Forest

The area subject to this statement of management intent also includes lands that are vested in the Minister administering the *National Parks and Wildlife Act 1974*. These lands are referred to

as Part 11 land and allow for continued access by private landowners through the park(s) to their land.

Some patches of Crown land occur in the Pilliga Outwash parks which are currently being managed as if they were included in the gazetted area of the parks. The most notable of these is the bed of Etoo Creek in the Pilliga National Park Etoo section (Figure 3). The bed of this creek contains high quality koala habitat and is in a strategic location for control of some pest species.

The Pilliga Outwash is almost entirely within the Brigalow Belt South Bioregion (Thackway & Cresswell 1995). Less than 1% on the south-west edge of Pilliga West State Conservation Area is within the Darling Riverine Plains Bioregion. The soils in the Brigalow Belt South Bioregion are relatively fertile and an estimated 80% of the bioregion has either been extensively cleared of native vegetation or substantially modified. The level of conservation in the bioregion is 8.7% and other than the Pilliga Forest, remnant vegetation is heavily fragmented, occurring on land found to be unsuitable for agriculture. To the south-east of the Pilliga Outwash parks are the Pilliga East parks: Timmallallie National Park, Pilliga East State Conservation Area and Pilliga Nature Reserve. Warrumbungle National Park is located to the south. These parks are addressed in separate statements of management intent and plans of management.

Climate in the Pilliga Outwash is temperate with a summer-dominant rainfall pattern and moderately dry winters. Mean annual rainfall is between 600 and 750 millimetres (Murphy 2013). Mean monthly temperatures range from 2°C to 33°C but maximum temperatures can reach the high 30s.

Several authorities operate within the area occupied by the Pilliga Outwash parks including:

- Baradine, Coonamble, Narrabri, Pilliga, Walgett and Wee Waa local Aboriginal land councils
- North West and Central West local land services
- Coonamble, Narrabri, Walgett and Warrumbungle shire councils.

Management directions

1a) Management activities will focus on the conservation of biodiversity and heritage values.

1b) NPWS will work cooperatively with neighbouring landholders, Forestry Corporation of NSW, shire councils, Local Land Services, local Aboriginal land councils and other stakeholders in managing the Pilliga Outwash parks.

1c) NPWS will continue to manage the values of the Crown land parcels.

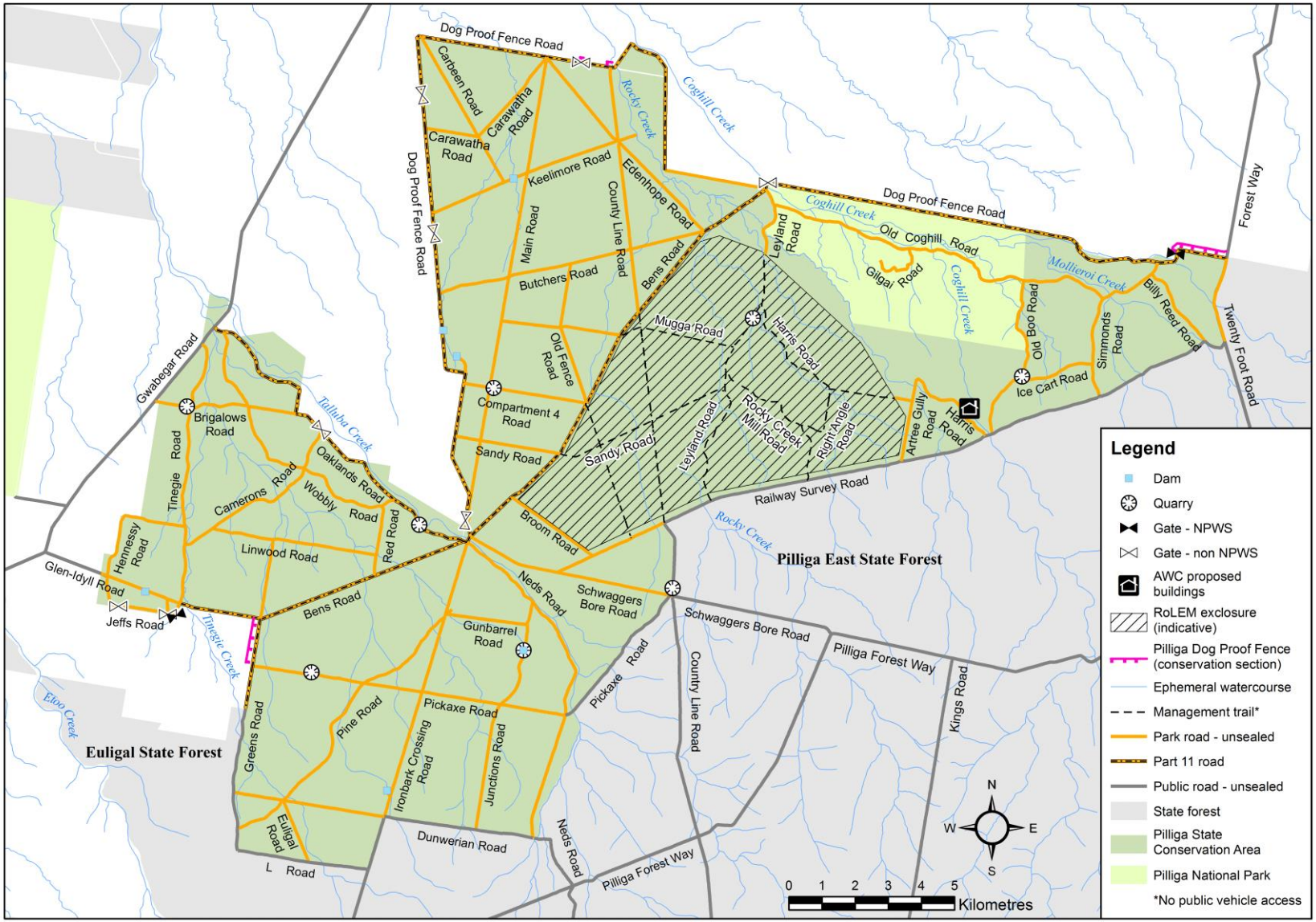


Figure 2. Pilliga North parks – Pilliga State Conservation Area and Pilliga National Park (Gilgais section)

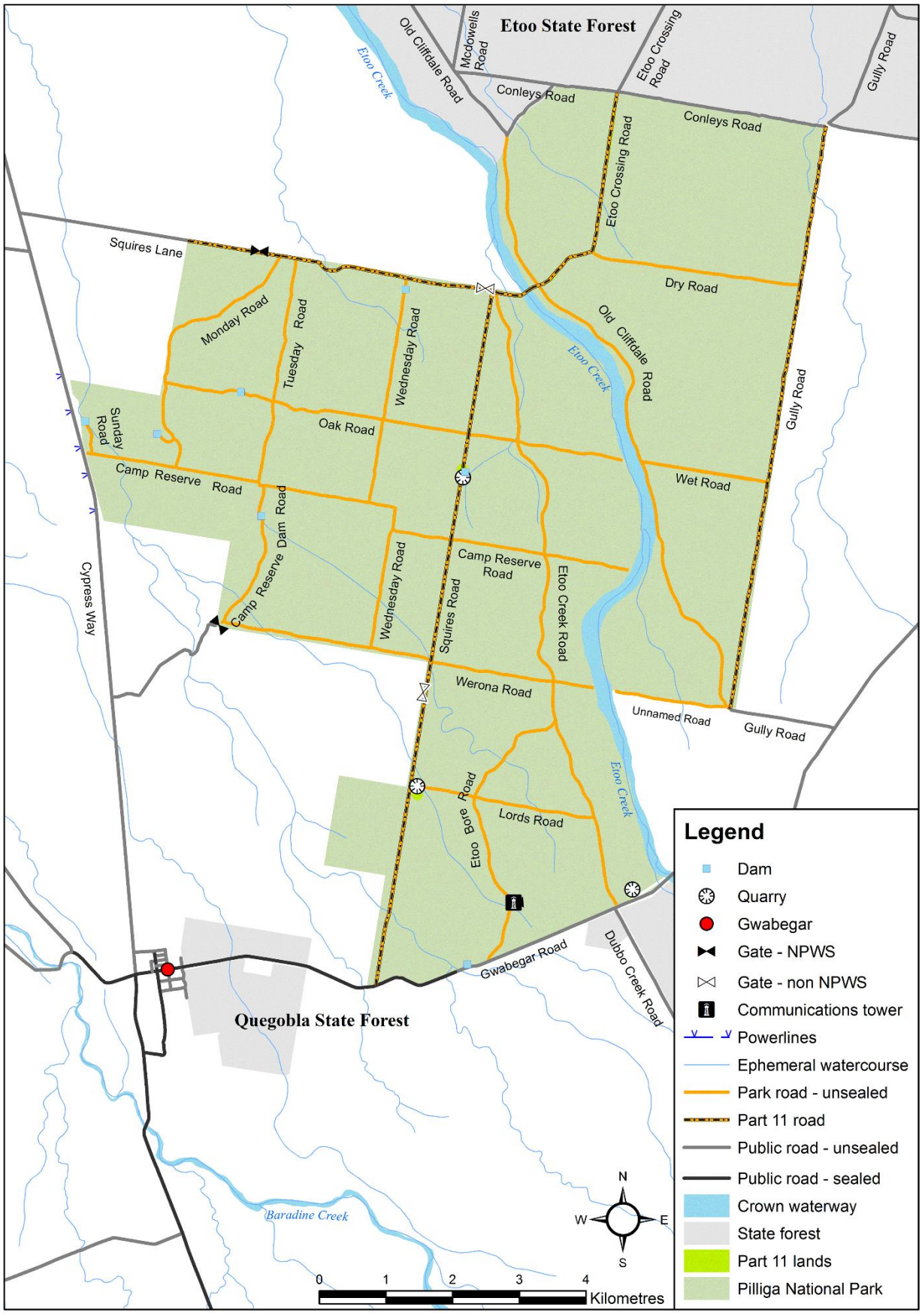


Figure 3. Pilliga North parks – Pilliga National Park (Etoo section)

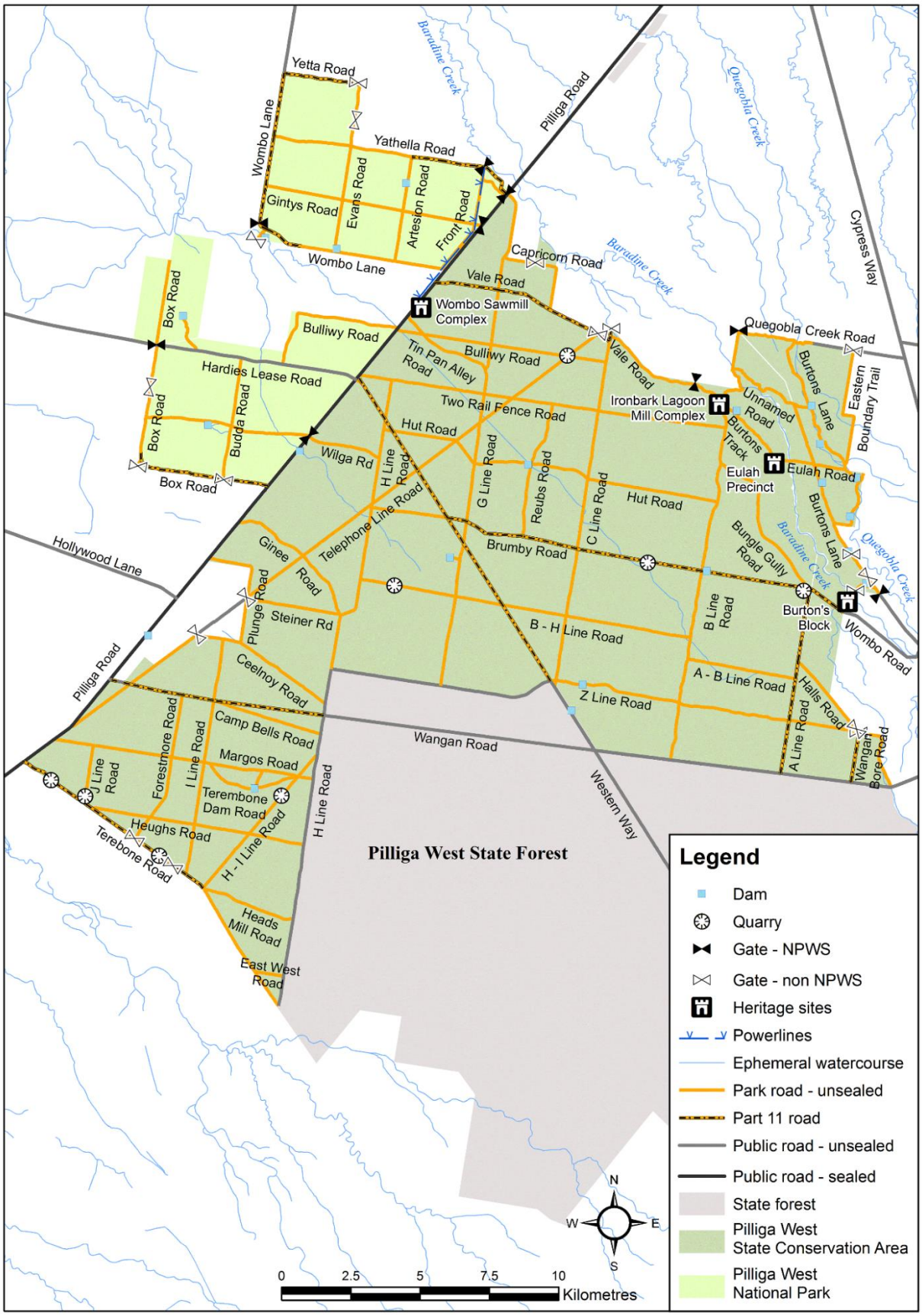


Figure 4. Pilliga West parks – Pilliga West State Conservation Area and Pilliga West National Park

Figure 5. Pilliga West parks – Merriwindi State Conservation Area

2 Protecting the natural environment

2.1 Geology and landform

Objective: Sensitive landscape features such as the gilgais and ephemeral wetlands are managed to avoid erosion and promote long-term protection

The geology of the Pilliga Outwash comprises predominantly coarse-grained sediments of the Great Artesian Basin and Surat Basin which were laid down during the Triassic and Jurassic periods (225–136 million years ago). In the Miocene epoch (23–5 million years ago) the area experienced igneous activity and subsequent movements of the earth's crust, which after a long period of weathering resulted in the Nandewar, Liverpool and Warrumbungle ranges.

However, the landscape of the Pilliga Outwash is the relatively flat base of a series of intersecting alluvial fans, formed in the Cainozoic era (65 million years ago to the present) as creeks drained northwards toward the Namoi River. The sedimentary deposits of the Pilliga Outwash are the quartz sandstones and mudstones of the Purlawaugh Beds dating from the lower and middle Jurassic period, and the quartz Pilliga Sandstones of the upper Jurassic period (NPWS 2000). Sediments are coarser towards the apex of the main alluvial fan (at the southernmost point of the Pilliga Forest) and finer clays occur towards the base in the Pilliga Outwash (Murphy & Shea 2013).

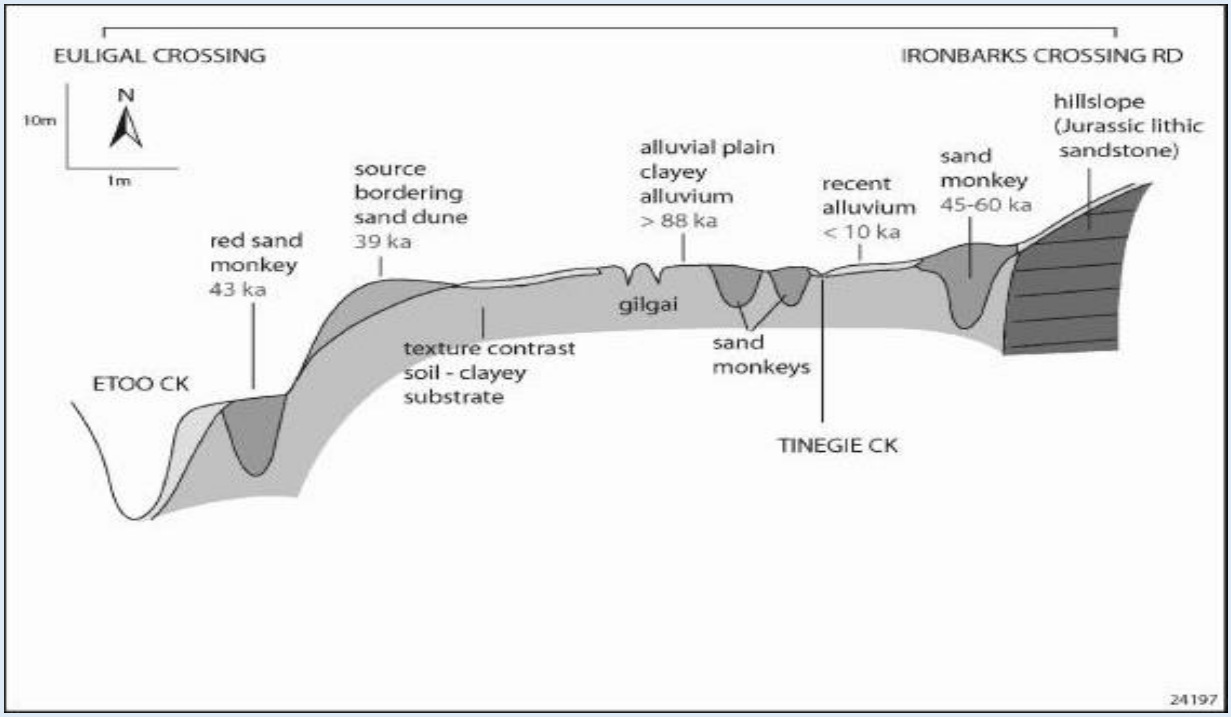
Box 1: Gilgais and sand monkeys

Gilgai is a term used throughout central and western New South Wales and Queensland for the shallow, natural depressions which form in cracking clay soils under brigalow woodland, as the result of distinctive morphological processes, and which occasionally fill with water after rain. 'Gilgai' has been incorrectly applied to the ephemeral wetlands in the Pilliga Outwash which have formed from predominantly sandplain geology and are thought to have originated from former billabongs or ponds left over from ancient drainage lines (Bell et al. 2012). This term is, however, still used to refer to these relatively rare, localised wetlands in the Pilliga Outwash landscape.

Old Boo, the largest ephemeral wetland in Pilliga National Park, after recent rain. Photo credit: P Berney, OEH

A unique assemblage of plants and animals is associated with these wetlands in Pilliga National Park, recently recognised as the Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion Endangered Ecological Community (see Section 2.2.2).

Sand monkey is a local term which refers to sand-filled palaeochannels or abandoned stream beds in the Pilliga Outwash landscape. Unlike palaeochannels which retain a concave shape and hold water, sand monkeys are convex at the surface. The channels are filled with deep medium sand, either yellow or red, depending on the drainage (DEC 2006).



Schematic cross section showing the landscape position and comparative age of sand monkeys in the Pilliga forest area. (Ka = *kilo annum* meaning thousand years). Source: from DMR 2002, as modified after Hesse 2000.

The soils in the Pilliga Outwash are typically soft sandy soils dominated by deep solodic soils with sandy to loamy top soils. These earthy and siliceous sands are hard setting, and the clays (grey, brown and red) found at the northern end of the Outwash are saline and often highly sodic (Namoi CMA 2009). Patches of quicksand occur in outwashes sometimes long after surface water has disappeared.

There are a number of major catchments within the Pilliga Outwash which all drain to the Namoi River. The main creek lines contained within these catchments include Baradine Creek, Quegobla Creek, Etoo Creek, Talluba Creek and Coghill Creek. These creeks are ephemeral in character and there is no permanent surface water in the Pilliga Outwash parks. Creek crossings on park roads are vulnerable to erosion.

Management directions

2a) Gilgais and other sensitive landscape features are protected and managed to avoid adverse impacts. This may require preventing access by vehicles and other measures.

2b) Creek crossings and other areas of potential or active erosion are monitored and stabilised as required.

2.2 Native plants

Objective: The structural and habitat diversity of vegetation communities is maintained

Objective: Native plant communities are protected and where necessary restored

Objective: Understanding of the ecology, distribution, threats and management needs of native plant communities is added to and applied in the parks

Objective: Negative impacts on threatened plant species are minimised

2.2.1 Native vegetation communities

The Pilliga Outwash parks are part of a larger Pilliga park system which conserves significant examples of the largest intact native forest west of the Great Dividing Range. The majority of native vegetation on more productive clay and loam soils in the surrounding area has been cleared for agriculture, and the forest that remains is a large dry woodland remnant on the poorest sandy soils (Murphy 2013).

The Pilliga Outwash parks are important for protecting a representative sample of the flora and fauna of the Brigalow Belt South Bioregion. The Brigalow Belt South Bioregion covers a large climatic range longitudinally (i.e. from north to south), and lies within an ecological gradient or ecotone between the dry, inland bioregions (or Eyrean zone) and wetter coastal bioregions (or Bassian zone). Consequently, the area is environmentally diverse and rich in biodiversity (NPWS 2000). This is clearly evident in the Pilliga Outwash parks in which 599 plant species from 82 families have been recorded.

The vegetation of the Pilliga today comprises a mosaic of cypress pine, box and ironbark open forests and woodlands, and is believed to represent about half of the original extent of the Pilliga forests (Norris et al. 1991 and Norris 1996, both cited in Porteners 2007).

Buloke – White Cypress Pine – Ironbark Woodland, Pilliga State Conservation Area. Photo credit: M Billington, OEH

The Pilliga Outwash forests comprise open eucalypt forest up to 25 metres tall on the more fertile areas. The generally open eucalypt canopy is interspersed with an open subcanopy of pines, casuarinas and wattles. Below this is an open sclerophyll shrub layer dominated by legumes and a grassy semi-continuous ground cover.

The vegetation of the Pilliga Outwash parks has been described in two main vegetation studies:

- the Pilliga North parks – Pilliga National Park and Pilliga State Conservation Area (Hunter 2010) to the north
- the Pilliga West parks – Pilliga West State Conservation Area, Pilliga West National Park and Merriwindi State Conservation Area (Porteners 2007).

These studies identified 12 vegetation communities occurring in the parks (see Table 2). The key species, ecological setting, vegetation class and vegetation formation for these communities are outlined in Appendix C.

Table 2. Vegetation communities occurring in the Pilliga Outwash parks

Community name (from largest area to smallest area)	Pilliga North parks	Pilliga West parks
Buloke – White Cypress Pine – Narrow-leaved Ironbark Woodland	✓	
Poplar Box – White Cypress Pine Woodland	✓	✓
Pilliga Box – White Cypress Pine Open Forest to Woodland	✓	✓
Narrow-leaved Ironbark – White Cypress Pine – Buloke Tall Open Forest		✓
Dirty Gum (Baradine Gum) – White Cypress Pine Tall Woodland	✓	✓
Derived Speargrass – Wallaby Grass – Wire Grass Mixed Forb Grassland	✓	✓
Blakelys Red Gum x Dirty Gum – White Cypress Pine Tall Riparian Woodland	✓	✓
Fringe Myrtle Shrubland	✓	
Belah Woodland on Alluvial Plains	✓	✓
Red Ironbark – White Bloodwood +/- Burrows Wattle Heathy Woodland	✓	
Broom Bush – Wattle Very Tall Shrubland	✓	
Pilliga ‘tank gilgai’ Wetland Sedgeland Rushland	✓	

In the Pilliga West parks (i.e. Pilliga West National Park, Pilliga West State Conservation Area and Merriwindi State Conservation Area), the dominant canopy tree species are narrow-leafed ironbark, poplar box (known locally as bimble box) and Pilliga box. Overall, the poplar box woodlands are characterised by older growth structure than the ironbark woodlands which were more intensively harvested for timber and show a higher degree of disturbance with fewer old-growth areas and less hollow development (Porteners 2007). The three main communities which together make up approximately 50% of the Pilliga West parks are:

- Poplar Box – White Cypress Pine Woodland
- Narrow-leaved Ironbark – White Cypress Pine – Buloke Tall Open Forest
- Pilliga Box – White Cypress Pine – Buloke Shrubby Woodland.

In the Pilliga North parks (i.e. Pilliga National Park and Pilliga State Conservation Area), 11 vegetation communities are recorded (see Table 2). Buloke – White Cypress Pine Woodland is by far the most dominant community, covering over a quarter of the total area.

Pilliga 'tank gilgai' Wetland Sedgeland Rushland is found only in the gilgai section of the north Pilliga Outwash and is a listed threatened ecological community (see Table 3 and Box 2).

Riparian communities are uncommon in the Pilliga Outwash parks, being restricted to the few sandy alluvial watercourses of ephemeral creeks. On sandier soils in watercourses and on the sand monkeys, vegetation tends to show a high degree of disturbance and there is little or only limited regeneration of primary tree species. This can be due to the combined effects of grazing of the grassy ground cover by stock, goats and rabbits, and the susceptibility of these soils to erosion. In addition, these communities usually have a high boundary length to area ratio which make them prone to weed infestation and disturbance (Sivertsen & Metcalfe 1995, cited in Hunter 2010).

Belah communities are also uncommon and occur in a series of small isolated patches and some larger areas on slightly higher alluvial flats adjacent to major creek lines. Belah is considered to be of conservation significance due to the high incidence of clearing and disturbance by agricultural practices across its range (Hunter 2010).

The areas of Derived Speargrass Grassland in the Pilliga Outwash parks include cleared land and areas which were heavily used by stock, in total, about 5200 hectares. These areas are monitored for weed incursion and are expected to gradually regenerate naturally.

The Pilliga Forest was previously managed primarily for timber production. Some areas were heavily selectively logged and occupational permits were available to nearby landowners for grazing stock on the grassy ground layers. Past management practices have resulted in extensive changes to forest and woodland structure and species composition.

2.2.2 Threatened communities and plants

Five threatened ecological communities (TECs) listed under the *Biodiversity Conservation Act 2016* are known to occur in the parks (see Table 3), but their extent in the parks is not yet known. Inland Grey Box Woodland and Brigalow are also listed nationally as threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999*.

Table 3. Threatened ecological communities in the Pilliga Outwash parks

Common name, BC Act	Description	Threats
Carbeen Open Forest Community in the Darling Riverine Plains and Brigalow Belt South Bioregions EEC	Open forest community which may now only exist as woodlands or remnant trees. Characteristic tree species are carbeen and white cypress pine. Occurs on riverine plains on siliceous, earthy and clayey sands.	• Land clearing and fragmentation • Weed invasion • Overgrazing • Drift of herbicides and pesticides • Inappropriate fire regimes
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions EEC (Brigalow [*Acacia harpophylla* dominant and co-dominant] EEC under the EPBC Act)	Low woodland or forest community dominated by brigalow with pockets of belah and poplar box	• Clearing, fragmentation and thinning for grazing and cropping • Roadworks and road maintenance activities • Logging for fence posts • Weed invasion

Common name, BC Act	Description	Threats
		• Predation of wildlife by foxes and feral cats
Fuzzy Box Woodland on Alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions EEC	Tall woodland or open forest dominated by fuzzy box often with inland grey box or kurrajong and buloke. Understorey species include wilga, Deane's wattle, hop bush, cassia, water bush and sifton bush.	• Clearing of remaining remnants and isolated paddock trees • Senescence and lack of regeneration • Inappropriate fire regimes, primarily complete suppression of fire • Weed invasion • Species diversity, composition and structure will be impacted by long-term climate change
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions EEC (Grey Box [*Eucalyptus macrocarpa*] Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia EEC under the EPBC Act)	Woodland community dominated by inland grey box in association with poplar box, white cypress pine and buloke. Shrubs are generally absent or sparse.	• Small-scale clearing for cropping, pasture improvement • Grazing by stock and rabbits • Poor representation in isolated conservation reserves • Illegal firewood collection • Inappropriate fire regimes • Competition of native understorey with invasive grasses and other weeds
Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion EEC	Wetlands associated with ephemeral creeks and waterways but in an exceptionally restricted geographic distribution. They are formed on cracking clay, alluvial soils. Species richness is extremely variable with the wetland depth gradient. Generally dominated by buloke, dirty gum, *Melaleuca densispicata* and mugga ironbark.	• Soil disturbance by feral pigs, recreational vehicles, stray stock, feral goats and horses • Road and drain construction and consequent hydrological change and/or sedimentation

BC = Biodiversity Conservation Act; EPBC Act = Environment Protection and Biodiversity Conservation Act; EEC = endangered ecological community. Source: OEH n.d., DoEE n.d.(a).

Box 2: Pilliga Outwash Ephemeral Wetlands Endangered Ecological Community (NSW SC 2015)

This community is extremely restricted, occurring as a chain of ponds each about 20 centimetres deep and usually less than 1 hectare. It occupies a total area of only about 84 hectares in the gilgai section of Pilliga National Park and approximately 0.5 hectares in Merriwindi State Conservation Area. It was first identified as a distinct vegetation community in 2010 (Pilliga 'tank gilgai' Wetland Sedgeland Rushland, Brigalow Belt South Bioregion by Benson et al. 2010).

In the Pilliga's dry subtropical climate, the wetlands form only under particular climatic conditions such as the large rainfall events in 2010 through to early 2011. The majority of these wetlands are likely to fill once a decade at most, and the smallest of them dry up in a matter of weeks (Bell et al.

2012). The larger wetlands fill more often and can retain water for months. Their ephemeral nature make them an important component of habitat for visiting birds, including migratory species, in an otherwise dry, sandy landscape (see Section 2.4).

Pilliga Outwash Ephemeral Wetlands community includes three threatened native herb species listed under the Biodiversity Conservation Act: austral pipewort, winged peppercress and a creeping matted herb called *Myriophyllum implicatum*. The community also includes six species considered to be regionally significant since they are disjunct or thought to be at or near their geographic limit.

Shallow ephemeral wetland, Pilliga National Park. Photo credit: P Berney, OEH

Box 3: Recovery of threatened plant species

In addition to threatened ecological communities, the Pilliga Outwash parks are known to contain 19 threatened plant species (see list in Appendix B).

Strategies for the recovery of threatened species, populations and ecological communities have been set out in a statewide *Biodiversity Conservation Program* (OEH 2017a) (formerly known as the *Threatened Species Priorities Action Statement*). These actions are prioritised and implemented through the *Saving our Species* program which aims to maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013c).

Three of the threatened species occurring in the Pilliga Outwash parks are being managed under targeted recovery strategies under the *Saving our Species* program.

Myriophyllum implicatum

This critically endangered plant species was previously thought to be extinct in New South Wales. It was recently discovered in Pilliga National Park in a large, partly open, inundated gilgai depression on cracking clay soil. Very little is known about the species' distribution, especially on private lands to the north. There is a high risk of extinction for this species due to the small population size and restricted distribution.

The recovery strategy developed for *Myriophyllum implicatum* covers an area of 100 hectares and includes a combination of protective measures, monitoring and establishment of a second

population by translocation. Management activities proposed to protect the species in Pilliga National Park are:

- pest control to reduce the density of feral pigs and maintain pig populations at low levels
- targeted surveys to identify additional populations
- increased staff surveillance and installation of barriers to prevent access by recreational users if illegal activities continue.

Monitoring of the populations and threats will also be carried out to determine population trends through time and assess the effectiveness of management actions.

Austral pipewort

This species grows in mud in ephemeral waterbodies and occurs in the northern section of Pilliga National Park and the north-east section of Pilliga State Conservation Area. The recovery strategy covers an area of 6794 hectares. Management actions include:

- targeted surveys to identify additional population(s)
- monitoring disturbance impacts to minimise impacts of recreational activities
- monitoring plant populations to track species abundance/condition over time.

Winged peppercress

This plant species is widespread in the semi-arid western plains regions of New South Wales but also occurs in the Pilliga Outwash. It occurs on seasonally moist to waterlogged sites on heavy fertile soils.

One of the key threats to this species in the Pilliga Outwash is disturbance by four-wheel drive vehicles which churn up the ground surface and disturb their preferred habitat structure. The recovery strategy occurs in the same location as the strategy for Austral pipewort and over an area of 5209 hectares. Management actions in the strategy include:

- construction of barriers to reduce access by recreational users
- monitoring of disturbance impacts
- monitoring of the populations to track species abundance/condition over time.

Winged peppercress, Pilliga National Park. Photo credit: OEH

Prasophyllum* sp. *Wybong

This terrestrial orchid is critically endangered under the Environment Protection and Biodiversity Conservation Act but not listed at the state level. It is endemic to New South Wales, and known from several sites in the Namoi catchment. It has been recorded in some parts of the Pilliga and is predicted to occur in the Pilliga Outwash parks. The population at Wybong in the Upper Hunter Valley is by far the largest.

No priority actions have been identified at present. In order to get a clearer understanding of the extent of the distribution and size of the population, surveys should be undertaken in spring to locate populations in suitable habitat, such as roadsides.

2.2.3 Restoring and maintaining native vegetation values in the parks

The vegetation of the Pilliga Outwash parks has been affected by past timber harvesting and associated silvicultural practices, and previous grazing of cattle and sheep under occupational permits. The effects of these disturbances on the native vegetation ecosystems include:

- concentrations of even-aged stands of trees
- changes in canopy species dominance
- creation of man-made clearings and snig tracks in the forest
- a loss of hollow-bearing trees.

Now that selective harvesting of some species and thinning to maximise growth of preferred species has ceased, one of the notable characteristics of the Pilliga Forest is the increase in stem density of dominant canopy species, including eucalypt, cypress and buloke (Whipp et al. 2012). As regeneration of native vegetation communities continues unaided in the NPWS-managed parks, it is likely that some species will re-establish at a greater density than others over time.

Grazing in the forest has also contributed to the introduction of pasture grasses and environmental weeds. The Pilliga Outwash parks are also susceptible to weed incursions via the many creek lines which dissect the alluvial plain. Scalded areas, roadsides and other disturbed sites are favoured habitats for weeds. Weeds are also introduced and readily spread through the parks during flood events. Pest animals are also a vector responsible for spreading weeds.

The *Biosecurity Act 2015* and regulations embed the principle of shared responsibility for biosecurity risks (including weeds) between the government, community and industry. This legislation applies to both public and privately owned land. A regional strategic weed management plan prepared under the Biosecurity Act identifies those pest plants that are being prioritised for management action, investment and compliance effort within the North West Local Land Services region (North West LLS 2017). These priorities will be implemented via relevant NPWS regional pest management strategies.

The invasive nature of environmental and state and regional priority weeds, their widespread occurrence in the broader landscape and the fact they compete with native species, requires their continued monitoring and management. NPWS prepares regional pest management strategies which identify priority pest plant and animal species and control programs. These include relevant actions listed in the *Biodiversity Conservation Program*, threat abatement plans, and strategies such as the NSW *Biodiversity Priorities for Widespread Weeds* (NSW DPI & OEH 2011) and the *NSW Biosecurity Strategy 2013–2021* (DPI 2013).

The overriding objective of the pest management strategy (OEH 2013b) is to minimise adverse impacts of introduced species on biodiversity and other park and community values while complying with legislative responsibilities. Populations and the distribution of weeds are monitored and appropriate treatment applied as required, such as herbicide application.

Priority weed species identified in the regional pest management strategy for control in the Pilliga Outwash parks include: tiger pear, prickly pear, tree pear (also known as velvety tree pear), mother-of-millions, carrion flower, Noogoora burr, African boxthorn, and spiny burrgrass. African boxthorn, tiger pear, prickly pear and other opuntioid species are identified as state priority species under the Biosecurity Act. Mother-of-millions is identified as a regional priority species under the *North West Regional Strategic Weed Management Plan* (North West LLS 2017). Control actions for priority weeds in the Pilliga Outwash parks are focused on areas where the weed species threaten the values of a threatened ecological community.

Management directions

2c) Relevant actions in the *Biodiversity Conservation Program* for threatened plant species, populations and communities will be implemented.

2d) Relevant recovery actions for threatened plant species recorded in the Pilliga Outwash parks will be integrated into the *Reintroduction of Locally Extinct Mammals* project.

2e) Vegetation mapping of the Pilliga Outwash parks will be reviewed.

2f) Survey and mapping for threatened ecological communities will be undertaken and used to inform park management.

2g) Weed management will be undertaken in accordance with legislative requirements and the pest management strategies relevant to the parks.

Box 4: An unusual emerging weed

Carrion flower first appeared in the gilgai section of Pilliga National Park in 2013. This succulent prostrate herb derives its name from the putrid stench of its striking purple and cream star-shaped flowers which attracts flies that assist in pollination.

Carrion flower in Pilliga National Park. Photo credit: M Billington, OEH

Carrion flower is a declared weed in South Australia where it invades chenopod shrublands and is associated with the decline and death of shrubs and ground layer herbs and grasses of arid

regions (DEWNR 2015). In Pilliga National Park, carrion flower grows in the shelter of fallen timber. A targeted eradication program is underway to ensure carrion flower does not proliferate and adversely impact the values of the ephemeral wetlands endangered ecological community.

2.3 Fire

Objective: Fire in the parks is managed to conserve and maintain Pilliga Outwash ecosystems while also protecting park management and other infrastructure

Objective: The fire regimes applied in the parks maintain and promote the conservation of biodiversity and other park values

Fire is an integral part of the Australian environment. It is a major factor in determining the structure and species composition of vegetation, and has long-term effects on animal populations. However, inappropriate fire regimes can lead to loss of particular plant and animal species and communities, and high-frequency fires have been listed as a key threatening process under the Biodiversity Conservation Act (NSW SC 2000c). The primary objectives of NPWS's fire management are to protect life, property and community assets from the adverse impacts of fire, while managing fire regimes in parks to maintain and enhance biodiversity.

The Pilliga Outwash accounts for approximately one-third of the Pilliga Forest and is dominated by white cypress pine and eucalypt woodlands. These woodlands have distinct fire behavior, fire frequency and area burnt compared to the rest of the Pilliga Forest (Brookhouse & Nicholson 1999). For example, the east and central areas of the Pilliga Forest are high fire risk areas which experience frequent and large wildfires, but in most years the Pilliga Outwash parks do not have sufficient fuel in the understorey to carry a fire, even in the shrubby grassy communities. Fire risk in the Pilliga Forest follows a decreasing gradient from east to west as the climate becomes more arid and the landscape becomes flatter.

Large-scale fire in the Pilliga Outwash is a rare event. Historically, large-scale wildfire has occurred in this landscape following two consecutive years of above-average rainfall, during a La Niña cycle. These conditions promote extensive growth of ephemeral grasses, which creates a continuous fuel load. Drying off of this grassy ground layer during the hot, dry weather of a following El Nino cycle produces the optimal circumstances for wildfire, which is usually ignited by a lightning strike.

2.3.1 Fire history in the parks

Aboriginal people are known to have used fire across the Australian continent to promote food animals and other resources by deliberate burning of known habitats, sometimes at a small or very small scale. Traditional fire management practices by Aboriginal people in the Pilliga Outwash are unknown but it is likely that burning regimes were used to some extent to encourage grazing areas, regenerate specific resources and keep corridors open for travel.

Accounts from the 19th century suggested that the Pilliga Forest underwent major structural changes once the Gamilaroi People were displaced by Europeans. According to these accounts, the forest was transformed from 'clear and open' forests (Oxley 1820, cited in Keith 2004) to 'heavily and thickly timbered' land some 50 years later (Battye 1887, cited in Keith 2004). These descriptions suggest there was an increase of woody vegetation and the forest became shrubbier once regular burning was excluded. However, further critique of the early explorer journals has found that conclusions about the nature of pre-European native vegetation and the effect of Aboriginal-initiated fire management are selective and inconclusive (Benson & Redpath 1997). It is also possible that other factors have contributed to thickening of the vegetation. For example, there have been periods when above-average

rainfall has coincided with effective suppression of rabbit activity resulting in a major regeneration event, such as occurred from 1947 to 1950 (Keith 2004).

Over the last 100 years or so when the Pilliga Forest was managed as a series of unbroken state forests, wildfire was actively suppressed in order to protect the commercial timber resource. On the basis of available records, it appears that fire occurred reasonably frequently but most fires were small. This fire regime has resulted in more uniform age classes in canopy species such as cypress pine and ironbark and has likely constrained recruitment of species that rely on fire for germination.

The fire history in the Pilliga Outwash is only partially known, with 60% of fires being ignited by lightning strikes (Brookhouse & Nicholson 1999). In November 1951, a vast fire devastated practically the whole of what was Pilliga East State Forest, now the area contained in Pilliga National Park (Gilgais) and Pilliga State Conservation Area (Forestry Commission of NSW 1951). The burnt area was estimated to be 800,000 acres (323,749 hectares) of state forest and 400,000 acres (161,874 hectares) private property. Since then, the largest fires in the western part of the Outwash were in 1984 (1292 hectares) and 1977 (450 hectares). Today, the majority of the Pilliga Outwash parks are long unburnt, and most of the West Pilliga has not burned in the last 50 years (Porteners 2007).

Table 4. Number and size of fires mapped on state forest and NPWS-managed lands in the Pilliga Outwash between 1950 and 2017

Area Burnt (ha)	Number of fires
<1	50
1–10	54
10–100	44
100–1,000	18
1,000–10,000	2
Total	**175**

2.3.2 Fire ecology and fire regimes for vegetation in the parks

Fire affects the functioning of ecosystems in a number of ways including changing vegetation structure, animal habitat, and fuel abundance and altering nutrient and energy flows. Ecosystems and the plants and animals that live in them have evolved under particular fire regimes. Altering fire regimes beyond the adapted thresholds can disrupt the functioning of these ecosystem (OEH 2013a).

Bushfire plays a vital role in Australian ecosystems and can have both beneficial and undesirable outcomes. For example, fire will benefit obligate seeders (such as acacias and cypress pine) which rely on fire or smoke to release seed. But these same species can become locally extinct if a fire occurs before they have sufficient time to establish a large enough seed bank (Bushfire CRC & AFAC 2009). Similarly, fire has the potential to produce resources needed by native animals, but too-frequent fire results in loss of habitat features such as old-growth trees and hollows. Catastrophic fire can also kill animals which act as seed dispersers.

Many species of plants and animals are adapted to specific stages of the post-fire regeneration cycle and, as such, different frequencies of fires will favour different species. Longer periods between fires will result in greater vegetation variety and cater for a greater variety of animals. NPWS manages fire in the Pilliga Outwash parks by applying fire intervals to different vegetation community types through a mosaic burning approach. The overall objective is to provide patchiness and multiple age classes while retaining tree hollows and other old-growth forest values where possible.

For the purpose of developing fire regimes, the 11 vegetation communities in the Pilliga Outwash parks are grouped into 7 broad community types. The vegetation management guidelines and expected fire behaviours for each of these community types are provided in Appendix D.

The fire regimes adopted for the vegetation communities in the Pilliga Outwash parks reflect the preferred fire intervals for plant communities and habitat requirements for animals where these are known. Research into preferred fire intervals for individual species is a continuing science. With increasing understanding about drier landscapes, NPWS is adopting longer, more conservative fire intervals than those in moister, coastal areas. In the ephemeral wetlands of the gilgai area (Pilliga National Park), fire should be completely excluded. The shortest fire interval for vegetation in the Pilliga Outwash parks is presently 15 years (for riparian/valley woodlands) and the current maximum fire interval is 30–50 years (for grassy box woodlands). However, research suggests that longer intervals of up to 70 or 80 years may be more appropriate for vegetation communities in the Pilliga Forest and it is likely that fire intervals will be extended in the future.

2.3.3 Fire management strategies

Three fire management strategies which define NPWS's approach to fire management have been developed for the Pilliga Outwash parks:

- the Pilliga North strategy covers Pilliga National Park and Pilliga State Conservation Area (OEH 2015b)
- the Pilliga West strategy covers Pilliga West National Park and Pilliga West State Conservation Area (OEH 2015c)
- Merriwindi State Conservation Area has its own strategy (OEH 2015a).

These strategies outline the recent fire history of the Pilliga Outwash parks, key assets within and adjoining the parks including built assets and sites of natural and cultural heritage value, fire management zones and fire control advantages such as management trails and water supply points. They also contain fire regime guidelines for conservation of the parks' vegetation communities.

There are a number of vulnerable assets both on-park and adjoining the parks. Vulnerable on-park assets include Aboriginal and historic heritage values such as scar trees, mill sites and cottages; and infrastructure such as the Etoo radio tower and powerlines.

The following objectives identify the fire management intent for the fire management zones identified in the Pilliga Outwash parks. The location of the zones will be reviewed and amended in conjunction with development of the *Reintroduction of Locally Extinct Mammals* project (see Box 6).

- Land management zones – almost the total area of the parks is presently managed as a land management zone. The objective of this zone is to conserve biodiversity and protect cultural and historic heritage. Fire in this zone is managed consistent with fire thresholds.
- Strategic fire advantage zones – the objective is to provide strategic areas of fire protection advantage which will reduce the speed and intensity of bushfires, and reduce the potential for spot fires. These zones also help to contain bushfires to existing management boundaries. The overall fuel hazard should be maintained in these zones at high or below, however adherence to guidelines for biodiversity will take precedence where practical.
- Asset protection zones – the objective of this zone is the protection of human life and property, and highly valued public assets such as built infrastructure. In this zone, these values take precedence over guidelines for the management of biodiversity. Overall fuel hazard should be maintained at or below moderate.

NPWS assists in developing fire management practices that contribute to conserving natural and cultural heritage across the landscape, and implements cooperative and coordinated fire management arrangements with other fire authorities, neighbours and the community (OEH 2013a).

NPWS maintains cooperative arrangements with surrounding landowners and the Rural Fire Service and is a member of the Namoi, North-West and Castlereagh Zone bush fire management committees.

Management directions

2h) Fire will be managed in accordance with the fire management strategies prepared for the Pilliga Outwash parks. The overarching objectives of the fire management strategies are to reduce the spread of wildfire across the landscape to prevent loss of life and property; and to use fire as a management tool to enhance biodiversity values.

2i) Fire thresholds will continue to be reviewed to ensure they are appropriate for local, fire-sensitive species and communities and incorporated into fire planning.

2.4 Native animals

Objective: Populations of all native animals are maintained

Objective: Populations of rare, threatened or regionally significant animal species are protected and maintained

Objective: Regular survey and monitoring add to knowledge of the animals and their habitats in the Pilliga Outwash parks

Objective: The *Reintroduction of Locally Extinct Mammals* project is implemented in Pilliga State Conservation Area

2.4.1 Habitat for native animals

The Pilliga Outwash parks are part of the Pilliga Forest which is the largest area of continuous native forest west of the Great Dividing Range and a significant wildlife refuge. Past management practices have resulted in extensive changes to native vegetation structure and species composition, but the Pilliga Forest continues to provide valuable habitat for woodland-dependent and forest-dependent fauna.

In addition to the value of the contiguous Pilliga Forest at a landscape scale, the Pilliga Outwash parks include important habitat features for native animals, such as:

- old-age canopy trees which contain cracks, spouts and hollows used by nesting birds, bats and other arboreal mammals
- fallen timber, litter and coarse woody debris used by ground-dwelling mammals and reptiles
- mixed-age forest that provides consecutive flowering and other resources for woodland birds and arboreal mammals
- ephemeral wetlands which provide fleeting opportunities for aquatic communities in an otherwise dry landscape.

To date, 260 native animal species have been recorded in the Pilliga Outwash parks, including 175 birds, 38 reptiles, 30 mammals and 17 amphibians. Of these, 31 are threatened species listed under the Biodiversity Conservation Act or the Environment Protection and Biodiversity Conservation Act (see Section 2.4.2). The invertebrate fauna of the Pilliga Outwash parks is

even more diverse and includes several species found in no other parks in New South Wales, including the sun moth (Murphy 2015) and the northern Australian mussel (Murphy & Shea 2013).

The Pilliga Outwash parks also support regionally significant species, including species at the extremes of their range and migratory birds which opportunistically visit when ephemeral wetlands form after occasional heavy rain events.

Nobbi, identified as a declining woodland reptile but widespread in the Pilliga Forest, at Merriwindi State Conservation Area. Photo credit: M Murphy, OEH

Although the Pilliga Forest is between 290 and 420 kilometres inland from the east coast, its wetlands have proven to be a valuable resource for shorebirds, such as happened following the La Nina (wet) conditions of 2010 to 2011 (Murphy 2013). Over a period of almost 2 years, seven species of shorebirds were recorded including four resident species, one migratory species and two nomadic species. An additional two nomadic species are known from single records. The Pilliga Forest has also been identified as an Important Bird Area, being recognised as internationally important for bird conservation, particularly threatened woodland birds (Dutson et al. 2009).

Aquatic systems in the Pilliga Outwash parks are within the Lowland Darling River Aquatic Ecological Community which is listed under the *Fisheries Management Act 1994* (FSC 2003). There are many threatening processes affecting this community, including river regulation, water extraction, clearing of riparian vegetation, stock access to riparian areas, removal of instream timber debris, insecticide and fertiliser runoff from agriculture, and introduced species. The high proportion of native woodland vegetation comprising stream catchments in the Pilliga landscape is probably a major factor in the survival of a relatively intact example of the fauna in this endangered community (Murphy & Shea 2013).

Over 100 years of logging has had extensive impacts on habitat and resources for native animals in the Pilliga. Even in the parks now managed for conservation, the drier, less productive and less predictable climate means that recovery is much slower than for the forests of the east coast (NPWS 2000). Threats to native animals in the Pilliga Outwash parks

are also ongoing and include competition and predation from introduced pest species (see Section 2.5)

Ephemeral wetland, Belah Road, Merriwindi State Conservation Area. Photo credit: M Murphy, OEH

2.4.2 Threatened animal species in the parks

A number of threatened animals that have been recorded in the Pilliga Outwash parks including: 21 bird species, 8 mammals, 1 amphibian and 1 reptile (see Appendix B). Many of these species use the varied resources and habitat features of the Pilliga Forest, underscoring its significance for biodiversity.

Hollow-bearing trees throughout the Pilliga Outwash parks provide habitat for large populations of hollow-dependent birds (e.g. threatened powerful owl) and micro-bats (e.g. threatened Corben's long-eared bat). Creek lines provide habitat corridors for threatened species such as the koala and pale-headed snake. Belah communities support a large population of glossy black-cockatoos. The fallen timber and sparse understoreys within the woodlands also provide habitat for the bush-stone curlew. One record of genus *Dasyurus,* likely to be a spotted-tailed quoll*,* has also been confirmed in Pilliga (Etoo) National Park (Paull & Date 1999). The broom bush plains in the central sections of the Pilliga Outwash provide habitat for the Pilliga mouse.

Strategies for the recovery of threatened species, populations and ecological communities have been set out in a statewide *Biodiversity Conservation Program* (OEH 2017a) (formerly known as the *Threatened Species Priorities Action Statement*). These actions are currently prioritised and implemented through the *Saving our Species* program, which aims to maximise the number of threatened species that can be secured in the wild in New South Wales for 100 years (OEH 2013c).

Box 5: Pilliga mouse

The Pilliga mouse has been recorded in the low-nutrient, deep sand soils of Pilliga National Park and Pilliga State Conservation Area. Recent taxonomic research indicates that the Pilliga mouse is or is closely related to the threatened delicate mouse (OEH 2016) and is therefore not endemic to the Pilliga as previously thought. The delicate mouse is distributed from the north-west of Western Australia across northern Australia to the south-east of Queensland (OEH 2016).

Pilliga mouse. Photo credit: M Murphy, OEH

This native rodent is very small, weighing between 6 and 15 grams, and is nocturnal but otherwise little is known about its behaviour. The greatest numbers of Pilliga mouse have been found in recently burnt moist gullies, areas dominated by broom bush, and areas with an understorey of kurricabah (also known as Burrow's wattle), with a bloodwood overstorey. Its survival is threatened by logging operations in its preferred habitat, inappropriate levels of broom bush harvesting, inappropriate fire regimes, non-native feral predators and competition from feral house mouse populations.

NPWS is managing the Pilliga mouse under the *Saving our Species* program at key management sites in the Pilliga Outwash parks. Key management activities are reducing the impact of pest species and maintaining an appropriate fire regime in its preferred habitat. Surveys will also be conducted regularly to determine population trends and monitor the extent and severity of threats so that management actions can be amended as needed.

Koalas are possibly the best known of the threatened mammal species which occur in the Pilliga Outwash parks but there has been a dramatic decline in their numbers in the Pilliga as a whole. A case study prepared for a review into the decline of koala populations in key areas of New South Wales advised (NSW Chief Scientist & Engineer 2016):

> Surveys of the Pilliga forests in the 1990s suggest that the forests were carrying the largest population of koalas west of the Great Dividing Range in NSW, with the population estimated at 15,000 … Repeat surveys within the Pilliga forests show a decline of over 80% since the 1990s.

In addition to threats common across much of New South Wales such as land-clearing and fragmentation of habitat,

> west of the Great Dividing Range, koalas are also affected by drought and extreme heatwaves…. Habitats that would have once likely functioned as refugia during times of drought are now highly disturbed and are unlikely to provide the required level of protection for the koala (NSW Chief Scientist & Engineer 2016).

Tree species preferred by koalas in the parks are Blakelys red gum, river red gum and white box, although Pilliga box, narrow-leaved ironbark and rough-barked apple are used occasionally. The shared boundary trees on the edges of the home ranges of individual koalas are also very important for interaction (NPWS 2000).

2.4.3 Restoring native animal values in the parks

The loss of many native animal species in Australia over the last 200 years is the result of a combination of factors. Clearing of vegetation, the introduction of hard-hoofed animals, bounty hunting for species considered to be pests (such as bettongs), changed fire regimes and the impact of non-native predators have all played a role in the decline and extinction of many native species in Australia.

The introduction of artificial water points for domestic stock fundamentally altered the dynamics of native animal species and non-native pest species. Ground tanks are useful for native animals as changes in land practices have restricted their access to natural water courses and have caused natural water courses to silt up over time. However, artificial sources of water also enable pest animals to become established in areas that were previously not habitable for most of the time. This has resulted in the persistence of larger and more widespread populations of these species than would otherwise be possible. In a number of cases, the increase in abundance of a species may have significant negative effects on other species (James et al. 1999).

Current estimates indicate that, of Australia's native animal assemblage, mammals have been most adversely affected by extinctions. In New South Wales, 59% of all mammal species historically recorded are now endangered or extinct (Lunney et al. 1994). In an effort to address this decline, NPWS has formed external partnerships under the *Saving our Species* program to deliver several *Reintroduction of Locally Extinct Mammals* projects. These partnerships recognise that securing threatened species in the wild is a complex challenge that extends beyond the park system and requires innovative conservation solutions.

National parks represent a feasible opportunity for this initiative as they are managed to address or exclude the threatening processes which operate on a landscape scale and which have caused the extinction of these species.

The Pilliga Outwash parks are considered suitable for a reintroduction project as the parks are part of the largest area of intact native vegetation west of the Great Dividing Range. Similar projects are being developed in Sturt National Park and Mallee Cliffs National Park. The key objectives of the projects are to:

- address the decline in mammal diversity
- improve the overall ecosystem health in these parks
- assist in securing existing threatened species and a number of previously extinct species.

Box 6: *Reintroduction of Locally Extinct Mammals* project

Many small native mammals that once occurred in New South Wales are now extinct, especially those of the Western Division and in the critical weight range of 35–500 grams (Dickman et al. 1993; Dickman 1994). The *Reintroduction of Locally Extinct Mammals* project seeking to re-establish populations of some of these species will commence in Pilliga State Conservation Area in 2017 under the *Saving our Species* program.

Predation by introduced pests, particularly cats and red foxes (see Box 7:), is recognised as playing a major role in the decline of Australia's native animals, which evolved without the responses needed to combat these pests. The removal of introduced predators from within securely fenced exclosures is therefore fundamental to the success of the *Reintroduction of Locally Extinct Mammals* project, as this has been proven to be an effective method for ensuring that reintroduced native species establish secure populations. In time, it is intended that these species will also be reintroduced outside the exclosures.

An exclosure of approximately 6000 hectares will be constructed in Pilliga State Conservation Area (see Figure 2 for an indicative location). Once all predators and other species with potential to disrupt the project (such as emus, rabbits and kangaroos) have been removed, the following species are intended to be progressively introduced:

- western quoll
- western barred bandicoot
- greater bilby
- brush-tailed bettong
- bridled nailtail wallaby
- plains mouse
- northern hairy-nosed wombat.

These are species which are no longer found in the parks but are known historically to have played an important role in maintaining healthy ecosystems in this environment. Each of these species is also threatened with extinction across its range. Ground-dwelling mammals such as bettongs, bilbies and bandicoots are known to have far-reaching, positive effects on entire ecosystems in the semi-arid and arid zones. Turning over soil in their search for food allows better penetration of water into soils and reduces surface runoff, as well as creating the disturbance needed for many plants to germinate. In this sense, such species function as ecological engineers (James et al. 2009; Read et al. 2008) and with the loss of these species, the important ecosystem services to which they contribute are in turn threatened (Fleming et al. 2014).

The final selection of species may vary slightly depending on the availability of animals and other factors. The final location and configuration of the fenced exclosure will be based on the suitability of habitat and the need to minimise disturbance to the park's natural and cultural values.

An initial 10-year contract has been awarded to the Australian Wildlife Conservancy for the project in the Pilliga Outwash parks. In addition to establishing and managing viable populations of locally extinct species, the contract includes the delivery of park management activities such as pest and weed control, asset maintenance and future visitor management across the entire Pilliga State Conservation Area and the gilgai section of Pilliga National Park (the *Reintroduction of Locally Extinct Mammals* project area is all the NPWS estate shown in Figure 2). NPWS will retain responsibility for fire management throughout the Pilliga Outwash parks including the project area, in accordance with the approved fire management strategies for the parks (see Section 2.3). At the end of the 10-year period the outcomes of the project will be assessed and reviewed to help determine the next steps for the project. Additional detail on the project is included in Section 5.5.

The management of genetic health and resilience of populations to be reintroduced is an important and essential component of the project. Animals for reintroduction will be sourced from a number of subpopulations, including wild populations, so as to maximise genetic diversity. Preference will be given to animals from populations in environments that are most similar to the conditions in the Pilliga Outwash and that are closest to the parks. In the event that suitable animals are not available from wild subpopulations, they may be selected from captive populations.

Reintroduced species will be translocated into an exclosure free of introduced predators. In the surrounding area outside the fence, intensive pest control, including targeted cat control, will benefit extant threatened species. This concentrated effort is expected to have benefits for all biodiversity in the parks. It will also improve knowledge of predator–prey interactions and improve expertise in effective pest control, particularly for cats and foxes. The long-term objective of the

program is that once the reintroduced populations become established and the threats to these species are effectively reduced more broadly throughout the park, animals will be released from the exclosure into the surrounding area.

Fencing for the exclosure has been designed to maximise cat, fox and dog exclusion as well as to exclude pest species such as rabbits, pigs and goats (see photo below of a similar exclosure). Special measures include two electrified wires at different heights, rabbit netting along the ground to prevent burrowing in, and floppy overhangs to prevent cats and foxes climbing over the fence. The exclosure will also be equipped with one-way gates to allow small mammals to disperse from the exclosure into the park in the long term. The integrity of the fence will be constantly monitored and maintained in conjunction with ongoing pest management.

Exclosure fence at Arid Recovery Centre, South Australia. Photo credit: K Moseby, Ecological Horizons Pty Ltd

Extensive environmental monitoring will be conducted regularly, both inside and outside the exclosure to assess reintroduced animals, responses of other native species including threatened species, and responses of other aspects of the ecosystem to the reintroduction of mammal species and threat management. Short-term, medium-term and long-term indicators of success towards establishing viable populations of each of the reintroduced species will be developed. The results of the monitoring will be used to guide ongoing management decisions, evaluate progress towards establishing viable populations and improving the ecological health of the park. Information about the progress of the project will also be made known to the public.

Management directions

2j) Relevant actions in the *Biodiversity Conservation Program* for threatened animal species and populations are implemented and where relevant, integrated with the *Reintroduction of Locally Extinct Mammals* project.

2k) Adverse impacts on native animal populations and their habitat will be minimised.

2l) Environmental restoration and other management measures aimed at reducing the impacts of key threatening processes may be carried out in accordance with NPWS policies and procedures.

2m) Further animal surveys will be carried out to support and inform park management.

2n) The *Reintroduction of Locally Extinct Mammals* project will be implemented in Pilliga State Conservation Area and will commence in the park in 2017 following completion of the environmental impact assessment. The project will include management of the gilgai section of Pilliga National Park. Information about the progress and findings of the project will be made available to the public.

2.5 Pest animals

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

NPWS manages pests in the parks under a regional pest management strategy (OEH 2013b) which identifies priority pest programs and is updated every 5 years. The overriding objective of the pest management strategy is to minimise adverse impacts of introduced pest species on biodiversity and other park values. The impacts of many introduced animal pests are classified as key threatening processes under the Biodiversity Conservation Act. To combat these impacts, programs have been identified in the *Biodiversity Conservation Program*. Some pest species, such as red foxes and pigs, are also addressed under a threat abatement plan.

The Northern Plains Region Pest Management Strategy focuses on the control of foxes to protect threatened species, with lower priorities given to pest animal control in compliance with legislative requirements. Additional control programs that have been implemented locally include goat mustering, targeted weed spraying, spread of biological control agents (cochineal) targeting different types of pear, and pig trapping and poisoning when required.

The pest management strategy identifies eight pest animals occurring in the Pilliga Outwash parks (see Table 5). Those of most concern are foxes, goats, pigs and cats.

Table 5. Pest animals recorded in the Pilliga Outwash

Common name	Comment
Goat	Widespread in the broader landscape.
Red fox~	Widespread in the broader landscape.
Pig~	Scattered. Main concern is in the gilgai area where the ephemeral wetlands endangered ecological community, including the threatened plant *Myriophyllum implicatum*, is sensitive to disturbance created by pigs.
Cat	Widespread in the broader landscape.
Deer	Emerging threat known from low numbers in Pilliga National Park and State Conservation Area. Populations are being monitored as they have the potential to explode when conditions are wet.
Wild dog~	Low numbers potentially threatening neighbours' livestock.
Rabbit~	Minor.
Hare	Minor.
Horse	Largest populations concentrated in the western Outwash (Pilliga West National Park and State Conservation Area) with scattered populations in the northern Outwash. Historical associations with pastoral activities and past forestry activities. Hazard on public roads traversing the parks.

~ Declared pest under the *Local Land Services Act 2013*.

The introduction of artificial sources of water for watering stock animals, particularly in the drier parts of Australia, has led to undesirable increases in populations of non-native pest animals and some native animals such as kangaroos. These increases have in turn led to significant adverse impacts on native vegetation communities and habitat values for native animals around the water points.

For an average of 50 weeks of the year, there is no surface water in the Pilliga Outwash parks and therefore the presence of ground tanks is contributing significantly to the persistence of pest animals. However, these artificial water points are also likely to provide an important resource in extended dry periods for native species in the Pilliga Outwash such as koalas. As part of a more strategic approach to pest control in the parks, NPWS is reviewing the number and distribution of ground tanks. Those that are excess to park requirements for fire management may be decommissioned or fitted with feral animal traps.

Ground tank, Pilliga West State Conservation Area. Photo credit: M Billington, OEH

Box 7: Introduced predators

Introduced predators such as red foxes and feral cats have played a significant role in the loss of native animal species throughout Australia. NPWS pest management is therefore focussed on controlling introduced predators.

Foxes suppress native animal populations, particularly medium and small-sized ground-dwelling and semi-arboreal mammals, ground-nesting birds and freshwater turtles. Foxes also prey on domestic stock, including lambs and poultry. Predation by the European red fox is a declared key threatening process under the Biodiversity Conservation Act and Environment Protection and Biodiversity Conservation Act (NSW SC 1998; DoE 2009 respectively). The fox is also a declared pest species in New South Wales under the *Local Land Services Act 2013*.

Foxes are considered a major pest species in the Pilliga Outwash parks because of the significant impact they have on native animals such as the threatened Pilliga mouse, and the ongoing threat they pose to domestic stock on neighbouring lands. Fox control has been carried out in the parks using both buried baits and spring-activated baiting devices (known as canid pest ejectors). As foxes are opportunistic feeders, both of these methods have proven to be environmentally safe and effective, particularly if done in cooperation with neighbouring landowners. Fox control is ongoing, due to the highly mobile nature of foxes which results in rapid repopulation of treated areas.

Together with foxes, **feral cats** are known to have caused the decline of many native species including extinctions of mammals. They are responsible for the failure of many threatened species

reintroduction programs that do not have effective exclusion fencing, and continue to pose a serious threat to Australian wildlife (Short et al. 1992 and Priddel & Wheeler 2002, both cited in Moseby & Hill 2011). Predation by feral cats has been listed as a key threatening process under the Biodiversity Conservation Act and Environment Protection and Biodiversity Conservation Act (NSW SC 2000b; DoE 2009 respectively). Cats are notoriously good hunters and can endure the harsh conditions of the semi-arid and arid zones where other predators fail. Cat control remains difficult and NPWS will continue to seek effective methods of control.

Feral horses

It is thought that Australia supports the largest population of free-ranging wild horses in the world (Dobbie et al. 1993). Feral horses are serious environmental pests (SEWPAC 2011). The impact of horses on native ecosystems are far-ranging and include soil hardening and erosion of frequently used routes, trampling and overgrazing of native plants, destruction of native animal burrows, competition with native animals for food and shelter, and spread of weeds.

Feral horses occur throughout the Pilliga Outwash parks with the largest populations occurring in Pilliga West National Park and Pilliga West State Conservation Area. In addition to the impacts listed above, horses pose a threat to public safety along major roads such as the Coonamble—Pilliga Road, Western Way, Wangan Road and Brumby Road. NPWS has erected road warning signage and is monitoring the population density and distribution of feral horses. If this signage proves to be ineffective, additional management actions may be considered, including fencing water points in high risk areas and mustering.

NPWS recognises that the feral horses in the Pilliga Outwash parks are descended from those used for log-hauling in the Pilliga Forest since the 1890s and have associations with the cultural heritage of that era. These important values will be considered together with impacts on human safety and park values in strategic management of feral horse populations.

Feral goats

The impact of feral goats on conservation values is substantial because they graze native plants, compete with native animals for shelter, spread weeds, trample vegetation and damage Aboriginal heritage sites. Congregations of goats in favoured locations can result in erosion and impacts on amenity. Competition and habitat degradation by feral goats is a key threatening process under the Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act (NSW SC 2004a; DoE 2009 respectively). The feral goat is also identified as one of the 100 worst invasive species in the Global Invasive Species Database (IUCN 2017).

Goats are a significant problem in western New South Wales since they can breed rapidly and are highly nomadic. Many landholders contribute to the maintenance of goat populations in the landscape because goats require little attention and their sale supplements traditional sheep or cattle incomes, particularly during drought. Goats are mobile, able to move many kilometres in a day, and are not impeded by standard stock fencing. Grazing by feral goats can severely impact the regeneration of native plant species.

Goats are widespread and occur throughout the Pilliga Outwash parks. Trapping and mustering have been carried out in the Pilliga Outwash parks.

Feral pigs

The impact of feral pigs on conservation values is substantial as they forage, wallow and dig in wetland areas, and cause major disturbance and damage to soils, roots, sensitive ground flora and wetland environments. Areas disturbed by feral pigs are at risk from subsequent weed invasion and soil erosion. Pigs are also a potential host of a number of exotic diseases.

Predation, habitat degradation, competition and disease transmission by feral pigs is listed as a key threatening process under the Biodiversity Conservation Act and the Environment Protection and Biodiversity Conservation Act (NSW SC 2004b; TSSC 2001b respectively). A threat abatement plan has been prepared under the Environment Protection and Biodiversity Conservation Act (DEH 2005) which sets out a national framework to guide coordinated actions to address this threatening process.

Feral pigs generally favour the wetter parts of the parks around the gilgais and are highly seasonal, increasing in numbers when ephemeral creeks are flowing. NPWS control programs are ongoing and include baiting and trapping.

Management directions

2o) Pest management will be undertaken in accordance with pest management strategies relevant to the parks.

2p) Monitor and report emerging pest animals and undertake control actions where necessary.

2q) NPWS will investigate the need for exclusion fences around ground tanks to control feral animals.

2r) NPWS will work with neighbouring landowners to deliver coordinated and strategic pest animal control.

2.6 Climate change

Objective: The resilience of the parks to the impacts of climate change is enhanced

Objective: Understanding the impacts of climate change is enhanced and informs management of the parks

Human-induced climate change is listed as a key threatening process under the Biodiversity Conservation Act (NSW SC 2000a), and habitat loss caused by human-induced greenhouse gas emissions is listed under the Environment Protection and Biodiversity Conservation Act (TSSC 2001a).

The latest information on projected changes to climate are from the NSW and ACT Regional Climate Modelling (NARClim) project (OEH 2014). The climate projections for 2020–2039 are described as ‘near future’, and projections for 2060–2079 are described as ‘far future’. The snapshot shown in Table 6 is for the New England North West Region which includes the Pilliga Outwash parks (OEH 2014).

Table 6. New England North West climate change snapshot

Projected temperature changes:	
Maximum temperatures are projected to increase in the near future by 0.4–1.0°C	Maximum temperatures are projected to increase in the far future by 1.9–2.7°C
Minimum temperatures are projected to increase in the near future by 0.5–1.0°C	Minimum temperatures are projected to increase in the far future by 1.6–2.7°C
The number of hot days (i.e. > 35°C) will increase	The number of cold nights (i.e. < 2°C) will decrease
Projected rainfall changes:	
Rainfall is projected to decrease over most of the region in winter	Rainfall is projected to increase in autumn
Projected Forest Fire Danger Index changes:	
Average fire weather is projected to increase in summer, spring and winter	Severe fire weather days are projected to increase in summer and spring

Source: OEH 2014.

The projected increases in temperature and increased number of hot days is likely to increase evaporation in the region throughout the year, especially in spring. Overall the water balance is likely to remain similar to what it is at present but with some redistribution of seasonal runoff and a substantial decrease during spring and winter (DECCW 2010b). Patterns of the El Nino Southern Oscillation and other climatic influences may be modified by global warming and this is an active area of research.

Weather conditions conducive to large, intense fires such as prolonged drought, days of high temperature and low humidity are anticipated to increase in the near future. However, fire frequency in the vicinity of the Pilliga Outwash parks may decrease due to the lower availability of herbaceous fuels. Future changes in fuel availability are the least certain of all fire hazard indicators (DECCW 2010b). Changes in farming practices are also likely to further reduce the incidence of fire in adjoining cropping lands. However, a much better understanding of future changes to the frequency and intensity of the El Nino Southern Oscillation is needed to project these changes with more certainty (DECCW 2010b).

Climate change may significantly affect biodiversity by changing the size of populations and the distribution of species, and altering the geographical extent of habitats and ecosystems. The likelihood of these changes occurring is difficult to assess since it depends on the compounding effects of other pressures, particularly barriers to migration and pressure from feral animals. Species most at risk are those unable to migrate or adapt, particularly those with small population sizes or with slow growth rates. Koalas in the Pilliga can be affected by drought and extreme heatwaves, as was seen in 2009. The impact of these extreme weather events on koalas is likely to increase with climate change (Lunney et al. 2012, cited in NSW Chief Scientist & Engineer 2016).

The New England North West Region contains a number of biological communities and species at their altitudinal, longitudinal or latitudinal limits. Temperature increases are likely to cause the range of many of these species to contract.

The ephemeral wetlands in the Pilliga Outwash provide important though unpredictable foraging habitat for a range of bird species including trans-equatorial species. Under likely climate change scenarios, the frequency of these wetlands forming is likely to be more variable than at present.

Heavily cleared and fragmented ecosystems in the New England North West Region are likely to be at greater risk than more intact ecosystems like the Pilliga Forest. Climate change may add yet another pressure on these already highly stressed ecosystems. Warmer conditions

are likely to favour weed species which could increase in abundance and continue to alter the mix of species in understorey vegetation.

Long-term conservation of biodiversity under changed climatic conditions depends on the protection, enhancement and connection of remaining habitat across the landscape, incorporating vegetation remnants on both public and private lands. Cooperative arrangements with neighbours will continue to be important in controlling pest species and maximising the connectivity of habitats across the landscape.

Programs at a landscape level which are aimed at reducing the pressures arising from other threats, such as habitat fragmentation, invasive species, bushfires and pollution, will help reduce the severity of the effects of climate change.

Management directions

2s) Existing fire, pest and weed management programs will contribute to the parks' capacity to cope with the impacts of climate change.

2t) NPWS will support and, where possible, contribute to research which adds to understanding about the impacts of climate change and the ability to manage the parks at a landscape level.

2u) NPWS will support initiatives aimed at adding additional vegetated lands to the parks.

3 Looking after our culture and heritage

History has taken place across the landscape. This includes the history of the first Australians – Aboriginal people – and our shared history since European settlement.

Heritage places and landscapes are made up of living stories and connections to the past that individuals and communities have inherited and wish to conserve for current and future generations, and can include natural resources, objects, customs and traditions. Cultural heritage comprises places and items that may have historical, scientific, aesthetic and social significance. NPWS conserves the significant heritage features of NSW parks.

Both Aboriginal and non-Aboriginal people place values on cultural and natural landscapes. These values may be attached to the landscape as a whole or to parts of the landscape (e.g. a particular plant, animal or place). All landscapes contain the imprint of human use. On any given area of land, some historical activity will have taken place (DECCW 2010a). Much of the Australian environment has been influenced by past Aboriginal and non-Aboriginal land-use practices, and people continue to influence the land through recreational use, cultural practices, the presence of introduced plants and animals, and in some cases air and water pollution.

3.1 Aboriginal culture and heritage

Objective: Understanding of Aboriginal cultural heritage is improved

Objective: Gamilaroi Aboriginal people have ongoing connection with Country and opportunities to participate in management of Aboriginal cultural heritage in the parks

Objective: Aboriginal cultural heritage is protected and impacts minimised

3.1.1 Connection to Country

Our knowledge of how Aboriginal people lived in what is now the Pilliga Forest is largely derived from oral histories, cultural plant surveys and Aboriginal site surveys conducted in the Brigalow Belt South Bioregion as part of the Western Regional Assessments (NPWS 2002). The bioregion contains a diverse range of Aboriginal organisations and groups, as the boundaries of 17 local Aboriginal land councils intersect within the bioregion. The oral history obtained from over 100 interviews demonstrated that the Aboriginal communities across the bioregion express a common understanding of their cultural landscape.

The Pilliga Outwash lies within the traditional Country of the Gamilaroi People (also known as the Gomeroi and Gamilaraay People). Aboriginal communities have an association and connection to the land. The land, water, plants and animals 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 and need to be managed in an integrated manner across the landscape.

> **What is Country?** To Aboriginal people, the landscape is made up of many features that are interrelated. These include land, water, plants and animals, places and stories, historical and current uses, and people's interactions with each other and place. These

features are central to Aboriginal spirituality and contribute to Aboriginal identity. They are inseparable and make up what is known as 'Country'.

The use of the Pilliga landscape by Aboriginal people was focussed on the availability of water. Meeting places were always at water (Mrs Noelene Briggs-Smith, cited in NPWS 2002). In relatively dry landscapes like the Pilliga Outwash, chains of ponds resulted in water being available for prolonged periods and supplemented the water supplied by intermittently flowing streams. Aboriginal occupation may therefore have occurred for prolonged periods under the right conditions. European land use has also resulted in greater mobility of sandy sediments and increased erosion, so there is less evidence of surface water today.

Wetlands and billabongs provided Aboriginal people with a wealth of food such as fish, mussels, turtles, crayfish and ducks. Kangaroos and other animals were hunted as they were drawn to the water. Plants used by Aboriginal people in the Outwash included wild limes, bumbles, yams, bluebells, wild tomatoes, wattle gum and pig weed (NPWS 2002).

The first recorded contact between Aboriginal people and Europeans in the Pilliga was when Surveyor General John Oxley traversed the southern reaches of the Pilliga Forest in 1818. Between 1826 and 1831 a runaway convict, George Clarke, reportedly lived with the Gamilaroi People. He was known as the 'the Flying Barber' bushranger (Free Settler or Felon? 2003–2017) and was apparently welcomed as a 'superior being' because the Gamilaroi thought he was a spirit of one of the departed.

The Gamilaroi People were fiercely resistant to invasion of their land and had many conflicts with the European settlers. The infamous Myall Creek massacre occurred in 1838 in the Gwydir region, some 160 kilometres north-east of the Pilliga Forest. Not only were many people from the Wirrayaraay clan of the Gamilaroi nation and at least 25 Europeans killed, but the Myall Creek massacre became significant as the first time that British subjects were tried and executed for the murder of Aboriginal people (National Museum Australia n.d.).

Pastoralists started to arrive in the Pilliga Outwash area in the 1830s (High Ground Consulting 2012) and with the colony's thirst for grazing lands, European settlement substantially expanded, effectively displacing Aboriginal people from their traditional lands. As a result, Aboriginal people became more dependent on squatters and station owners for their livelihoods. Many in the Pilliga area were engaged in timber cutting, feral animal shooting and trapping, shearing, domestic labour, and as stock hands.

Many Aboriginal people who were unable to remain on their traditional lands lived on reserves or in fringe camps that were under the control of the Aborigines Protection Board for more than 100 years from 1833 to 1940. This exerted a tighter grip on the lives of Aboriginal people, placing even more restrictions on the rights of these communities. Originally there were a number of camps in the Pilliga Outwash between Pilliga, Wingadee and Cuttabri.

Minnom Mission Reserve (also known as Pilliga Mission), established in 1902, was about 10 kilometres north of what is now Pilliga West State Conservation Area. Unlike other parks and camps in the area, the Mission had a variety of amenities, including a school, store, community hall and housing of a more permanent nature. In 1923 the Aborigines Protection Board made the reserve into a station and employed a manager. A timber mill, built using Pilliga Forest timber, provided local jobs for both Aboriginal and non-Aboriginal people and produced and supplied timber throughout the area. Minnom Mission closed in 1952 (Coonamble Elders n.d.). Its cemetery is now maintained by the Pilliga Aboriginal community. In 2010, Aboriginal human remains were repatriated and buried within the cemetery.

3.1.2 Aboriginal cultural heritage

Aboriginal sites are places with evidence of Aboriginal occupation or that are related to other aspects of Aboriginal culture. They are important as evidence of Aboriginal history and as part of the culture of local Aboriginal people.

The Pilliga Outwash parks represent a significant Aboriginal cultural landscape. Cultural heritage surveys have been undertaken by members of Coonamble, Pilliga, Walgett and Wee Waa local Aboriginal land councils in Pilliga West State Conservation Area and Pilliga National Park. Sites identified include modified trees, artefact scatters and resource areas.

In the Pilliga Outwash parks, the most common Aboriginal sites recorded are modified trees and artefacts. It is not surprising that in a dry landscape where there is no permanent surface water these sites are concentrated along the course of ephemeral creeks such as Etoo, Tinegie, Mollieroi and Rocky creeks in the Pilliga North parks, and Baradine Creek in Pilliga West State Conservation Area. Recorded Aboriginal heritage also includes occasional grinding grooves, waterholes, early dwelling structures and a grave.

Aboriginal sites are highly valued physical evidence of traditional use of the land by generations of Gamilaroi People. Not all known sites have been formally recorded in the Pilliga Outwash parks, and there is a high likelihood of additional sites being present. Although NPWS has legal responsibility for the protection of Aboriginal sites and places under the National Parks and Wildlife Act, it acknowledges the right of Aboriginal people to make decisions about their own heritage. Aboriginal communities are consulted and involved in managing Aboriginal sites, places and related issues; and in promoting and presenting Aboriginal culture and history.

NPWS also supports the cultural use of wild resources by Aboriginal people, such as medicinal plants and bush tucker, subject to NPWS policies and licensing.

The Pilliga Outwash parks are part of an extensive Native Title Claim lodged in the name of the Gomeroi People (NC2011/006). The claim has not yet been determined.

Management directions

3a) Aboriginal cultural heritage values will be investigated as part of planning for works proposed in the parks.

3b) Aboriginal people will be consulted and invited to be involved in managing Aboriginal sites and other Aboriginal cultural heritage values in the parks.

3c) NPWS will support initiatives aimed at allowing members of the Aboriginal community to access Country for cultural purposes.

3.2 Shared cultural heritage

Objective: Significant historic features are appropriately conserved and managed

Objective: Historic heritage sites are recorded and interpreted where appropriate

3.2.1 Settlement by non-Aboriginal people

The first non-Aboriginal people to settle in the Pilliga were part of the relentless drive for grazing lands as the Colony of New South Wales continued to grow beyond the Nineteen Counties first declared by Governor Darling in 1826, in and around what is now the Sydney Basin.

The first settlers were squatters without legal rights to what was considered to be Crown land. Free land grants were brought to an end in 1831 and an Act ‘for regulating the Waste Lands belonging to the Crown in the Australian Colonies’ was passed by the British Parliament in 1836 (High Ground Consulting 2012). This meant that land beyond the Nineteen Counties, known as the unsettled districts, was not available for sale but could be leased. The conditions

allowed lessees a 14-year lease to run no more than 4000 sheep for a £10 fee. By 1848, seven such runs had been established in the Pilliga Forest region, including Wangan and Coghill which are now within the Pilliga Outwash parks. By the mid-1870s, numerous leases had been established, including Sandy Creek, Meriumborough, Dunwerian, Cubbo, Bullerawa, Talluba, Eato West, Eato East, Werai, Vivianfield, East Cumble, Back Vacant Cumble and Coormoore.

Despite attempts to establish closer settlement in the late 19th century much of the region around the Pilliga continued to be characterised by large cattle and sheep runs (High Ground Consulting 2012). During the 19th century a network of travelling stock routes was established to facilitate the movement of stock around the colony. A number of these stock routes followed the creek lines of the Pilliga to provide water for stock being driven through the forest. One such stock route followed Milchomi or Bungle Gully Creek (also named Baradine Creek) in West Pilliga State Conservation Area. The historic Eulah precinct formed part of this route (High Ground Consulting 2012).

3.2.2 Forestry

Commercial timber-getting began in the Pilliga as early as the 1870s (High Ground Consulting 2011). Timber cleared by settlers provided housing and fencing materials. By the early 1900s narrow-leaved ironbark was being harvested for the underframes of carriages and wagons and then the coming of the railways created demand for railway sleepers which continued well into the 1930s. Cypress pine was harvested for house frames, weatherboard cladding and floorboards.

In those days, there was no defined management strategy or regulation for hardwood resources and hardwood sleepers were cut according to demand and availability (Forestry Commission of NSW 1986). By the early 19th century, the government became concerned about the diminution of the state's forest resources (High Ground Consulting 2011). The subsequent Royal Commission in 1907–08 led to passing of legislation, and the dedication of state forests Pilliga East Block and Pilliga West Block over the Pilliga Scrub (now the Pilliga Forest). The Forestry Commission was established in 1916.

The Pilliga Forest was dotted with sleeper cutter camps. Many sleeper cutters camped in the bush for years, living in tents or rough huts made from corrugated iron, wheat bags and saplings. By the late 1920s there were approximately 150 families of sleeper cutters established in the area and horse-drawn drays visited camps to collect sleepers. Remains of sleeper dumps remain in the Pilliga Outwash parks today.

The Great Depression in 1933 saw a great number of employment projects commence in the Pilliga Forest. In the Pilliga Outwash, these included the construction of roads, tanks and bores, and sections of the Pilliga Dog Proof Fence (see below) while elsewhere in the forest, fire towers and telephone lines were erected.

In September 1937, Pilliga National Forest No. 7 became the largest state forest in Australia, with an area of 625,593 acres (253,168 hectares). This state forest was of national importance and included the former Cumbil, Euligal, Merriwindi, Pilliga West and Yarrigan state forests.

The outbreak of World War II saw a massive increase in demand for local timber needed to replace imports and to support defence projects. By the end of the war, there were 14 mills operating in the Pilliga area to supply the demand created from the baby boom and to address building material shortages. Conservation management strategies have been completed for several former saw mill sites in the Pilliga Outwash parks. These include the decommissioned Wombo Saw Mill (Sue Rosen Associates 2009b) and Ironbark Lagoon Saw Mill (Sue Rosen Associates 2009a) both in Pilliga West State Conservation Area (see Figure 4), and both of which were considered to be of local heritage significance.

Cypress milling continued to expand during the 1950s, with steam-operated mills replaced by electric- and diesel-operated mills. Many of the 63 remaining sleeper cutters went out of

business in the mid-1950s when big rains made the area so wet that there was no access to sleeper dumps. However, sleeper cutting continued into the 1980s when a new high-tech, specialist timber mill was established at Baradine.

3.2.3 The Pilliga Dog Proof Fence

Pastoralists in south-east Queensland and northern New South Wales began to build dog-proof fences in the early 1880s (Pickard 2007) in response to the threat to sheep from escalating numbers of dingoes and wild dogs. In the Pilliga, the Narrabri Pastures and Stock Protection Board commissioned a 'barrier fence' as early as 1902 (High Ground Consulting 2008). What became known as the 'Pilliga Dog Proof Fence' was developed in various sections over a period of 60 years between 1880 and 1940. Initially, private landholders started to build the fence, then the government stepped in to unify efforts to keep out wild dogs. During the Great Depression between 1937 and 1939, 1400 men were employed to make improvements to what became a 60-mile dog-proof and rabbit-proof fence along the northern and eastern edges of the Pilliga Forest.

The alignment of the Pilliga Dog Proof Fence is still visible, but most of the fence has either been replaced by modern fencing or is in a degraded state. These remnants nevertheless provide information about various stages of development of predator-proof fences in the late 19th and early 20th centuries.

The Pilliga Dog Proof Fence has been assessed to be of state heritage significance (High Ground Consulting 2008) and NPWS will pursue its listing on the State Heritage Register. A few representative sections are being conserved along the border of Pilliga National Park (Gilgais) in accordance with a conservation management strategy (High Ground Consulting 2008) as shown on Figure 2. Conservation works are undertaken to repair components of the fence while preserving as much of the original fabric as possible. Agreements have also been formed with adjoining landowners to ensure that the historical significance of the dog fence is preserved.

Section of fence along Dog Proof Fence Road, Pilliga National Park. Photo credit: High Ground Consulting

3.2.4 Other shared cultural heritage

A variety of historic sites have been recorded throughout the Pilliga Outwash parks, most of which represent themes of past occupation including forestry and pastoral activities. Traces of pastoral history are present in the form of cypress pine fence posts, telephone line poles, graves, and informal bridges of logs and rough-felled timber known as corduroy crossings. Historic heritage associated with past forestry includes timber-felling campsites, sleeper dumps, survey marker trees, snig tracks and large tree stumps with incised step holes.

In the West Pilliga State Conservation Area there are two historic heritage sites which provide evidence of a former pastoral lease on the Wangen Run which was first taken up in 1884 (see Figure 4). Eulah Precinct includes remains of a saddle shed, well, tank stand, chicken run and Ironbark Lagoon Sawmill Cottage which was relocated to the site in the mid 1950s (High Ground Consulting 2012). Burtons Block contains Tindall's cottage dating from about 1933 and remains of other standing heritage including cattle yards, a windmill, tank, slab-walled shed and carved-log water trough. The conservation management strategies that were prepared for Eulah Precinct (High Ground Consulting 2012) and Burtons Block (High Ground Consulting 2011) found the items to be of local heritage significance.

There are many other items of historic heritage present throughout the Pilliga Outwash parks which have not yet been recorded or assessed. It is likely that these additional sites are of local historic significance.

Management directions

3d) Shared heritage items will be maintained and managed in accordance with their assessed level of significance.

3e) NPWS will support the listing of sections of the Pilliga Dog Proof Fence on the State Heritage Register.

3f) Non-intrusive works may be undertaken where necessary to protect cultural heritage items from further deterioration, ensure the safety of visitors, protect wildlife or prevent damage to park values.

3g) Interpretation materials will be developed to contribute to visitor understanding of the history of the parks, including the Pilliga Dog Proof Fence and other significant shared historic items.

4 Public use of the park

Objective: There is widespread understanding and appreciation of the rich natural and cultural values of the Pilliga Outwash parks

Objective: Public access and recreational use of the parks is sustainable and managed to ensure park values are not compromised

Objective: Visitor safety is maintained for all public users of the parks

NPWS parks provide a range of visitor opportunities. NPWS aims to ensure that visitors enjoy, experience and appreciate parks at the same time as conserving and protecting park values. Future development of additional low-key visitor activities in the parks for should be considered.

Access to the Pilliga Outwash is via an extensive network of roads and trails which were originally developed for timber harvesting. This includes unsealed arterial roads such as Western Way and Pilliga Forest Way, and major sealed roads such as the Newell Highway and the Pilliga–Coonamble Road.

The NPWS Discovery Centre in Baradine provides orientation for visitors to parks in the Pilliga Forest area. The current focus of visitation is towards Pilliga East parks, in particular Pilliga East State Conservation Area and Timmallallie National Park. NPWS is now considering how visitors can also be directed to the Pilliga Outwash parks and the Pilliga West parks in particular. This includes investigation of the viability of a visitor use area which could act as a gateway or orientation site to the Pilliga West parks.

4.1 Recreation

The appeal of the Pilliga Outwash parks for visitors includes their natural western slopes setting encompassing unique landscape features such as gilgais, billabongs and ephemeral wetlands.

The Pilliga Outwash parks generally experience very low levels of visitation. No visitor facilities are currently provided in the parks and visitation is centred on low-key, self-regulated activities such as bushwalking, birdwatching, scenic drives and cycling. Local ‘Bird Route’ guides provide directions for bird enthusiasts to travel through and spot birds in the Pilliga Forest area. Historic heritage sites in the parks have potential to provide a more varied experience for visitors. For example, Burtons Block and Eulah precinct in West Pilliga State Conservation Area have standing heritage buildings which could provide a focus for pastoral history.

Self-supported bush camping is allowed in the Pilliga Outwash parks, except in the area east of Bens Road and north of Schwaggers Bore Road in the Pilliga North parks (see Figure 2). There are no designated camping areas and no amenities will be provided.

Horse riding is permissible in the Pilliga Outwash parks on all park roads except for the following main thoroughfares:

- Wangan Road, Western Way and Brumby Road (Pilliga West National Park)
- Squires Road and Squires Lane (Pilliga National Park, Etoo section)
- Bens Road, Schwaggers Bore Road and Ironbark Crossing Road (Pilliga State Conservation Area).

Riders are permitted to cross these roads but not to travel along them. Horse riding is also not permissible off-road. Horse-riders must comply with the NPWS *Horse Riding Policy*.

Group activities such as car rallies may be carried out in the Pilliga Outwash parks with consent.

The *Reintroduction of Locally Extinct Mammals* project is due to commence in Pilliga State Conservation Area in 2017 (see Box 7) and will allow for authorised public access. A visitor strategy will be developed to manage public access to the project area and is expected to provide rare opportunities for visitors such as visiting scientists, school groups, educational tours and community groups to observe threatened species in the reintroduction area on guided tours. Under this strategy, visitors associated with the project will be allowed to stay in the park within the project's operations base (see Section 5.5). A campground for visitors to the project may also be considered.

4.2 Firewood collection

Firewood collection for use outside of the parks is not permitted. This is because it can result in the loss of woody debris and fallen logs which are needed as habitat for native plants and animals. The removal of dead wood and dead trees has been identified as having a significant negative impact on habitat availability and ecosystem functioning and is listed as a key threatening process under the Biodiversity Conservation Act (NSW SC 2003).

4.3 Illegal activities

The main illegal activities that impact natural and cultural values in the Pilliga Outwash parks are felling of trees, illegal collection of firewood, hunting and off-road driving.

The gilgai section of Pilliga National Park is particularly sensitive to damage by off-road vehicles and NPWS has conducted a public awareness campaign to discourage people from driving off-road. If this is unsuccessful in reducing impacts, NPWS will consider closing public access to Old Coghill Road.

4.4 Research

There have been many impacts on the ecosystems in the Brigalow Belt South and Nandewar bioregions over the past 100 years. These impacts are the result of pastoralism and forestry, including logging of native cypress and ironbark, culling of eucalypts and understorey plants for silvicultural purposes, changes to grazing regimes, and changes to fire regimes including the exclusion of fire.

Now that the Pilliga Outwash parks are being managed for conservation, this creates an ideal opportunity to observe the forest in transition as important ecosystem processes become re-established. Research is needed to monitor progressive changes to vegetation structure and the restoration of logged areas of forest to provide a more natural ecosystem.

Since the parks were formed, NPWS has initiated baseline surveys to provide information on biodiversity within the Pilliga Outwash, for example, monitoring of barking owl roost and nest trees to gain an understanding of population dynamics of the species. Continued survey and research is needed for a range of plants and animals to add to understanding of their habitat needs, ecology and threats to their continued survival, particularly for the critically endangered plant *Myriophyllum implicatum* and threatened animal species such as the bush-stone curlew, pale-headed snake and micro-bats. Research of this nature is expected to contribute to improve park management.

There are also opportunities to add to the record of the rich cultural history of the Pilliga Outwash and long associations with local families. Potential research topics include pioneer farming, forestry, agriculture, and development of communications and technology.

NPWS encourages environmental research and student field work training projects in parks provided they are of benefit to the park and provided they do not cause undue disturbance to park values and management operations. Preference is given to applied research which will benefit ongoing adaptive management for the parks' significant natural values.

Monitoring and research will continue to be allowed in the Pilliga Outwash parks by approved researchers and institutions. Research related to ecosystem restoration and species reintroductions will be conducted in Pilliga State Conservation Area by the Australian Wildlife Conservancy as part of the *Reintroduction of Locally Extinct Mammals* project (see Box 7). An Ecological Health Monitoring Framework and research strategy will be developed to examine key aspects of species reintroductions including viability of reintroduced mammal populations, status of extant species, threat levels and the improvement of ecosystem health.

Management directions

4a) Visitor safety will be maintained for all public users of the parks.

4b) Law enforcement programs will be implemented to discourage illegal activities in the parks.

4c) A public awareness campaign is being conducted to discourage off-road driving in the gilgai section of Pilliga National Park. If this proves unsuccessful in reducing adverse impacts, consideration will be given to closing public access to Old Coghill Road.

4d) Self-supported bush camping is allowed throughout the parks, except in the area east of Bens Road and north of Schwaggers Bore Road in the Pilliga North parks.

4e) The viability of a new low-key visitor use area which could act as a gateway to the West Pilliga parks will be investigated.

4f) Visitation to the *Reintroduction of Locally Extinct Mammals* project will be allowed in accordance with a visitor strategy.

4g) Information about the *Reintroduction of Locally Extinct Mammals* project will be made available to the public.

4h) Horse riding is permissible on all park roads except the main thoroughfares of Wangan Road, Western Way, Brumby Road, Squires Road, Squires Lane, Bens Road, Ironbark Crossing Road and Schwaggers Bore Road. Horse riding is permitted in accordance with the NPWS policy.

4i) Self-guided tour materials will be developed to contribute to visitor experiences in the parks.

4j) The parks will be made available for research by approved research institutions. Research and survey of natural and cultural park values by NPWS will be continued where appropriate and where it can be applied to park management.

4k) Research findings generated by the *Reintroduction of Locally Extinct Mammals* project will be applied to park management.

5 NPWS infrastructure and services

Objective: All infrastructure needed to manage the park is sited, constructed and maintained to adequately service management needs and to have minimal environmental impact

5.1 Park roads and management trails

The network of park roads as shown on Figures 2 to 5 provides for park management purposes including pest, weed, fire and visitor management. These roads also allow public access throughout the parks. The roads will be maintained to the standard outlined in the fire management strategies for the parks.

Several roads have also been identified as Part 11 land under the National Parks and Wildlife Act for the purpose of providing access to private lands adjoining the parks. This land is vested in the Minister and does not form part of the gazetted area of the parks, but the management of these roads is subject to this plan, the National Parks and Wildlife Regulation and the requirements of the Environmental Planning and Assessment Act.

Many park roads are used by local traffic and heavy vehicles (logging contractors, harvesting contractors, livestock trucks) travelling between towns within the local area. These roads are maintained by NPWS, with the exception of Wombo Road in Pilliga West State Conservation Area which is maintained by Walgett Shire Council, and a small section of Bens Road in Pilliga State Conservation Area which is maintained by Narrabri Shire Council.

The extensive road and trail network through the Pilliga Outwash parks was created to suit the operational needs of previous state forest land tenure. Some of these roads and trails may no longer be required for visitor access, fire management or other NPWS operational purposes. The network of park roads and management trails may be rationalised to match NPWS's management requirements and meet visitor needs.

As explained in Section 4.3, NPWS is considering closing Old Coghill Road in Pilliga National Park in order to protect sensitive ephemeral wetland values which are being impacted by illegal off-road driving.

The Pilliga Outwash parks cover an extensive area and share boundaries with approximately 89 neighbouring properties (as at 2017). Some parts of the boundary fence between the parks and neighbouring properties are in a state of disrepair which allows stock to stray into the parks.

5.2 Water supply infrastructure

Ground tanks are present in all Pilliga Outwash parks. They provide water for fire suppression, a resource for native animals and a focus for visitors. The presence of artificial water points in the Pilliga Outwash parks is contributing directly to the persistence of non-native pests (see Section 2.5). Exclusion fencing around ground tanks may be considered.

5.3 Quarries

Prior to the gazettal of the Pilliga Outwash parks, a number of quarries (also known as borrow pits) were opened by Forestry Corporation NSW to provide road construction and maintenance material. NPWS continues to use this resource from the quarries shown on Figures 2 to 5 for maintaining the extensive road network in the parks.

Using quarry material from within the parks has the benefit of avoiding freighting costs and reducing the threat of introducing pathogens, weeds and pests into the parks from external sources.

Extractive activities such as quarries are managed under the *Mines Inspection Act 1901* and the *Mines Act General Rule 2000*. Once the rock resource is exhausted, quarries will be allowed to regenerate naturally.

5.4 Etoo radio tower and bore

The Etoo Radio Tower and solar-powered bore are on Etoo Bore Road near the southern boundary of the Etoo section of Pilliga National Park. The tower was constructed by NPWS for the purpose of radio communications. The bore, which was installed by the former Forestry Commission of NSW provides water for fire management.

5.5 Fencing and other infrastructure for the Reintroduction of Locally Extinct Mammals project

Establishment of the *Reintroduction of Locally Extinct Mammals* project (as detailed in Box 7) will require clearing of approximately 62 hectares of vegetation to allow construction of infrastructure to support operations and to engage authorised visitors with the project. Clearing of a corridor for the exclusion fencing amounts to approximately 48 hectares. Where possible felled timber will be used to create habitat features or in the construction of the operations base and other facilities.

New infrastructure will be required to meet OEH standards and will include:

- secure pest-proof fencing around the project area
- management trails connecting to and within the project area
- an operations base for Australian Wildlife Conservancy staff, researchers and visitors outside the fenced exclosure on Harris Road (see Figure 2)
- office, workshop, power system and fuel storage
- a UHF radio tower.

Provision may also be made for a campground for visitors to the project.

All houses and other accommodation facilities will be fitted with water tanks and will be reliant on rainwater for their domestic supply. An additional supply of water for fire protection may also be considered.

Existing park roads within the project area will be reclassified as management trails and closed to public access.

A detailed environmental impact assessment will be undertaken prior to any works being carried out in the park for this project. The outcomes of the assessment will determine the final location of the project's outer boundary, the operations base and infrastructure within this area; and the alignment of additional management trails needed to service the operations base.

Factors to be considered in siting all infrastructure include:

- the need to minimise the footprint of environmental disturbance
- the need to minimise impacts on habitat needed by extant threatened species while including a diversity of habitat within the exclosure for the reintroduced species
- effective asset protection
- cost-effective service provision
- location of existing management trails
- potential impacts on existing park management activities
- operation and workability of the overall project
- aesthetics, design and visual impact on park landscape values.

Management directions

5a) NPWS infrastructure and services needed to manage the parks will be sited, constructed and maintained to adequately service management needs and have minimal environmental impacts.

5b) The network of park roads may be rationalised to match NPWS's management requirements and meet visitor needs.

5c) NPWS will monitor the effectiveness of boundary fencing. NPWS will invite neighbouring landowners to enter into fencing agreements consistent with NPWS policy.

5d) Infrastructure will be constructed in Pilliga State Conservation Area to support the *Reintroduction of Locally Extinct Mammals* project.

6 Non-NPWS activities and infrastructure

Objective: Non-NPWS uses and activities have minimal impacts on the parks

6.1 Apiary sites

There is a long history of beekeeping in the Brigalow Belt South Bioregion and an established apiary industry which relies on the natural resources of the Pilliga Forest.

There is an extensive network of beekeeping sites in each of the Pilliga Outwash parks, although not all are active (as at 2017). Existing beekeeping sites will continue to be licensed and managed in accordance with licence conditions and NPWS beekeeping policy. Existing sites within the *Reintroduction of Locally Extinct Mammals* project area may be relocated in consultation with licence holders.

6.2 Transmission lines and telecommunications

Essential Energy has a powerline traversing the parks along Front Road in Pilliga West National Park. This power line is not covered by a formal easement. In accordance with the *Electricity Supply Act 1995* a network operator can operate and use the existing powerlines whether or not there is a formal easement in place.

Clearings and vehicle trails along powerlines can potentially have significant environmental and visual impacts. NPWS proposes to negotiate a memorandum of understanding with Essential Energy to reach agreement about appropriate maintenance works which can be carried out without NPWS consent.

Telstra optical fibre cables in Pilliga West National Park pre-date gazettal of the park. These cables were installed under Commonwealth legislation which provided an exemption at the time from the requirement for authorisation under state legislation. While maintenance of these facilities, as defined under the Commonwealth *Telecommunications Act 1997*, can be undertaken without NPWS approval, any works other than maintenance will require NPWS approval and licensing under the National Parks and Wildlife Act.

6.3 Mining

Exploration for minerals and petroleum (including gas), as well as mining and petroleum production, are permissible uses within state conservation areas, subject to environmental assessment.

The Department of Planning and Environment – Resources and Energy is the lead authority for mining and petroleum activities, including mineral exploration and mine site rehabilitation. NPWS and Resources and Energy work together to ensure that exploration and production proposals in state conservation areas comply with all statutory requirements, including any necessary environmental impact assessments and approvals.

Resources and Energy also regulates fossicking in New South Wales. No fossicking has been undertaken in the Pilliga Outwash parks since they were reserved. Fossicking has the potential to adversely impact natural and cultural values in parks, particularly Aboriginal cultural heritage and water quality.

The Pilliga Outwash parks overlay the extensive petroleum resources of the Surat–Bowen Basin, both oil and coal seam gas, which are considered to be of state and possibly national significance. Two petroleum titles apply (PEL 238 and PEL 428), held by Orion Petroleum Limited. Exploration is ongoing and there is high potential for coal seam gas in Pilliga and Pilliga West state conservation areas. A review of state conservation areas in 2013 found that the status of these parks as state conservation areas should remain unchanged.

Up to 850 coal seam gas wells are planned across the Pilliga and the potential development of the coal seam gas resource is being addressed as part of broader government processes. The Pilliga is groundwater-dependant and any mining on- or off-park that impacts groundwater may have detrimental impacts on park values. Any proposal for exploration or production in the state conservation areas of the Pilliga Outwash requires compliance with statutory requirements administered by the Department of Planning and Environment – Resources and Energy.

Management directions

6a) All proposals for non-NPWS managed infrastructure in the parks will be preceded by an appropriate level of environmental and cultural impact assessment and will be undertaken in accordance with all relevant approvals.

6b) Existing beekeeping sites will continue to be licensed and managed in accordance with licence conditions and NPWS beekeeping policy. Existing sites within the *Reintroduction of Locally Extinct Mammals* project area may be relocated in consultation with licence holders.

Appendices

Appendix A Legislation and policy

The following laws and policies apply to how we manage our parks:

NSW legislation

- *Biosecurity Act 2015*
- *Biodiversity Conservation Act 2016*
- *Environmental Planning and Assessment Act 1979*
- *Heritage Act 1977*
- *Local Land Services Act 2013*
- *National Parks and Wildlife Act 1974* and National Parks and Wildlife Regulation
- *Rural Fires Act 1997*

Other NSW laws may also apply to park management:

- *Brigalow and Nandewar Community Conservation Area Act 2005*

Commonwealth legislation

- *Environment Protection and Biodiversity Conservation Act 1999*

NPWS policies and strategies

These NPWS policies and strategies may also apply to park management:

- Beekeeping Policy
- Boundary Fencing Policy
- Aboriginal Partnerships Policy
- Cultural Fire Management Policy
- Horse Riding Policy
- Managing Parks Prior to Plan of Management Policy
- Regional pest management strategies
- *Saving our Species* Program

Other laws, policies and strategies may also apply; please contact NPWS for advice.

Legislative and policy framework

The management of a Community Conservation Area in NSW 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, strategies and international agreements may also apply to management of the area. In particular, the NSW *Environmental Planning and Assessment Act 1979* may require assessment of environmental impact of works proposed in this plan. The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* may apply in relation to actions that impact on matters of National Environmental Significance, such as migratory and threatened species listed under that Act.

Management purposes and principles

Community Conservation Areas

Community conservation areas are established under the *Brigalow and Nandewar Community Conservation Area Act 2005*. This Act provides for four dedicated management zones of which zones 1, 2 and 3 relate to land reserved under the National Parks and Wildlife Act as a national park, Aboriginal area or a State conservation area, respectively. Land in zones 1, 2 and 3 are managed consistent with the management principles set out in the National Parks and Wildlife Act.

Zone 1 National Parks

Zone 1 community conservation areas are reserved as a national park under the National Parks and Wildlife Act to protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor use.

Under the Act (section 30E), Zone 1 community conservation areas are therefore managed to:

- conserve biodiversity, maintain ecosystem functions, protect geological and geomorphological features and natural phenomena and maintain natural landscapes;
- conserve places, objects, features and landscapes of cultural value;
- protect the ecological integrity of one or more ecosystems for present and future generations;
- promote public appreciation and understanding of the park's natural and cultural values;
- provide for sustainable visitor or tourist use and enjoyment that is compatible with conservation of natural and cultural values;
- provide for sustainable use (including adaptive reuse) of any buildings or structures or modified natural areas having regard to conservation of natural and cultural values; and
- provide for appropriate research and monitoring.

The primary purpose of Zone 1 community conservation areas is to conserve nature and cultural heritage. In doing so, opportunities are provided for appropriate and sustainable recreation.

Zone 3 State Conservation Areas

Zone 3 community 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 use and enjoyment, the sustainable use of buildings and structures, or research
- are capable of providing opportunities for uses permitted under other provisions of the Act.

Under the Act (section 30G), Zone 3 community conservation areas are therefore 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 National Parks and Wildlife 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 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 reuse) 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.

Land is reserved as a state conservation area where mineral values do not allow for reservation under another category. The National Parks and Wildlife Act requires a review of the classification of state conservation areas every five years in consultation with the Minister administering the Mining Act 1992. A review was undertaken in 2013 in which the status of all Pilliga Outwash Community Conservation Areas, Zone 3 State Conservation Areas remained unchanged.

In the long term it is intended for Merriwindi and Pilliga West Community Conservation Area, Zone 3 State Conservation Areas to become a national park and to be added to the Pilliga Outwash parks and therefore management of the state conservation area will also be guided by the management principles for national parks as far as possible.

Appendix B Scientific names

The following tables list scientific names of common names mentioned in the text.

Key:

CE = critically endangered

E = endangered

V = vulnerable

X = presumed extinct

~ = likely to occur in the park

Plants

Common name	Scientific name	BC Act	EPBC Act
A creeping matted herb	*Myriophyllum implicatum*	CE	–
A prostrate shrub	*Commersonia procumbens*	V	V
A sedge	*Cyperus conicus*	E	–
A terrestrial orchid	*Prasophyllum* sp. *Wybong*	–	CE
A twiner	*Tylophora linearis*	V	E
Austral pipewort	*Eriocaulon australasicum*	E	E
A wide-spreading shrub	*Philotheca ericifolia*	–	V
Belah	*Casuarina cristata*		
Blakelys red gum	*Eucalyptus blakelyi*		
Bluegrass	*Dichanthium setosum*	V	V
Brigalow	*Acacia harpophylla*		
Broom bush	*Melaleuca uncinata*		
Buloke	*Allocasuarina luehmannii*		
Burrows wattle	*Acacia burrowii*		
Carbeen	*Corymbia tessellaris*		
Cassia	*Cassia* spp.		
Casuarinas	*Allocasuarina* spp.		
Coolabah bertya	*Bertya opponens*	V	V
Deane’s wattle	*Acacia deanei*		
Dirty gum (Baradine gum)	*Eucalyptus chloroclada*		
Fringe myrtle	*Calytrix tetragona*		
Fuzzy box	*Eucalyptus conica*		
Greenhood orchid	*Pterostylis cobarensis*	V	V
Hop bush	*Dodonaea viscosa*		

Common name	Scientific name	BC Act	EPBC Act
Inland grey box	*Eucalyptus macrocarpa*		
Kurrajong	*Brachychiton populneus*		
Kurricabah	*Acacia burrowii*		
Large-leafed monotaxis	*Monotaxis macrophylla*	E	–
Mugga ironbark	*Eucalyptus sideroxylon*		
Narrow-leaved ironbark	*Eucalyptus crebra*		
Native milkwort	*Polygala linariifolia*	E	–
Pilliga box	*Eucalyptus pilligaensis*		
Pine donkey orchid	*Diuris tricolour*	V	–
Poplar box (bimble box)	*E. populnea* subsp. *bimbil*		
Red ironbark	*Eucalyptus sideroxylon*		
River red gum	*Eucalyptus camaldulensis*		
Rough-barked apple	*Angophora floribunda*		
Scant pomaderris	*Pomaderris queenslandica*	E	–
Shrub sida	*Sida rohlenae*	E	–
Sifton bush	*Cassinia arcuata*		
Slender darling pea	*Swainsona murrayana*	V	V
Small purple-pea	*Swainsona recta*	E	E
Speargrass	*Austrostipa* spp.		
Spiny peppercress	*Lepidium aschersonii*	V	V
Wallaby grass	*Austrodanthonia bipartita*		
Water bush (Western boobialla)	*Myoporum montanum*		
Wattles	*Acacia* spp.		
White bloodwood	*Corymbia trachyphloia*		
White box	*Eucalyptus albens*		
White cypress pine	*Callitris glaucophylla*		
Wilga	*Geijera parviflora*		
Winged peppercress	*Lepidium monoplocoides*	E	E
Wire grass	*Cymbopogon* spp.		

Source: BioNet 2017b.

Animals

Common Name	Scientific Name	BC Act	EPBC Act
Invertebrates			
Northern Australian mussel	*Velesunio wilsonii*		
Sun moth	*Synemon laeta*		
Amphibian			
Sloane's froglet	*Crinia sloanei*	V	
Reptiles			
Nobbi	*Diporiphora nobbi*		
Pale-headed snake	*Hoplocephalus bitorquatus*	V	
Birds			
Australasian bittern	*Botaurus poiciloptilus*	E	E
Barking owl	*Ninox connivens*	V	
Black-chinned honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V	
Black-necked stork	*Ephippiorhynchus asiaticus*	E	
Brown treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	V	
Bush stone-curlew	*Burhinus grallarius*	E	
Diamond firetail	*Stagonopleura guttata*	V	
Dusky woodswallow	*Artamus cyanopterus cyanopterus*	V	
Emu	*Dromaius novaehollandiae*		
Glossy black-cockatoo	*Calyptorhynchus lathami*	V	
Grey-crowned babbler (eastern subspecies)	*Pomatostomus temporalis temporalis*	V	
Hooded robin (south-eastern form)	*Melanodryas cucullata cucullata*	V	
Little eagle	*Hieraaetus morphnoides*	V	
Little lorikeet	*Glossopsitta pusilla*	V	
Malleefowl	*Leipoa ocellata*	E	V
Masked owl	*Tyto novaehollandiae*	V	
Painted honeyeater	*Grantiella picta*	V	
Powerful owl	*Ninox strenua*	V	
Speckled warbler	*Chthonicola sagittata*	V	
Square-tailed kite	*Lophoictinia isura*	V	
Turquoise parrot	*Neophema pulchella*	V	
Varied sittella	*Daphoenositta chrysoptera*	V	

Common Name	Scientific Name	BC Act	EPBC Act
White-bellied sea eagle	*Haliaeetus leucogaster*	V	
Mammals			
Bettongs	*Betongia* spp.		
Corben's long-eared bat	*Nyctophilus corbeni*	V	V
Delicate mouse	*Pseudomys delicatulus*	E	
Dingo	*Canis lupus dingo*		
Eastern cave bat	*Vespadelus troughtoni*	V	
Koala	*Phascolarctos cinereus*	V	V
Little pied bat	*Chalinolobus picatus*	V	
Pilliga mouse	*Pseudomys pilligaensis*	V	V
Squirrel glider	*Petaurus norfolcensis*	V	
Rufous bettong	*Aepyprymnus rufescens*	V	
Spotted-tailed quoll ~	*Dasyurus maculatus*	V	E
Yellow-bellied sheathtail-bat	*Saccolaimus flaviventris*	V	
Reintroduction project mammals			
Bridled nailtail wallaby	*Onychogalea fraenata*	X	E
Brush-tailed bettong	*Bettongia penicillata*	X	X
Greater bilby	*Macrotis lagotis*	X	V
Northern hairy-nosed wombat	*Lasiorhinus krefftii*	*	E
Plains mouse	*Pseudomys australis*	**	V
Western barred bandicoot	*Perameles bougainville*	X	X
Western quoll	*Dasyurus geoffroii*	X	V

Source: BioNet 2017b.

* Listed as endangered under the *Queensland Nature Conservation Act 1992*
** Listed as vulnerable under the *South Australian National Park and Wildlife Act 1972*, endangered under the *Territory Parks and Wildlife Conservation Amendment Act 2000* and endangered under the *Queensland Nature Conservation Act 1992,* respectively.

Weeds and pest animals in the park

The following table summarises key information on pests in the parks at the time of publication of this plan. The most recent information on the status of pests and whether they have a threat abatement plan can be found on the Office of Environment and Heritage website. The Local Land Services Act declares certain animals to be pests.

Key:

DP = declared pest under the Local Land Services Act

KTP = key threatening process listed under Biodiversity Conservation Act and/or the Commonwealth Environment Protection and Biodiversity Conservation Act

WONS = Weed of National Significance

SP = state priority species under the Biosecurity Act

RP = regional priority species under the Local Land Services regional strategic weed management plan

Common name	Scientific name	Status
Weeds		
African boxthorn	*Lycium ferocissimum*	WONS,SP
Carrion flower	*Orbea variegata*	
Mother-of-millions ~	*Bryophyllum delagoense*	RP
Noogoora burr	*Xanthium occidentale*	
Prickly pear	*Opuntia stricta*	WONS, SP
Spiny burrgrass	*Cenchrus spinifex*	
Tiger pear	*Opuntia aurantiaca*	WONS, SP
Tree pear (velvety pear)	*Opuntia tomentosa*	WONS, SP
Pest animals		
Cat	*Felis catus*	KTP
Deer	*Dama dama*	
Red fox	*Vulpes vulpes*	KTP, DP
Goat	*Capra hircus*	KTP
Hare	*Lepus europaeus*	
House mouse	*Mus musculus*	
Horse	*Equus caballus*	
Pig	*Sus scrofa*	KTP, DP
Rabbit	*Oryctolagus cuniculus*	KTP, DP
Sheep	*Ovis aries*	
Wild dog	*Canis lupus* subspp.	DP

Appendix C Vegetation communities in the Pilliga Outwash parks

PCT name (NPWS Vegetation Information System)	Key species	Ecological setting	NSW Class (Keith 2004)	Porteners description (2007)	Hunter description (2010)
Buloke – White Cypress pine woodland on outwash plains in the Pilliga Scrub and Narrabri regions, BBS bioregion (ID 411)	Allocasuarina luehmannii Callitris glaucophylla	Found almost exclusively on flats and lower slopes	Pilliga Outwash Dry Sclerophyll Forests	n/a	C8: White Pine - Bulloak
Poplar Box - White Cypress Pine shrub grass tall woodland of the Pilliga - Warialda region, Brigalow Belt South Bioregion (ID 397)	Eucalyptus populnea Callitris glaucophylla	Found on flat, moist and deep soils that are orange brown to light brown and a clay loam, loam or sandy loam texture	Pilliga Outwash Dry Sclerophyll Forests	Community 1: Poplar Box - White Cypress Pine Woodland	C13: Poplar Box - White Pine
Narrow-leaved Ironbark - White Cypress Pine - Buloke tall open forest on lower slopes and flats in the Pilliga Scrub and surrounding forests in the central north Brigalow Belt South Bioregion (ID 398)	Callitris glaucophylla Eucalyptus crebra	Found throughout the Pilliga Outwash but primarily on slightly more elevated sites	Western Slopes Dry Sclerophyll Forests	Community 3: Narrow-Leaved Ironbark - White Cypress Pine - Bulloak Open Forest to Woodland	n/a
Pilliga Box – White Cypress Pine – Buloke shrubby woodland in the Brigalow Belt South Bioregion (ID 88)	Callitris glaucophylla Eucalyptus pilligaensis	Found primarily on mid-slopes but also on lower or upper slopes	Pilliga Outwash Dry Sclerophyll Forests	Community 2: Pilliga Box - White Cypress Pine Open Forest to Woodland	C9: White Pine - Pilliga Box
Dirty Gum - White Cypress Pine tall woodland of alluvial sand (sand monkeys) in the Darling Riverine Plains Bioregion and Brigalow Belt South Bioregion (ID 206)	Eucalyptus chloroclada Callitris glaucophylla	The community occurs on sandy yellow earths and light red loams of Quaternary alluvium formed by prior streams on meander plain landforms.	North-west Alluvial Sand Woodlands	Community 4: Baradine Gum - White Cypress Pine Open Woodland	C3: White Pine - Dirty Gum

PCT name (NPWS Vegetation Information System)	Key species	Ecological setting	NSW Class (Keith 2004)	Porteners description (2007)	Hunter description (2010)
Blakelys Red Gum x Dirty Gum - White Cypress Pine tall riparian woodland, NSW South Western Slopes Bioregion (ID 356)	*Eucalyptus camaldulensis* *Eucalyptus blakelyi* *Eucalyptus chloroclada* *Callitris glaucophylla* *Angophora floribunda*	Along major creek lines and ephemeral watercourses on deep coarse, pale yellow to red siliceous sands	Inland Riverine Forests	Community 5: Red Gum Riparian Woodland	n/a
Belah woodland on alluvial plains and low rises in the central NSW wheatbelt to Pilliga and Liverpool Plains regions (ID 55)	*Casuarina cristata* *Geijera parviflora*	Found on lower slopes and flats with moist and deep soils particularly in the western parts of Etoo. Also occurs in drainage depressions and alluvial plains with light clay with Gilgai microrelief present	North-west Floodplain Woodlands	Community 6: Belah Woodland	C12: Belah - Wilga
Derived Speargrass – wallaby grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (ID 395)	*Tripogon loliiformis* *Enteropogon acicularis*	Found in areas previous cleared and/or heavily used by stock primarily in Burtons Block	Western Slopes Grassy Woodlands	Cleared	C10: Five Minute - Curly Windmill Grass
Fringe Myrtle shrubland of the Pilliga Scrub (ID 415)	*Calytrix tetragona* *Westringia cheelii*	Found on mid to lower slopes on well drained deep soils that are light chocolate brown to orange brown and loamy sand, sandy loam or sand in texture	Western Slopes Dry Sclerophyll Forests	n/a	C5: Fringe Myrtle - Westringia
Red Ironbark – White Bloodwood +/- Burrows Wattle heathy woodland on sandy soil in the Pilliga forests (ID 404)	*Eucalyptus fibrosa* *Acacia burrowii* *Corymbia trachyphloia*	Found on mid to lower slopes on deep soils. Soils are light, chocolate or reddish brown and of a sandy loam or loamy sand texture	Western Slopes Dry Sclerophyll Forests	n/a	C6: Burrow's Wattle – Broad-leaved Ironbark

PCT name (NPWS Vegetation Information System)	Key species	Ecological setting	NSW Class (Keith 2004)	Porteners description (2007)	Hunter description (2010)
Broombush – wattle very tall shrubland of the Pilliga to Goonoo regions, Brigalow Belt South Bioregion (ID 141)	*Melaleuca uncinata Micromyrtus sessilis*	Found on flats where soils are well drained to moist and deep	Pilliga Outwash Dry Sclerophyll Forests	n/a	C4: Broom Bush - Heath Myrtle
Pilliga "tank gilgai" wetland Sedgeland rushland, BBS Bioregion (ID 416)	*Bulbine semibarbata Calandrinia eremaea*	Found predominantly in the Gilgai section of Pilliga NP on open and closed depressions. Occur on soils where light grey sandy loam and were moist to wet and deep	Inland Floodplain Swamps	n/a	C11: Tank Herbfield

Source: Keith 2004, Porteners 2007, Hunter 2010

Appendix D Vegetation management guidelines by community type for fire

– Vegetation management guidelines		
Community	– **Management guidelines**	**Fire Behaviour**
Wetlands	• No prescribed burning to applied • Exclude the use of machinery	• Potential rates of spread is low due to **NIL** / **Low** OFH
Riparian / Valley woodlands	• An interval between fire events less than 15 years and greater 40 years should be avoided • A high intensity fire may be permitted after a fire free period 25 years	• Potential rates of spread is higher due to **Moderate** ground and near surface hazard
Belah & Brigalow woodlands Alluvial woodlands	• An interval between fire events less than 20 years should be avoided • Exclude the use of machinery from Brigalow woodland	• Potential rates of spread is low due to **Low** OFH • Fire runs are likely to slow down when entering this vegetation
Grassy Box woodlands	• An interval between fire events less than 20 years should be avoided • A high intensity fire may be permitted after a fire free period 30 – 50 years	• Potential rates of spread is low due to **Low** OFH • Fire runs are likely to slow down when entering this vegetation
Ironbark / White Pine / Bulloak woodlands	• An interval between fire events less than 20 years should be avoided • A high intensity fire may be permitted after a fire free period 30 – 50 years	• Potential rates of spread is low due to **Low – Moderate** OFH • Localised areas of **High** OFH may produce restricted areas of higher fire intensity
Sandstone shrubby woodlands	• An interval between fire events less than 15 years and greater 40 years should be avoided • A high intensity fire may be permitted after a fire free period 25 years	• Potential rate of spread is highest in stands of elevated (shrub) fuel • Localised areas of **High** OFH
Shrublands	• An interval between fire events greater than 25 years should be avoided	• Potential rates of spread is very high due to VERY HIGH – EXTREME elevated fuel hazard (3+kph)
OFH – Overall fuel hazard - A rating system that includes surface (leaf litter), near surface (low shrubs & grasses), elevated (shrubs), and bark fuels.		
Strategic Zones - Prescribed burn should be considered where the OFH has been assessed at HIGH, after an interval of 7 years.		
Ephemeral Fuels - Ephemeral fuel conditions occur after consecutive years of effective rainfall. This in turn leads to the growth and build-up of fine surface fuels such as grasses and herbs, which can create a continuous fuel load across all of the above vegetation communities.		
Long Unburnt - it is desirable in woodland plant communities to retain some parts of the landscape in a long unburnt state to promote the presence of species that are sensitive to fire and to maintain old-growth trees capable of forming hollows.		

Source: OEH (2015a, 2015b, 2015c)

References

Bell DM, Hunter JT & Montgomery L 2012, Ephemeral wetlands of the Pilliga Outwash, northwest NSW, *Cunninghamia* 12(3): 181–190.

Benson JS & Redpath PA 1997, The nature of pre-European native vegetation in south-eastern Australia: a critique of Ryan DG, Ryan JR and Starr BJ (1995), *The Australian Landscape – Observations of Explorers and Early Settlers, Cunninghamia, 5(2)* pp. 285–328

Benson JB, Richards PG, Waller S & Allen CB 2010, New South Wales Vegetation Classification and Assessment, Part 3, Plant communities of the NSW Brigalow Belt South, Nandewar and west New England Bioregions and update of NSW Western Plains and South-western Slopes plant communities, Version 3 of the NSWVCA database, *Cunninghamia* 11:457–579.

Brookhouse P & Nicholson D 1999, Large Pilliga fires and the development of fire management and fire suppression strategies, Bushfire 99: Proceedings of the Australian Bushfire Conference, 7–9 July 1999, Albury, Australia.

Bushfire CRC & AFAC 2009, *Plants and Fire: Survival in the bush*, Fire Note 47, Bushfire Cooperative Research Centre & the Australasian Fire and Emergency Service Authorities Council, www.bushfirecrc.com/sites/default/files/managed/resource/0911_firenote47_lowres2.pdf.

Coonamble Elders (n.d.), Minnom Mission: Coonamble Elders speak of their life at the Minnon Mission, Pilliga, www.coonamble.org/murries/history/historymain.htm, accessed 6 June 2017.

DEC 2006, *Aboriginal Cultural Heritage Regional Studies: An illustrative approach*, Department of Environment and Conservation, Sydney, www.environment.nsw.gov.au/resources/cultureheritage/RegionalStudiesfinal.pdf.

DECCW 2010a, *Cultural landscapes: A practical guide for park management*, Department of Environment, Climate Change and Water, Sydney, www.environment.nsw.gov.au/resources/cultureheritage/20100052CulturalLandscapes.pdf.

DECCW 2010b*, NSW Climate Impact Profile: The impacts of climate change on the biophysical environment of New South Wales*, Department of Environment, Climate Change and Water, Sydney, http://climatechange.environment.nsw.gov.au/Impacts-of-climate-change/2010-NSW-climate-impact-reporting.

DEH 2005, *Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*, Commonwealth Department of Environment and Heritage, Canberra, www.environment.gov.au/cgibin/sprat/public/publicshowkeythreat.pl?id=11.

DMR 2002, *Geology – integration and upgrade, NSW Regional Assessments, Brigalow Belt South, Stage 2*, report prepared for Resource and Conservation Assessment Council, NSW Department of Mineral Resources, Geological Survey of New South Wales. http://www.epa.nsw.gov.au/resources/forestagreements/wra19.pdf.

DEWNR 2015, *Declared plant: Carrion flower* Orbea variegata, Factsheet accessed 27 June 2017, http://pir.sa.gov.au/__data/assets/pdf_file/0013/240025/carrion_flower_fsheet.pdf.

Dickman CR, Pressey RL, Lim L, & Parnaby HE 1993, Mammals of particular conservation concern in the Western Division of New South Wales, *Biological Conservation*, 65, pp. 219–248.

Dickman CR 1994, Mammals of New South Wales: past, present and future, *Australian Zoologist* 29 pp. 3–4.

Dobbie WR, Berman D & Braysher ML 1993, *Managing Vertebrate Pests: feral horses*, Australian Government Publishing Service, Canberra.

DoE 2009, Listed Key Threatening Processes, Department of the Environment, www.environment.gov.au/cgi-bin/sprat/public/publicgetkeythreats.pl.

DoEE n.d. (a), Feral cats. www.environment.gov.au/biodiversity/invasive-species/feral-animals-australia/feral-cats.

DoEE n.d. (b), Species Profile and Threats Database, http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

DPI 2013, *NSW Biosecurity Strategy 2013–2021*, Department of Primary Industries, a division of NSW Department of Trade and Investment, Regional Infrastructure and Services, Orange, www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/467699/NSW-biosecurity-strategy-2013-2021.pdf.

Dutson G, Garnett S & Gole C (2009), *Australia's Important Bird Areas: Key sites for bird conservation,* Birds Australia (RAOU) Conservation Statement No 15, Birds Australia www.birdlife.org.au/documents/OTHPUB-IBA-supp.pdf.

Fleming PA, Anderson H, Prendergast AS, Bretz MR, Valentine LE & Hardy GEStJ 2014, Is the loss of Australian digging mammals contributing to a deterioration in ecosystem function? *Mammal Review*, 44, pp. 94–108.

Forestry Commission of NSW 1951, Internal memorandum: Bush Fire Pilliga East State Forest 5//11/51, District Forester, Baradine.

Forestry Commission of NSW 1986, *Management Plan for Pilliga Management Area*, Forestry Commission of NSW.

Free Settler or Felon? 2003-2017, Hunter Valley Bushrangers, George Clarke (alias 'The Barber') www.jenwilletts.com/george_clarke.htm, accessed 6 June 2017,

FSC 2003, *Final Recommendation, Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River*, Fisheries Scientific Committee, www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/636498/FR22-Darling-River-EEC.pdf

High Ground Consulting 2008, Conservation Management Strategy: Pilliga Dog-proof Fences, Pilliga Nature Reserve, Pilliga East [Willala] Aboriginal Area, Pilliga National Park, Pilliga State Conservation Area, prepared for Department of Environment and Climate Change, (NSW) National Parks and Wildlife Service.

High Ground Consulting 2011, Conservation Management Strategy: Burtons's Block, Pilliga West SCA, prepared for Office of Environment and Heritage, National Parks and Wildlife Service.

High Ground Consulting 2012, Conservation Management Strategy: Eulah Precinct, Pilliga West SCA, prepared for Office of Environment and Heritage, National Parks and Wildlife Service.

Hunter JT 2010, Vegetation and floristics of Cubbo, Etoo and Dewsons lease sections of the Pilliga SCA, Pilliga NP and Pilliga West SCA, a report to the Department of Conservation, Climate Change & Water.

IUCN 2017, Global Invasive Species Database, viewed 3 May 2017, https://www.iucngisd.org/gisd/100_worst.php.

James CD, Landsberg J & Morton SR 1999, Provision of watering points in the Australian arid zone: a review of effects on biota, *Journal of Arid Environments*, 41, pp. 87–121.

James AI, Eldridge DJ & Hill BM 2009, Foraging animals create fertile patches in an Australian desert shrubland, *Ecography* 32, pp. 723–732.

Keith D 2004, *Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT*, The Department of Environment and Conservation (NSW), Hurstville.

Lunney D, Curtin A, Ayers D, Cogger HG & Dickman CR 1994, Identifying the endangered fauna of New South Wales: an ecological approach to a systematic evaluation of the status of all species, *Pacific Conservation Biology,* 5, pp. 148–57.

Moseby KE & Hill BM, 2011, The use of poison baits to control feral cats and red foxes in arid South Australia 1. Aerial baiting trials, *Wildlife Research*, 38 (4), pp. 338–349.

Murphy MJ 2013, Survey of shorebird populations and habits in the Pilliga Forest in northern inland New South Wales, Australia, *Stilt*, 63–64, pp.1–5.

Murphy MJ 2015, First records of the sun moth *Synemon laeta* Walker, 1854 (Lepidoptera: Castniidae) from New South Wales, *Victorian Naturalist*, 132 (2), pp. 44–48, http://search.informit.com.au/fullText;dn=165856207584969;res=IELHSS.

Murphy MJ & Shea M 2013, Survey of the terrestrial and freshwater molluscan fauna of the Pilliga forest area in northern inland New South Wales, Australia, *Molluscan Research.*

Namoi CMA 2009, *Land Management Units in the Namoi catchment,* Namoi Catchment Management Authority.

National Museum Australia (n.d.), D*efining moments in Australian History – Myall Creek Massacre*, www.nma.gov.au/online_features/defining_moments/featured/myall-creek-massacre, accessed 6 June 2017.

North West LLS 2017, *North West Regional Strategic Weed Management Plan 2017–2022*, prepared by the North West Regional Weed Committee and published by North West Local Land Services, www.lls.nsw.gov.au/biosecurity/weed-control/nsw-weed-reforms.

NPWS 2002, *Aboriginal Cultural Heritage Assessment, NSW Western Regional Assessments, Brigalow Belt South Bioregion (Stage 2)*, a project undertaken for the Resource and Conservation Assessment Council, accessed 26 June 2017, www.environment.nsw.gov.au/resources/forestagreements/wra18.pdf.

NSW Chief Scientist & Engineer 2016, *Report of the Independent Review into the Decline of Koala Populations in Key Areas of NSW*, NSW Chief Scientist & Engineer, accessed 8 June 2017, www.chiefscientist.nsw.gov.au/__data/assets/pdf_file/0010/94519/161202-NSWCSE-koala-report.pdf.

NSW DPI & OEH 2011, *Biodiversity Priorities for Widespread Weeds*, report prepared for the 13 Catchment Management Authorities (CMAs) by NSW Department of Primary Industries and Office of Environment & Heritage, Orange.

NSW SC 1998, *Final Determination to List Predation by the European Red Fox* Vulpes vulpes (Linnaeus1758) *as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/determinations/EuropeanRedFoxKTPListing.htm.

NPWS 2000, Preliminary Overview of the Brigalow Belt South Bioregion (Stage 1), NSW Western Regional Assessments, a project undertaken for the Resource and Conservation Assessment Council, NSW Western Regional Assessments Project No WRA09, NSW National Parks and Wildlife Service Western Directorate www.epa.nsw.gov.au/resources/forestagreements/BBSoverviewfinal.pdf.

NSW SC 2000a, *Final Determination to List Anthropogenic Climate Change as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/threatenedspecies/HumanClimateChangeKTPListing.htm.

NSW SC 2000b, *Final Determination to List Predation by the Feral Cat* Felis catus *(Linnaeus, 1758) as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20008.

NSW SC 2000c, *Final Determination to List High Frequency Fire Resulting in the Disruption of Life Cycle Processes in Plants and Animals and Loss of Vegetation Structure and Composition as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20014.

NSW SC 2002, *Final Determination to List Competition from Feral Honeybees (*Apis mellifera*) as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/determinations/FeralHoneybeesKTPListing.htm.

NSW SC 2003, *Final Determination to List Removal of Dead Wood and Dead Trees as a Key Threatening Process on Schedule 3 of the TSC Act,* Scientific Committee www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20011.

NSW SC 2004a, *Final Determination to List Competition and Habitat Degradation by Feral Goats,* Capra hircus Linnaeus 1758 *as a Key Threatening Process on Schedule 3 of the TSC Act,* New South Wales Scientific Committee, www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20017.

NSW SC 2004b, *Final Determination to List Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*, Sus scrofa Linnaeus 1758 *as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=20020.

NSW SC 2007 *Final Determination to List Loss of Hollow-bearing Trees as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/determinations/LossOfHollowTreesKtp.htm

NSW SC 2015, *Final Determination to List the Pilliga Outwash Ephemeral Wetlands in the Brigalow Belt South Bioregion as an Endangered Ecological Community on Part 3 of Schedule 1 of the TSC Act*, New South Wales Scientific Committee, www.environment.nsw.gov.au/resources/threatenedspecies/determinations/FDPilliOutwashEEC.pdf.

OEH 2011, *NSW Threat Abatement Plan for Predation by the Red Fox* (Vulpes vulpes), Office of Environment and Heritage, Sydney, www.environment.nsw.gov.au/threatenedspecies/ThreatAbatementPlans.htm.

OEH 2013a, *Living with Fire in NSW National Parks: A strategy for managing bushfires in national parks and reserves 2012–2021*, revised edition, Office of Environment and Heritage, Sydney, www.environment.nsw.gov.au/fire/120690livfire.htm.

OEH 2013b*, Regional Pest Management Strategy 2012–2017, Northern Plains Region: A new approach for reducing impacts on native species and park neighbours*, office of environment and Heritage, Sydney, www.environment.nsw.gov.au/resources/pestsweeds/20120376nprpms.pdf.

OEH 2013c, *Saving our Species*, Office of Environment and Heritage, Sydney, www.environment.nsw.gov.au/savingourspecies/about.htm.

OEH 2014, *New England North West: Climate change snapshot*, Office of Environment and Heritage, Sydney, www.climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/Climate-projections-for-your-region/Central-West-and-Orana-Climate-Change-Downloads.

OEH 2015a, *Merriwindi State Conservation Area Fire Management Strategy 2015–2020*, Office of Environment and Heritage, www.environment.nsw.gov.au/firemanagement/MerriwindiSCAfms.htm.

OEH 2015b, *Pilliga North Fire Management Strategy – Pilliga National Park and Pilliga State Conservation Area 2015–2020*, Office of Environment and Heritage, www.environment.nsw.gov.au/resources/firemanagement/final/baradine/150571-PilligaNorthFms.pdf.

OEH 2015c, *Pilliga West (Pilliga West NP & Pilliga West SCA) Fire Management Strategy 2015–2020*, Office of Environment and Heritage, www.environment.nsw.gov.au/resources/firemanagement/final/baradine/150569-pilliga-west-fms.pdf.

OEH 2016, *Delicate mouse – profile*, www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10685.

OEH 2017a, *Biodiversity Conservation Program*, Office of Environment and Heritage, www.environment.nsw.gov.au/threatenedspecies/pas.htm.

OEH 2017b, *NSW BioNet, Atlas of NSW Wildlife*, Office of Environment and Heritage, Sydney, www.bionet.nsw.gov.au/.

OEH (n.d.), Threatened species, www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species.

Paull DC & Date EM 1999, Patterns of decline in the native mammal fauna of the north-west slopes of New South Wales, *Australian Zoologist*, 31(1), pp. 210–224.

Pickard J 2007, Predator-proof fences for biodiversity conservation: some lessons from dingo fences, Animals of Arid Australia.

Porteners MF 2007, Aerial photography of vegetation communities for the Pilliga Community Conservation Areas Zones 1–3, Stage 1 West Pilliga CCA Zones 1 and 3, Merriwindi CCA Zone 3, Report to the Department of Environment & Climate Change NSW.

Read JL, Carter J, Moseby KM & Greenville A 2008, Ecological roles of rabbit, bettong and bilby warrens in arid Australia, *Journal of Arid Environments*, 72, pp. 2124–2130.

SEWPAC 2011, *Feral horse (*Equus caballus*) and feral donkey (*Equus asinus*)*, Department of Sustainability, Environment, water, Population and Communities www.environment.gov.au/system/files/resources/b32a088c-cd31-4b24-8a7c-70e1880508b5/files/feral-horse.pdf.

Sue Rosen Associates 2009a, Ironbark Lagoon Conservation Management Plan, Pilliga West State Conservation Area, prepared for the Department of Environment and Climate Change, National Parks and Wildlife Service.

Sue Rosen Associates 2009b, Wombo Sawmill Conservation Management Plan, Pilliga West State Conservation Area, prepared for the Department of Environment and Climate Change, National Parks and Wildlife Service.

Thackway R & Cresswell ID 1995, *An Interim Biogeographic Regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperative Program*, Version 4.0. Australian Nature Conservation Agency, Canberra.

TSSC 2001a, *Commonwealth Listing Advice on Loss of Terrestrial Climatic Habitat Caused by Anthropogenic Emissions of Greenhouse Gases*, Threatened Species Scientific Committee, www.environment.gov.au/cgi-bin/sprat/public/publicshowkeythreat.pl?id=7.

TSSC 2001b, *Commonwealth Listing Advice on Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*, Threatened Species Scientific Committee, www.environment.gov.au/cgi-bin/sprat/public/publicshowkeythreat.pl?id=11.

Whipp RK, Lunt ID, Spooner PG & Bradstock RA 2012, Changes in forest structure over 60 years: tree densities continue to increase in the Pilliga forests, New South Wales, Australia, *Australian Journal of Botany*, 60, pp. 1–8.