NSW National Parks & Wildlife Service
Office of Environment & Heritage

Wild Deserts:
A project to reintroduce locally extinct mammals to Sturt National Park in NSW

Review of Environmental Factors

August 2017

Report prepared for the NSW Office of Environment and Heritage by Rebecca West and Reece Pedler, Wild Deserts, Centre for Ecosystem Science, School of Biological, Earth and Environmental Science, UNSW Australia, NSW 2052.

Cover photo – Red siliceous sand dunes within the Sturt National Park (Rebecca West / Reece Pedler; UNSW Wild Deserts)

Photos presented in this report have been taken by the UNSW Wild Deserts Team

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Contents

List of figures

List of tables

Abbreviations

AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
HHIMS	Historic Heritage Information Management System (OEH database)
NPWS	NSW National Parks and Wildlife Service
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
OEH	Office of Environment and Heritage
PCT	plant community type
REF	review of environmental factors
SNP	Sturt National Park
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
TSR	travelling stock route
UNSW	The University of New South Wales

1. Introduction

The NSW National Parks and Wildlife Service (NPWS) proposes to reintroduce locally extinct mammals to Sturt National Park. The proposal is to construct two 20-square kilometre (km^2) feral exclosures, eradicate feral predators, herbivores and rabbits from within, and then conduct reintroductions of seven locally extinct mammals (referred to as the 'Sturt Species'), both within the exclosures and beyond the fence. The proposal is referred to as 'A project to reintroduce locally extinct mammals to Sturt National Park' and will take place within the 350 km^2 Sturt Service Site, within the Simpson–Strzelecki Dunefields Bioregion (north-west corner of Sturt National Park, to the west of the Fort Grey Homestead, Figure 1). The search area used for this review of environmental factors (REF) is also detailed in Figure 1.

The NSW Office of Environment and Heritage (OEH) contracted Wild Deserts (a partnership between The University of New South Wales [UNSW] and Ecological Horizons) to conduct the project. The Wild Deserts team consists of UNSW staff: Professor Richard Kingsford, Associate Professor Mike Letnic, Dr Keith Leggett, Professor David Keith, Sharon Ryall, and Ecological Horizons staff: Dr Katherine Moseby and Dr John Read. The project has also employed an operational team consisting of Project Coordinator Reece Pedler and Ecologist Dr Rebecca West. The team members have significant expertise and experience in the construction of feral-proof exclosures, reintroduction of extinct mammals and research and innovation in reintroduction biology (Appendix 1).

Wild Deserts was contracted to prepare a review of environmental factors (REF) for the project. The procedures set out in *Guidelines for preparing a Review of Environmental Factors* (OEH 2016) were followed, given that the proposal would be located within Sturt National Park (SNP) and that OEH would be the determining authority. The standard template for preparing a REF in lands reserved or acquired under the NSW *National Parks and Wildlife Act 1974* (NPW Act) was also adopted in the preparation of this REF.

This REF will assess the environmental impacts of:

- establishment of the fenced exclosures and the removal of pest animals (including the impacts on resident species)
- reintroduction of the Sturt Species (including impact on resident species and communities as well as risks to the establishment of the reintroduced mammals)
- the impacts associated with the establishment and use of other infrastructure, excluding the Fort Grey Homestead Precinct.

This REF has been prepared in accordance with the requirements of section 111 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and section 228 of the Environmental Planning and Assessment Regulation 2000, specifying a 'duty to consider environmental impact'. Details of the professional expertise of those involved in preparing this REF are included in Appendix 1.

2. Brief description of the proposed activity

The project will construct two 20-km^2 (5 x 4km) feral-proof exclosures within the 350-km^2 'Sturt Service Site' (Figure 1), referred to as the 'project area' throughout this REF. Once constructed, feral and introduced mammals (cats, foxes and rabbits) will be eradicated from within the exclosures and kangaroo numbers reduced, by allowing them to leave via one-way exits. Seven locally extinct mammal species, known as the 'Sturt Species', will be reintroduced:

- burrowing bettong (*Bettongia lesueur*)
- greater bilby (*Macrotis lagotis*)
- western barred bandicoot (*Perameles bougainville*)
- golden bandicoot (*Isoodon auratus*)
- greater stick-nest rat (*Leporillus conditor*)
- crest-tailed mulgara (*Dasycercus cristicauda*)
- western quoll (Dasyurus geoffroii).

The project also aims to establish the Sturt Species beyond the exclosures. To do this, three 'wing fences' (totalling 10km) will be constructed to join the exclosures to each other and to the South Australian/Queensland wild dog fence (the 'Dog Fence'), enclosing an area of 104km^2, called the 'wild training zone' (Figure 1). Many of the Sturt Species only exist in fenced reserves or on offshore islands, which has created predator-naïve individuals that cannot be successfully established beyond fences. The wild training zone will provide opportunity for the Sturt Species to develop anti-predator behaviours through exposure to low densities of feral predators, increasing the chance of successful establishment into the broader Sturt Service Site. This concept has recently been proven at the Arid Recovery Reserve in South Australia (West et al. 2017) and is discussed in further detail in Section 10.2.

The following activities will be conducted to establish the infrastructure required for the project:

- grading of an 8m easement to form the perimeter of two fenced exclosures (18km long each) and three wing fences (10km long total). This allows a 1m-wide area either side of the fence, with 500mm foot netting on either side of the fence and a 3m-wide access track on both the inside and outside of the fence
- establishment of six borrow pits to provide clay for capping eight unstable dunes
- creation of two lay-down yards for storage of construction materials
- creation of an all-weather track to enable access to the exclosures when rain events make swampy ground on the current access roads impassable
- construction of two 12-hectare (ha) release pens (one in each exclosure, no grading will be required for these)
- temporary installation of a shipping container to store equipment close to the exclosures
- construction of two fenced exclosures and three wing fences (fences will be 1.8m high and made from wire netting, with a 600mm overhang, creating a 'floppy top' to deter feral cats and foxes from climbing over, and up to 500mm of 'foot netting' apron at the base of each side of the fence to prevent burrowing by predators and rabbits).

The project commenced on 1 August 2016 when an agreement was signed between OEH and UNSW. The current agreement is signed for 10 years (until 31 July 2026). There is the potential for a rolling 10-year contract following this period.

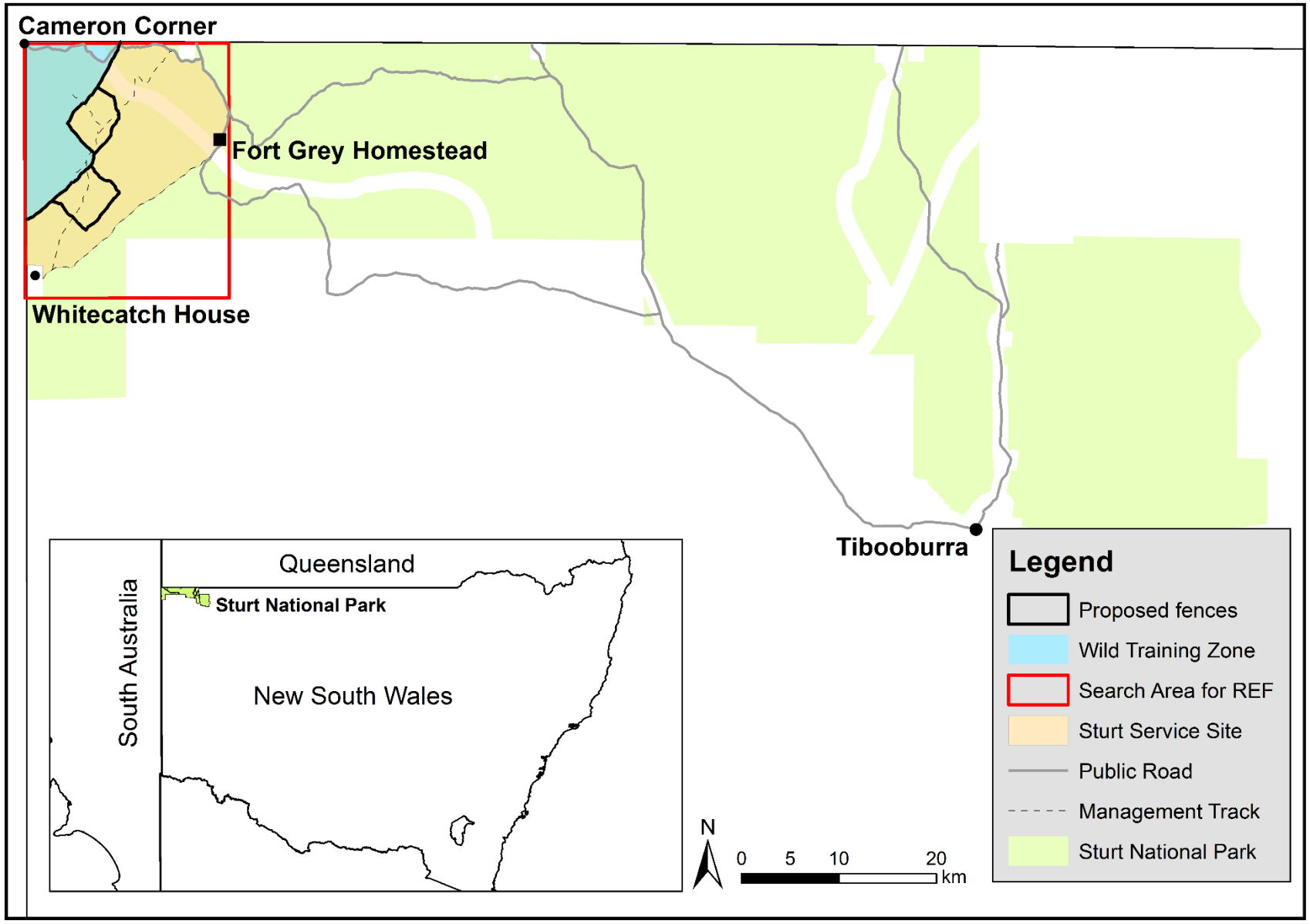

Figure 1: Map of the project location within the regional area, and specifically within the Sturt Service Site, including the search area applied to this REF

3. Proponents details

The proponent for the proposal is the NSW Office of Environment and Heritage. Full contact details of the proponent are provided in Table 1.

Table 1: Proponent details

Name	Title: Mr Given name: Michael
	Surname: Wright
Organisation	Office of Environment and Heritage
ACN/ABN (if applicable)	ABN: 30 841 387 271
Section/Division (OEH proponents only)	NSW National Parks and Wildlife Service, Park Programs
Position	Executive Director, Park Programs
Address	59–61 Goulbourn Street
	South Sydney
	NSW 2000
Phone numbers	02 9995 5000 Mobile: n/a
Fax	n/a
Email	Michael.Wright@environment.nsw.gov.au

4. Permissibility

4.1. Legal permissibility

☒	***National Parks and Wildlife Act 1974* (NPW Act)**
Justification (consider the following matters):	
☒	Objects of the Act (s.2A)
The proposed activities comply with the following subsections of s.2A: 1a) For the conservation of: (i) habitat, ecosystems and ecosystem processes, and (ii) biological diversity at the community, species and genetic levels 1c) Fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation 1d) Providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation (national park).	
☒	Reserve management principles (ss.30E–30K)
The proposed activities comply with the following management principles for a national park under s.30E: 2(a) the conservation of biodiversity, the maintenance of ecosystem function, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes 2(c) the protection of the ecological integrity of one or more ecosystems for present and future generations 2(d) the promotion of public appreciation and understanding of the national park's natural and cultural values 2(e) provision for sustainable visitor or tourist use and enjoyment that is compatible with the conservation of the national park's natural and cultural values 2(g) provision for appropriate research and monitoring.	
☒	Title and relevant sections of plan of management or statement of management intent (or drafts)
The proposed activity is detailed specifically within the *Sturt National Park Draft Plan of Management* (OEH 2017b). Detail of the project is provided in the Draft Plan Appendix 1: Reintroduction of Locally Extinct Mammals Project. The proposed activity is outlined as a specific management direction in section 2.3: • assist ecosystem restoration through reintroduction of locally extinct threatened species, many of which are integral in maintaining ecosystem function. In addition, the proposed activity aligns directly with the following specific management directions in section 2.3: • control priority pest plant and animal species in the park to protect and enhance native species habitat and support the recovery of rare and threatened plant and animal species	

☒	***National Parks and Wildlife Act 1974* (NPW Act)**

- reduce artificially high grazing pressure and restore more natural patterns of surface water availability through progressive removal of artificial watering points
- conserve Aboriginal and non-Aboriginal cultural heritage values including examples of gold-mining, pastoralism and early exploration
- encourage and facilitate scientific, historic and archaeological research into the natural and cultural values of the park
- provide and promote sustainable and appropriate environmental education opportunities within the park.

The proposed activity is consistent with the following specific management responses detailed within the Draft Plan of Management for Sturt National Park:

- 3.2.2 Facilitate the implementation of the Reintroduction of Locally Extinct Mammals project under the *Saving our Species* program.
- 3.2.3 Implement relevant recovery actions in the *Priorities Action Statement* and recovery plans for threatened plant species, populations and communities occurring in the park.
- 3.2.4 Conduct and support biodiversity surveys to inform park management.
- 3.3.5 Undertake Aboriginal cultural heritage surveys, assessment and consultation prior to all works that have the potential to impact Aboriginal cultural heritage in the park.
- 3.4.3 Undertake a cultural heritage assessment as part of statutory approvals prior to carrying out works with the potential to impact cultural and historic sites and places of significance.
- 3.5.2 Work with the broader community, regional and state tourism bodies to promote Sturt as the focus of a remote, arid landscape tourism experience, which includes historic and Aboriginal cultural heritage and wildlife conservation programs.
- 3.5.4 Allow the construction of visitor infrastructure to support the Reintroduction of Locally Extinct Mammals project within Fort Grey Campground and the wider project area.
- 3.5.6 Support educational, guided wildlife viewing experiences as part of the Reintroduction of Locally Extinct Mammals project.
- 3.6.3 Support a program of visitor experiences based on the Reintroduction of Locally Extinct Mammals project.
- 3.6.5 Continue to encourage and support the educational and research activities in the park.
- 3.6.6 Identify research opportunities that will support decision-making about the park. High priorities include the management of Lake Pinaroo Ramsar site; predator–prey relationships; and ecosystem restoration through reintroduction of locally extinct species.
- 3.6.7 Encourage organisations and individuals to take up priority research opportunities and, where appropriate and possible, provide support for this research.
- 3.6.8 Support cooperative research partnerships and agreements with educational and research organisations.
- 4.1.1 Manage and monitor pest species in accordance with the current regional pest management strategy for the park and best practice adaptive management. Priority will be given to Noogoora burr, feral goat, feral pig, wild dog, cat and fox control.
- 4.1.2 Implement fox control in accordance with the threat abatement plan.
- 4.1.3 Regularly monitor the park for new and emerging weeds and pest threats, and treat outbreaks as a priority.
- 4.1.4 Coordinate pest and weed actions in consultation with park neighbours, Western Local Lands Services, the Wild Dog Destruction Board and other stakeholders.

☒	***National Parks and Wildlife Act 1974* (NPW Act)**

- 4.1.5 Support research and incorporate new research findings into pest management programs.
- 4.3.1 Continue existing fire, pest and weed management programs to increase the park's capacity to cope with climate change and adapt where required to minimise climate change–induced threats.
- 4.3.2 Encourage research into appropriate indicators to monitor the specific effects of climate change on the natural and cultural values of the park.
- 4.3.3 Support or undertake research relevant to arid landscape processes and ecosystems to facilitate improved management of the park at a landscape scale. Apply the outcomes of research in developing adaptive risk management practices.
- 5.1.4 New management trails may be constructed for accessing the Reintroduction of Locally Extinct Mammals project exclosures, maintaining fence lines and facilitating pest control. Trail location, design and construction will require environmental impact assessment and relevant approvals.
- 5.2.2 Facilitate and support the construction of exclosure fences and other infrastructure needed to support the Reintroduction of Locally Extinct Mammals project.

☒	Leasing, licencing and easement provisions of Part 12

As NPWS is the proponent, and there is no plan to include any lease or licence for visitor or tourist infrastructure (e.g. tourism accommodation) then there are no leasing, licensing or easement provisions required under Part 12 of the NPW Act.

☒	Management powers and responsibilities of OEH (s.8 and s.12) (for internal OEH projects only)

The proposal is consistent with the management powers and responsibilities listed within the Act. As per s.8 there is a Regional Advisory Committee which covers SNP.

Special note: for lease proposals under s.151 of the NPW Act involving new buildings or structures:

Section 151A (5) of the NPW Act states that the Minister must not grant a lease under s.151 for visitor or tourist uses that authorises the erection of a new building or structure unless the plan of management identifies the purpose as permissible and the general location for the new building. If relevant to the proposal, indicate whether this requirement has been met, or will be.

The construction of the fenced exclosures for the reintroduction of extinct mammal species is outlined within the Draft Plan of Management for Sturt National Park.

☐	***Wilderness Act 1987* (for activities in wilderness areas consider objects of the Act, management principles, s.153, etc.)**

Justification: Not applicable as the proposed study area is not in an area identified as wilderness under the Wilderness Act 1987. There are no wilderness areas listed within Sturt National Park. (See OEH website: How and where can I experience wilderness?)

☒	***Environmental Planning and Assessment Act 1979* (EP&A Act) (consider aims and objectives of relevant environmental planning instruments, zoning and permissible uses, development controls, etc.)**

☒	***National Parks and Wildlife Act 1974* (NPW Act)**
As the project is within Sturt National Park it is subject to Part 5 of the EP&A Act. This REF fulfils the requirements of an environmental impact assessment as listed under Part 5. Section 5A of the EP&A Act contains seven factors to be considered by determining authorities when considering the significance of impacts on threatened biota associated with activities under Part 5 of the Act (the '7-part test'). Should the 7-part test determine that a 'significant effect' on any threatened biota listed under the TSC Act is likely, then the authority must prepare a species impact statement. Species which occur or have the potential to occur in the study area have been considered in the 7-part test included in Appendix 4.	
Justification (indicate any or all of the following that are relevant):	
☒	The activity may be undertaken without development consent as it is **on reserved land** and/or: ☒ for a purpose authorised under the NPW Act (cl.65 Infrastructure SEPP) ☐ zoned E1 under the [*insert name of relevant local environmental plan*].
☐	The activity is **not on reserved land** but may be undertaken without development consent because: ☐ it is zoned E1 under the [*insert name of relevant local environmental plan*] or ☐ the zoning of the land does not require development consent for the activity. [*Identify and briefly outline the alternative zoning of the land under the relevant local environmental plan.*]
Not applicable as the activity is on reserved land	
☐	The activity is on land that contains coastal wetlands (SEPP 14), littoral rainforest (SEPP 26), or koala habitat (SEPP 44) and: ☐ the relevant aims, objectives, principles and provisions of the SEPP have been considered in preparation of the REF (discuss below). **Explanatory note**: these SEPPs do not apply to land dedicated or reserved under the NPW Act. However, it is OEH policy that the principles of these SEPPs are applied to on-park activities and that assessment requirements that would otherwise apply are considered.
Not applicable as the activity is not on land designated within SEPP 14, SEPP 26 or SEPP 44.	
☒	***Heritage Act 1977* (for activities likely to affect items or places of historic cultural heritage value)**
Justification (indicate any or all of the following that are relevant):	
☒	The activity is on land that contains: ☐ an item listed on the State Heritage Register (SHR) ☐ an item not listed on the SHR but identified by OEH as being of state significance ☒ an item listed on the OEH Heritage and Conservation Register (contained in the Historic Heritage Information Management System) ☐ a place, building landscape feature or moveable heritage item older than 25 years. [A*ctivities likely to affect the above may require expert advice and assessment, such as preparation of a heritage impact statement.*]

☒	***National Parks and Wildlife Act 1974*** **(NPW Act)**

A number of pieces of pastoral infrastructure are present within the project area and listed on the OEH Heritage and Conservation Register. These items will not be disturbed by the project activities. Details of the items are provided in Section 11.22. The activity is therefore consistent with the *Heritage Act 1977*.

☒	***Threatened Species Conservation Act 1995*** **(TSC Act) (Is the activity consistent with the biodiversity conservation objectives of the Act?)**

The TSC Act has been addressed in this REF by undertaking database searches and desktop analysis for any threatened species, populations or communities previously recorded within the locality and by undertaking targeted field surveys to detect threatened species in the project area.

The results of these searches indicate 41 threatened species that either occur, or have the potential to occur, within the Sturt Service Site. Seven-part tests were conducted for the 41 species, the results of which are included in Appendix 4. There are no listed threatened ecological communities within the study area. Key threatening processes listed under Schedule 3 of the Act relevant to the proposal have been identified as part of the assessment of potential impacts in the 7-part test for each of the 41 species.

Justification: The results of the 7-part tests conducted as a component of this REF indicate that the proposed activity is not expected to significantly impact any species scheduled in the TSC Act and is therefore consistent with the biodiversity objectives of the Act.

☒	***Rural Fires Act 1997*** **(Is the activity consistent with the objectives of protecting life and property and protection of the environment? Is it consistent with bush fire management plans?)**

The fire management objectives of the NPWS *Living with Fire in NSW National Parks: A strategy for managing bushfires in national parks and reserves 2012–2021* (OEH 2012a) are to:

1. protect life, property and community assets from the adverse impacts of fire

2. develop and implement cooperative and coordinated fire management arrangements with other fire authorities, reserve neighbours and the community

3. manage fire regimes to maintain and enhance biodiversity values

4. protect Aboriginal sites and places, historic places and culturally significant features known to exist in NSW from damage by fire

5. assist other fire agencies, land management authorities, landholders and Aboriginal communities to develop fire management practices that contribute to conserving biodiversity and cultural heritage across the landscape.

The proposal will not in any way affect the ability to manage bushfires or implement hazard reduction burns within the project area. The proposed activity will provide additional access tracks for fire management around each of the exclosures and the new all-weather track.

Justification: The proposal is therefore consistent with the objectives of the Rural Fires Act of protecting life and property and protection of the environment.

☒	***Fisheries Management Act 1994*** **(Will the activity affect fish or marine vegetation, including threatened species? Is approval required under the Act?)**

Justification: Not applicable as the proposed site does not fall within fish habitat or marine vegetation as managed under the Fisheries Management Act.

☒	***National Parks and Wildlife Act 1974* (NPW Act)**
☒	**Commonwealth legislation (including the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Telecommunications Act 1997*)** Note: if matters of national environmental significance are likely to be affected, identify these below.
Justification (indicate any of the following that are relevant):	
☒	The activity is on land that contains the following, or the activity may affect: ☐ places identified on the World Heritage List or National Heritage List ☒ Ramsar wetlands ☒ nationally listed threatened species and ecological communities, or migratory species ☐ the Commonwealth marine environment.

An EPBC Act Protected Matters Report of the study area (Appendix 5) reported:

- 1 Wetland of international importance – Lake Pinaroo (15km east of the project area)
- 5 threatened species
  - Curlew sandpiper, *Calidris ferruginea*
  - Night parrot, *Pezoporus occidentalis*
  - Australian painted snipe, *Rostratula australis*
  - Sea heath, *Frankenia plicata*
  - Dusky hopping-mouse, *Notomys fuscus*
- 4 migratory species
  - Grey wagtail, *Motacilla cinerea*
  - Yellow wagtail, *Motacilla flava*
  - Latham's snipe, *Gallinago hardwickii*
  - Curlew sandpiper, *Calidris ferruginea.*

Species were assessed against the relevant criteria within the *Matters of National Environmental Significance: Significant impact guidelines 1.1* Environment Protection and Biodiversity Conservation Act 1999 (DEWHA 2013). Full details of the tests and results can be found in Appendix 6 and are summarised in Table 25.

The results indicated the proposed activity is not expected to have any significant impacts on matters of national environmental significance protected under the EPBC Act.

The proposed activity will also contribute to the conservation of the seven Sturt Species which are listed under the EPBC Act:

- burrowing bettong, *Bettongia lesueur* (vulnerable)
- greater bilby, *Macrotis lagotis* (vulnerable)
- western barred bandicoot, *Perameles bougainville* (endangered)
- golden bandicoot, *Isoodon auratus* (vulnerable)
- greater stick-nest rat, *Leporillus conditor* (vulnerable)
- crest-tailed mulgara, *Dasycercus cristicauda* (vulnerable)
- western quoll, *Dasyurus geoffroii* (vulnerable)

The proposed activity is not expected to have any significant impacts on EPBC-protected species.

4.2. Consistency with OEH policy

4.2.1. *Saving our Species* program

The proposed activity is consistent with the OEH *Saving our Species* program which sets out the NSW Government's threatened species management plan and what needs to be done to secure NSW's threatened species in the wild for the next 100 years. Specifically, the program aims to:

- consult extensively with experts and apply independent peer-reviewed science to species, populations and ecological community projects
- take a rigorous and transparent approach to prioritising investment in projects that ensure benefit to the maximum number of species
- provide targeted conservation projects that set out the actions required to save specific plants and animals on mapped management sites
- regularly monitor the effectiveness of projects so they can be improved over time
- encourage community, corporate and government participation in threatened species conservation by providing a website and a database with information on project sites, volunteering and research opportunities.

4.2.2. Plan of management for Sturt National Park

The proposed activity is consistent with the Draft Plan of Management for Sturt National Park, specifically the management directions to:

- assist ecosystem restoration through reintroduction of locally extinct threatened species, many of which are integral in maintaining ecosystem function
- control priority pest plant and animal species in the park to protect and enhance native species habitat and support the recovery of rare and threatened plant and animal species
- reduce artificially high grazing pressure and restore more natural patterns of surface water availability through progressive removal of artificial watering points.

4.2.3. NPWS regional pest management strategy

The proposed activity is consistent with the following prioritised regional pest programs within Sturt National Park as outlined in the NPWS *Regional Pest Management Strategy 2012–2017: Far West Region – A new approach for reducing impacts on native species and park neighbours* (OEH 2012b).

Critical priority – threatened species conservation

- Fox baiting to protect long-haired rat, Australian bustard, flock bronzewing, squatter pigeon, Centralian blue-tongued lizard, collared whip snake, narrow-banded snake, Stimson's python
- Rabbit warren ripping, blasting, poisoning and exclusion fencing for protection of threatened flora

Critical priority – economic

- Wild dog baiting and trapping for protection of neighbouring stock

Medium priority – recreation and aesthetic values

- Feral goat shooting and trapping

Medium priority – isolated infestations

- Foliar spray of Noogoora burr, Bathurst burr and tobacco bush

4.2.4. Aboriginal cultural heritage policies

This REF was prepared in alignment with two key policies relating to the protection of aboriginal cultural heritage:

- *Operational Policy: Protecting Aboriginal Cultural Heritage* (DECC 2009)
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a).

At all times, the preparation of this proposal followed the principles 1 and 2 of the Operational Policy:

- Policy 1. We recognise and acknowledge that Aboriginal people are the primary determinants of the cultural significance of their heritage.
- Policy 2. We acknowledge, accept and will act on the principles that Aboriginal people:
    - are the primary source of information about the value of their heritage and how this is best protected and conserved
    - must have an active role in any Aboriginal cultural heritage planning process
    - must have early input into the assessment of the cultural significance of their heritage and its management so they can continue to fulfil their obligations towards their heritage
    - must control the way in which cultural knowledge and other information relating specifically to their heritage is used, as this may be an integral aspect of its heritage value.

4.2.5. Translocation of Threatened Fauna Policy

Consistent with *Policy and Procedure Statement no 9: Policy for the Translocation of Threatened Fauna in NSW* (NPWS 2001), the reintroductions of the Sturt Species will be justified under sections:

- 4.2.1 Species recovery programs
- 4.2.2 Biodiversity reconstruction programs.

Translocation proposals will be prepared for each reintroduction of the Sturt Species as stated in policy 5.7 ‘Each translocation program must be undertaken in accordance with a Translocation Proposal (TP) which has been prepared following the guidelines in the policy and is licensed by the NPWS’.

5. Type of approval sought

5.1. OEH proponents

☒	Internal OEH approval* or authorisation, including expenditure

*****OEH does not grant park approvals (e.g. leases, licences, consents, etc.) to itself, but has a range of general powers to undertake activities in parks, for example, ss. 8 and 12 of the NPW Act.

Are there any existing approvals, such as permits, leases, licences or easements, which apply to part of or all of the activity?

☒	Yes Scientific Licence permit SL 101862 UNSW Animal Care and Ethics approval 17/23A

6. Consultation – general

6.1. Public exhibition

This REF will be placed on public exhibition in accordance with OEH policy.

6.2. Statutory consultations

The proposed activity does not affect:

☒ local council infrastructure or services (such as stormwater, sewer and roads)

☒ heritage items listed under the local environmental plan (LEP)

☒ flood liable land

☒ navigable waters or traffic generating development.

Consultation with the relevant local council or public authority, as required by *State Environmental Planning Policy (Infrastructure) 2007* was not required. The activity also does not require a lease or licence under s.151A of the NPW Act so therefore does not require notification and consultation under s.151F and/or s.151G.

6.3. Stakeholders and government agencies

As part of the preparation of this REF, consultations have occurred with a wide range of stakeholders including NPWS, Aboriginal traditional owners, local landholders, local community members, and the Wild Dog Destruction Board. Details of all consultations are included in Appendix 2. This appendix includes a letter of support from the Wild Dog Destruction Board in relation to the proposal to join the wing fences to the Dog Fence on the South Australian and Queensland borders.

6.4. NPWS support

NPWS is the proponent of this REF and contracted Wild Deserts to complete the REF. Extensive consultation with the regional and local OEH NPWS offices in Tibooburra and Broken Hill has been conducted in the preparation of this REF (see Appendix 2). An inception meeting took place on 26 September 2016 at which staff from both offices met with Wild Deserts staff to discuss the project. Since then, numerous formal and informal conversations have been held between the two parties. Formal monthly meetings between Tibooburra and Broken Hill NPWS staff and the Wild Deserts operational team have taken place since February 2017. A formal process for ratification of the fence design and layout was carried out with OEH and NPWS staff. A document *Wild Deserts – Proposed fence design and layout, including two exclosures and wing fences* was submitted to OEH on 20 March 2017, with formal written feedback received on 12 April 2017. Feedback was addressed in a revised version of the document, which was resubmitted to OEH on 23 April 2017. Following a further meeting on 23 May 2017, and a final round of responses to queries, the proposed layout was endorsed in principle by NPWS on 27 June 2017. The email documenting this endorsement can be found in Appendix 2.

7. Consultation – native title

1. Is the land subject to an Indigenous land use agreement?

☒ No (go to Q 2)

2. Has there been a determination of native title applicable to the land or is there a native title claim pending

☒ No (go to Q 3)

☐ Yes

- If yes, contact the OEH Aboriginal Heritage and Joint Management Team.
- You may need to consult with the native title claimant regarding the proposed activity.

If relevant, provide details	A native title determination is currently in process for the Wongkumara People close to the Sturt Service Site. However, the area is to the north and east of the Sturt Service Site (east of Lake Pinaroo), see Figure 2, and does not currently contain the Sturt Service Site.

3. Has native title been extinguished?

☐ Yes

- Clear evidence will be needed to demonstrate extinguishment.
- If extinguished, the NT Act procedures do not apply. However, other policies about consultation with Aboriginal people will still be relevant.

☒ No or unclear (go to Q 4)

4. If native title is not confirmed as extinguished, does the activity have a high risk of adversely affecting native title (e.g. major infrastructure works, new buildings or granting of leases).

☒ No

- No further consideration required

If relevant, provide details	NPWS has sought advice from the Crown Solicitor regarding native title. The Crown Solicitor has advised that due to previous grazing leases, native title is likely to be extinguished on parcels of land relevant to the Wild Deserts Service Site within Sturt National Park. In addition, the Sturt Service Site is currently outside the Wongkumara Native Title Claim Area.

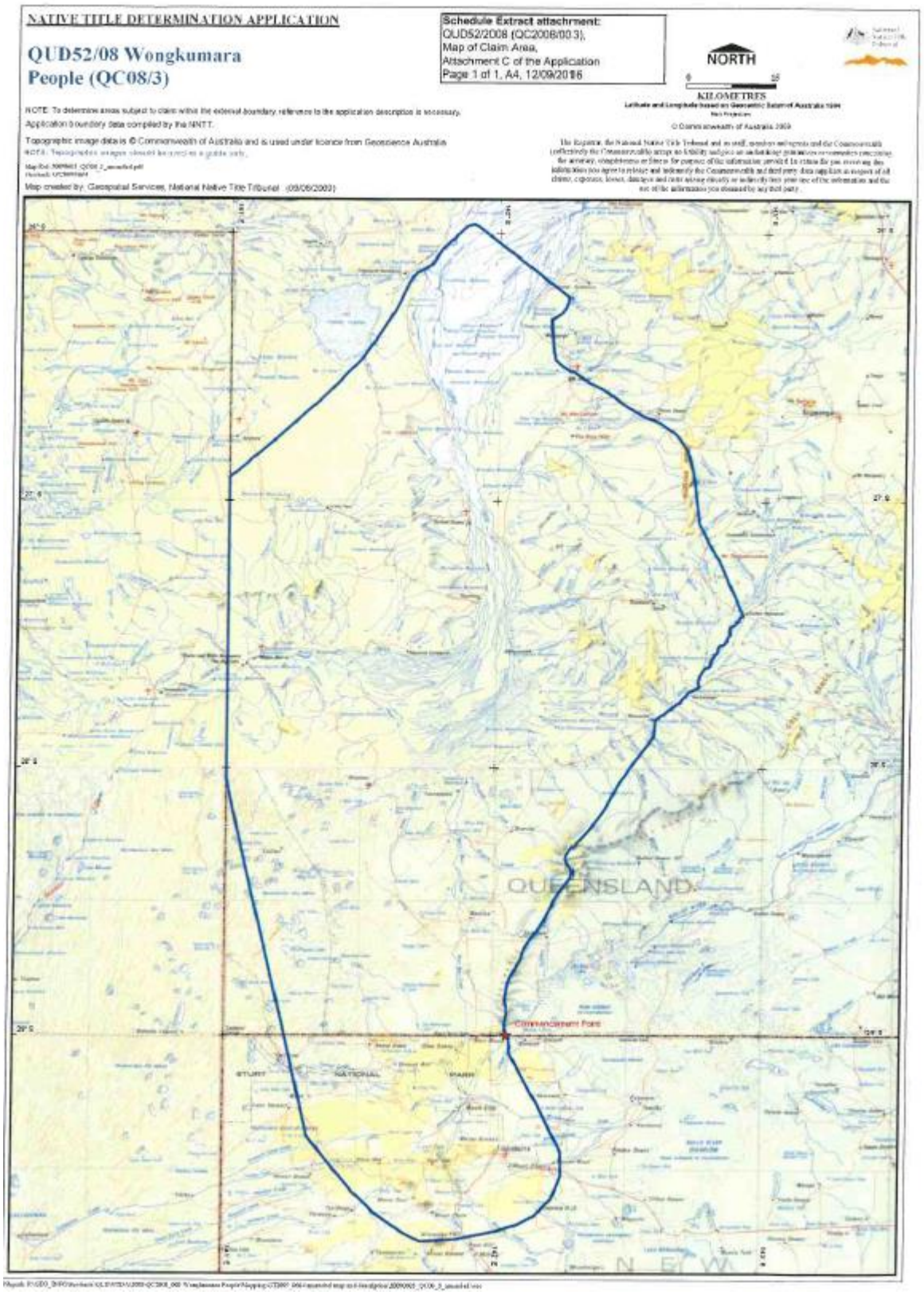

Figure 2: Map of the Wongkumara claim area which does not currently include the Sturt Service Site

Map reproduced with the permission of the National Native Title Tribunal.

8. Proposed activities

8.1. Location of activity

Table 2: Details of the location of the activity

Description of premises' location	West of Fort Grey Homestead within Sturt National Park	
Site reference	Easting: 504868	Northing: 6786926
	AMG zone: 54	Reference system: WGS84
Local Government Area	LG Unincorporated	
NSW State electorate	Barwon	
Catchment	Lake Frome Catchment Area	
National Park	Sturt National Park	

The proposed activities are located within Sturt National Park (Figure 1). The specific location of the activity and the proposed infrastructure is shown in Figure 3.

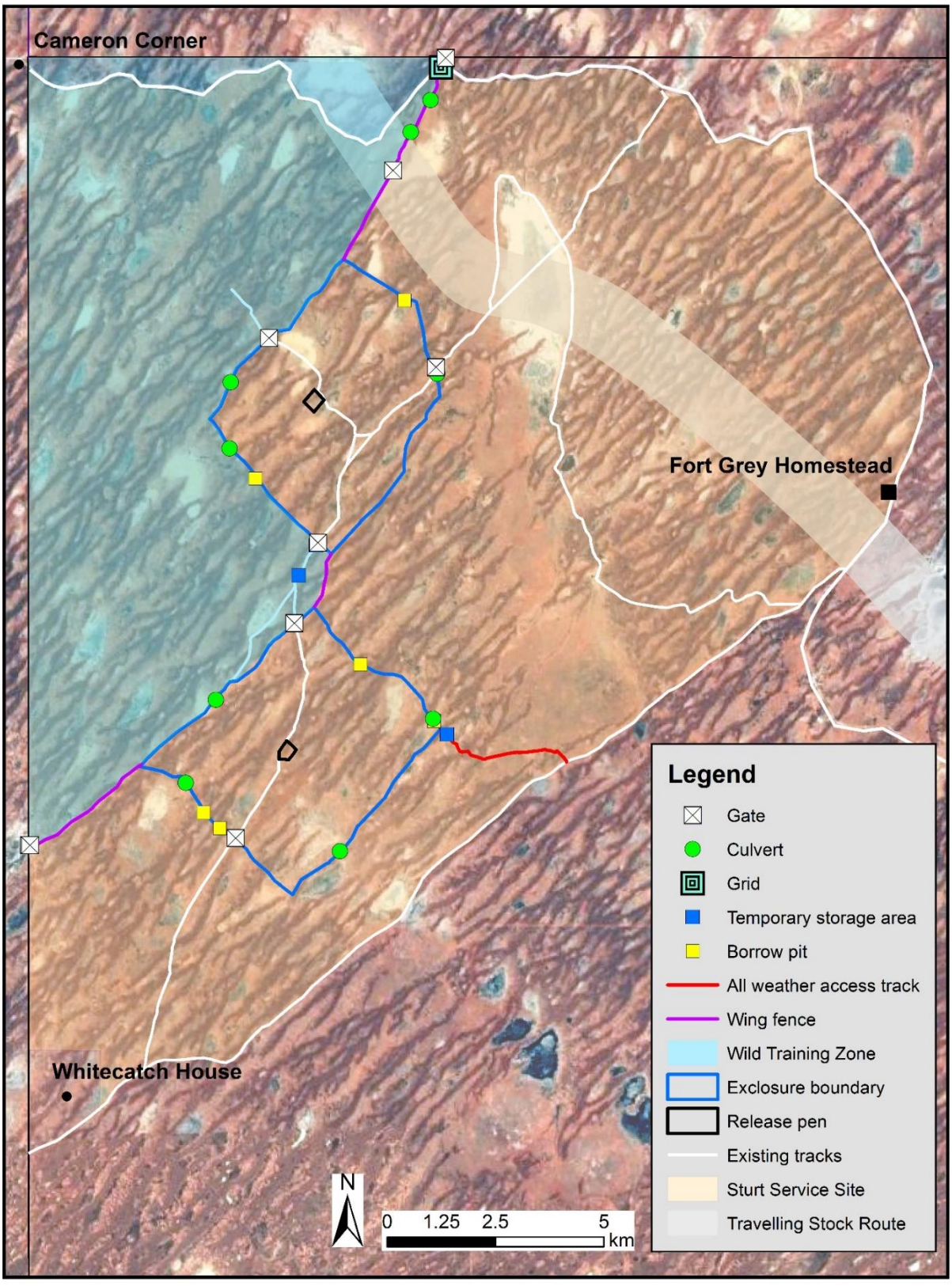

Figure 3: Layout of the infrastructure for the proposed activities within the Sturt Service Site

8.2. Description of the proposed activity

The design of the enclosure boundary fence is based on that first built 20 years ago at Arid Recovery, Roxby Downs, in northern South Australia, by members of the Wild Deserts team, Dr Katherine Moseby and Dr John Read. This fence design underwent extensive in-situ testing and has been gradually refined over many years (Moseby & Read 2006). The Arid Recovery fence pioneered rabbit, cat and fox exclusion fencing in Australia and has been adopted at many other sites across the continent. As such, the proposed Wild Deserts fence design and associated construction and pre-construction activities builds on this wealth of knowledge and experience. Additionally, Wild Deserts staff have held detailed consultations with the Wild Dog Destruction Board and its maintenance staff, who have maintained similar fences in the Strzelecki Dunefields over many decades. This feedback on dealing with local, specific conditions has been invaluable in shaping the fence design and placement, particularly in relation to sand drift, vegetation accumulation (e.g. 'roly-poly bushes' or 'tumbleweed'), surface water flow and large animals which may impact the fence (macropods, pigs, emus).

8.2.1. Pre-construction

The proposed activity involves the construction of 48km of feral-proof exclosure fences. To allow fence construction, the following site preparation actions are necessary:

Clearing of fence line corridors

- Although great effort has been taken to minimise clearance of vegetation, particularly mature trees and long-lived perennial shrubs, some vegetation removal will be necessary along the 8m-wide fence corridor to allow erection of the fence. The 8m-wide corridor consists of a 2m-wide section to allow the fence (1m either side of fence, complete with up to 500mm of foot netting), and a 3m-wide vehicle access track on each side (Figure 4).
- Special care will be taken to minimise soil disturbance, interruption of surface water flows and unnecessary vegetation damage.
- The proposed fence corridor crosses 44 sand dunes, which support large shrubs and small trees. In these areas, a bulldozer with stick rake will be used to create the 8m-wide fence corridor.
- On interdunal swales, where there is little vegetation, a Caterpillar 12H motor grader (or similar) will be used to smooth sections of uneven ground (usually disturbing just the top 1–5cm). To minimise soil disturbance, areas that are sufficiently flat will not be graded. This includes up to 30% of the proposed fence line corridor.
- Additionally, 2.9km of the southern exclosure fence line and the entire 3.3-km length of the southern section of wing fence follow an existing 6m-wide graded vehicle track (Figure 5). This track is to be widened with a grader by 2m. The use of these existing tracks significantly reduces the clearance footprint.

Figure 4: Corridor width comparison

The 8m-wide corridor required for the fence line includes a 1 m section for the fence (with 0.5 m foot apron on each side) and a 3-m wide maintenance access track on each side of the fence. The above image shows the 8-m wide Whitecatch Management Track near the project site, with vehicle for scale.

Figure 5: Diggers Tank Track

The entire 3.3-km length of the southern section of wing fence and 2.9km of the southern exclosure fence follows the existing Diggers Tank Track, thus significantly minimising the potential clearance footprint.

Clay capping of unstable dunes

- Advice from the NSW Wild Dog Destruction Board and its maintenance staff (who have decades of experience in maintaining netting fences of similar nature in the same landscape) and Arid Recovery personnel (who built and maintain ~100km of netting fence in sand dune environments at Roxby Downs), is that capping highly mobile dune crests is essential to prevent catastrophic sand drift during dry climatic periods. The proposed fence lines for the two exclosures and three wing fences cross 39 dunes (Table). The all-weather access track and release pens cross 6 other dunes, giving a total of 44. However, most crossings have been selected at low sections and thus do not require capping. Eight steep and mobile dune crests have been identified as in need of clay capping to allow vehicle access and minimise sand drift that will impact the fence (Figure 7).
- Near these eight dune crossings, six 50m x 40m clay excavation pits ('borrow pits') have been identified in the adjoining swale area (Figure 6). The sites of these proposed pits were carefully chosen to avoid trees and shrubs, including long-lived chenopods, with all proposed sites supporting short-lived annual grasses and herbage only. The sites were also selected to avoid harm to aboriginal stone artefacts and were surveyed as part of the cultural heritage field assessment as not containing any stone artefacts (Appendix 3).
- The location of pits in relation to surface drainage was also a primary consideration, as siting pits in low-lying areas prone to surface water accumulation may create artificial water sources, present soil erosion potential and sites for weed invasion. As such, all proposed pit sites are on areas of high ground in interdunal swales.
- To further reduce the likelihood of borrow pits collecting water and creating an artificial water source, all pits will have a 0.5m perimeter bund constructed around their rim (Figure 6), using clay from within the pit. This serves to prevent two of the major impacts of borrow pits in arid environments: 1) water inflow into the pit, providing an artificial water source; 2) surface water erosion creating gullies that degrade the surrounding soil surface. Six of the eight borrow pits are located either inside the two exclosures or within the wild training zone, meaning they will be remote from high kangaroo and emu densities; species which typically benefit from the provision of artificial water sources.
- Proposed borrow pit sites are located along the north to east and south to west boundaries of the exclosures (which cross the dunes), within 100–200m of each clay capping site. This positioning also allows for future usage in capping other neighbouring dune sites, in the unlikely event this becomes necessary in future. All dune crossings will be monitored as part of weekly fence audits and a strategic adaptive management approach implemented to trigger seeking of approvals to conduct further clay capping.
- During construction, surface vegetation, leaf litter and inorganic material from the soil surface will be stockpiled separately to other material, for re-spreading upon completion of all works to aid in rehabilitation. Pits will be open for a period of days to weeks, with topsoil re-spread at closure to maximise seed viability (in comparison to long-term soil storage).
- Similarly, all topsoil removed during the development will be stockpiled for use in the rehabilitation of the site, and will not be mixed with other overburden products. The topsoil material will be re-spread upon completion of all works to aid in rehabilitation.
- The clay-based soil will be removed from the six identified pits using a 40-tonne scraper (with a $15m^3$ bowl) and placed directly onto the dune. The scraper will then be used to roll the newly laid clay cap to a maximum depth of 30cm.
- Following excavation, a 0.5m bund wall will be made around the pit perimeter using material excavated from within. This will serve to limit surface water inflow, avoiding the creation of artificial water sources and limiting water-driven erosion of the sloping pit walls.

- In addition to earthmoving machinery listed above, other equipment to be used may include: tray-top trucks, tip truck with axle tag and various tray-top utilities.
- All borrow pits will be monitored after closure to ensure that plant species begin to regrow in these areas. Previous borrow pits within the park, which were rehabilitated in the same manner, are now supporting regenerating annuals and perennial shrubs (*Acacia ligulata, Maireana pyramidata*), suggesting the same response could be expected. Should plant regrowth not occur within pits, an adaptive management approach will be implemented to explore options for direct seeding from local sources, or other rehabilitation techniques.

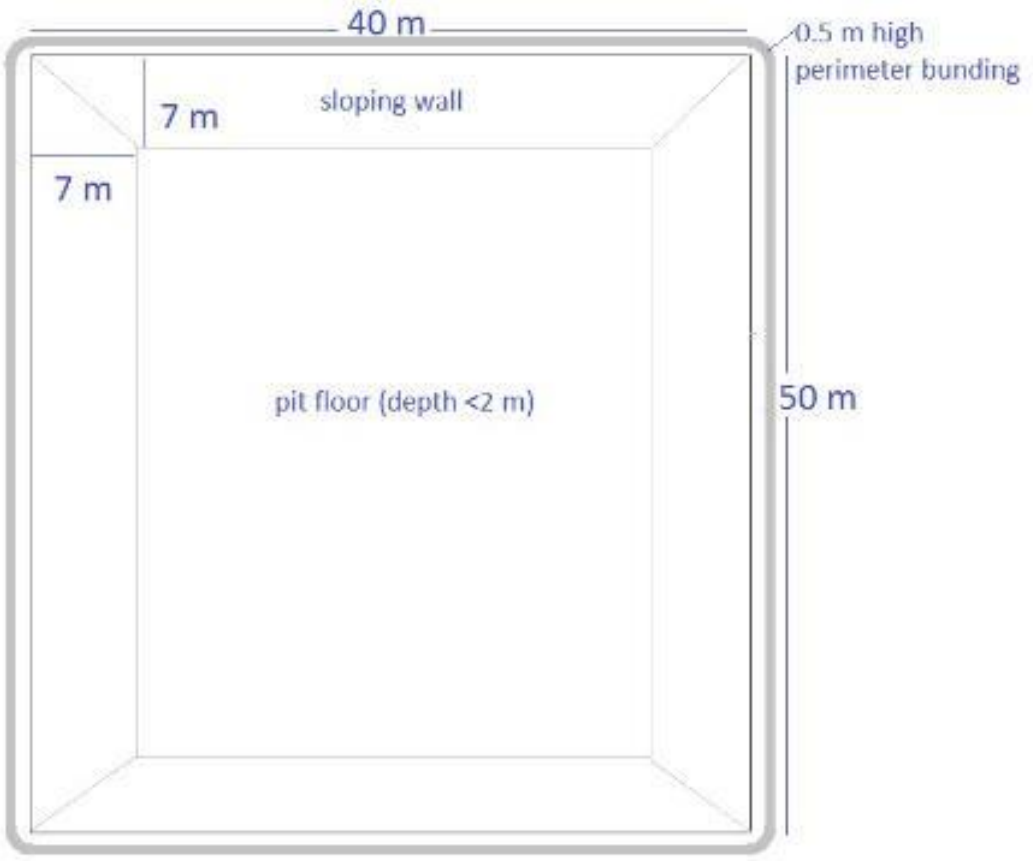

Figure 6: Proposed borrow pit dimensions and features

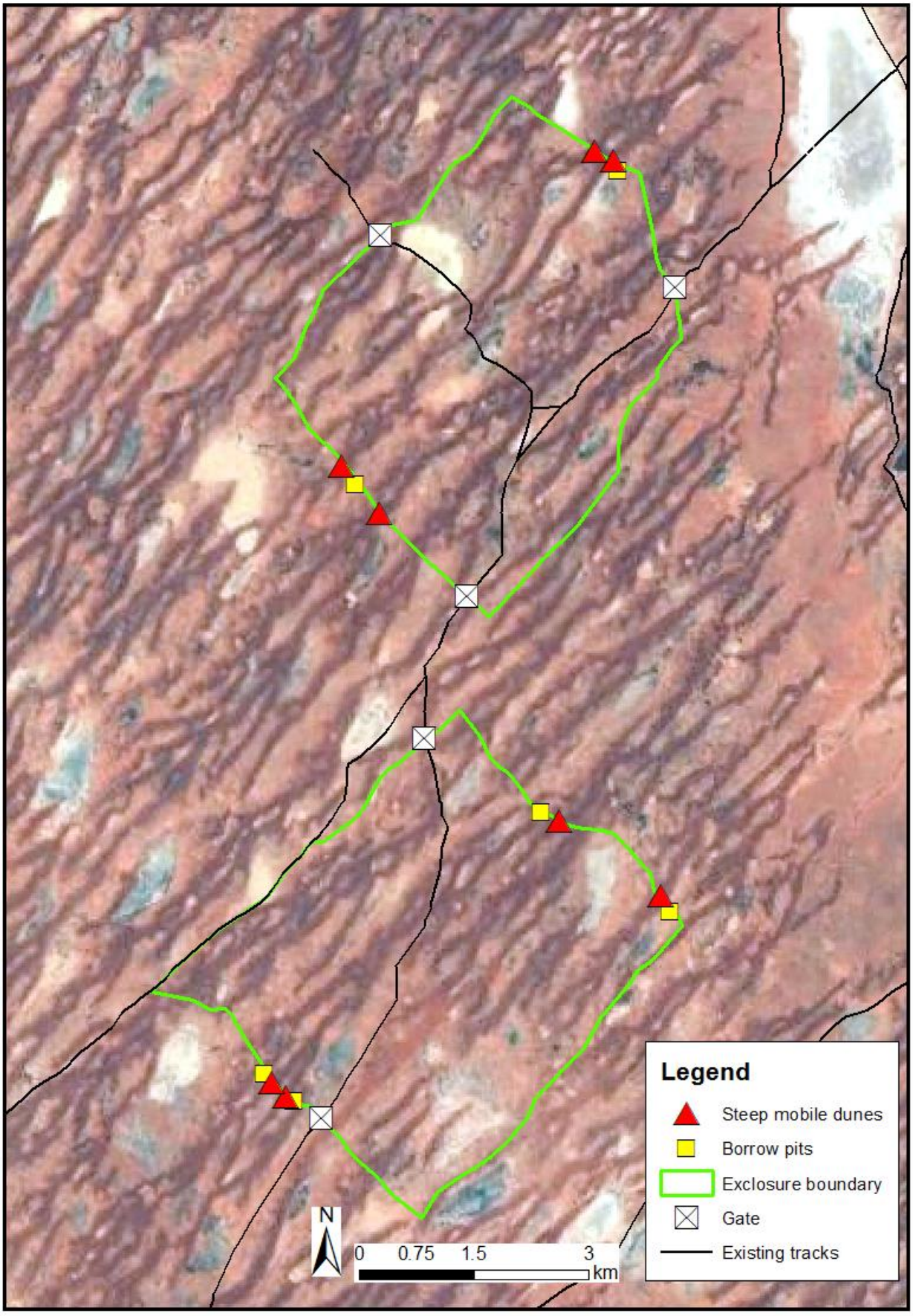

Figure 7: Map showing location of eight steep and mobile dune crests which require clay capping, plus proposed borrow pits for sourcing clay material

Temporary storage areas

- Approximately 240 tonnes (~10 semitrailer loads) of fencing material are required to complete the proposed fence infrastructure.
- These will be delivered to the site and unloaded in two temporary storage areas near Collins Bore (Figure 8, Figure 9 and map: Figure 3). A third area, near the eastern corner of the southern exclosure has been surveyed for the temporary storage of a 40-foot shipping container, for weatherproof storage of fencing materials and equipment.
- The two lay-down areas are flat and un-vegetated, supporting no perennial plants, with sparse annual grasses and herbage following rain only. Both areas were selected based on the central location, within the proposed fence layout and where there was high historic disturbance by sheep and cattle congregating around the former bore head. This reduced the impact to previously undisturbed areas.
- Pallets of fence posts, mesh and wire will be stacked on the soil surface with a forklift. Aside from soil disturbance caused during delivery and unloading of vehicles, no excavation, grading or other earth moving is to occur in these areas.

Figure 8: Temporary fence material lay-down storage area 1, 0.5km north of Collins Bore

Figure 9: Temporary fence material lay-down storage area 2, south of Collins Bore in the stock-degraded zone near the bore head

8.2.2. Construction

Exclosure and wing fences

This is the specific design of the feral-proof exclosure and wing fences:

- 1.8m-high netting fence with a 0.6m overhang, creating a cat- and fox-proof 'floppy top' and a minimum width of 0.5m apron of 'foot netting' inside and out (in some areas up to 0.6m). Foot netting is laid parallel to the ground surface and lightly covered with soil or held down with rocks or pegs.
- On exclosure fence lines, 30mm aperture netting will be used on the lower sections of the fence and the external foot netting to prevent incursion of juvenile rabbits. On wing fences, 50mm aperture netting will be used in place of 30mm netting, making these sections cat- and fox-proof, but not rabbit-proof.
- 2.7m strainer posts made from recycled steel bore casing or water pipe will be spaced at 100m intervals, and droppers or pickets spaced at 7–8m.
- Where the fences cross potential ephemeral floodways, the foot netting apron will be reinforced by wider netting, held down by stones or stakes.
- Exclosure fences will be equipped with two electric wires added at a height of 1.4 and 1.6m (offset 6cm from the netting) to provide maximum protection against climbing cats and foxes. These will be powered by two solar energisers, with one on each exclosure.
- The northern exclosure will have three gates and the southern exclosure two gates, to allow access for management of the area. These will be reinforced by locking mechanisms top and bottom and a solid steel plate buried at ground level to prevent animals from accessing under or around the gate.

- These specifications are based on research into the most effective fence design for exclusion of feral animals (Moseby & Read 2006). The fence layout, gate placement and other site factors are show in Figure 3; the exclosure and wing fence designs are shown diagrammatically in Figure 10.

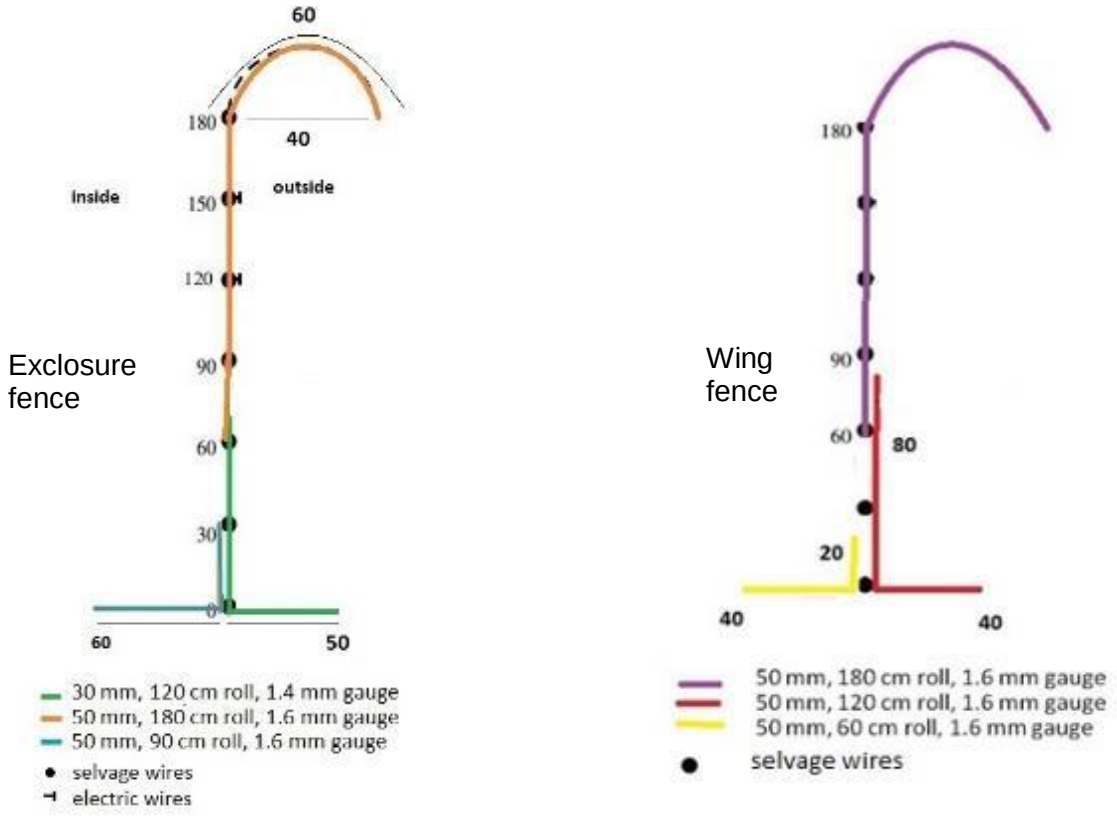

Figure 10: Exclosure and wing fence designs in cross-section view

Based on consultations with the Wild Dog Destruction Board (Appendix 2), the wing fences will meet the Dog Fence at right angles with independent strainer posts. Additionally, access gates will be constructed to allow free passage of vehicles along the Dog Fence maintenance track and the larger parallel vehicle service track, with signage warning approaching service vehicles to these gate intersections. This approach is supported by the Wild Dog Destruction Board (see Appendix 2).

The northern wing fence will also cross a travelling stock route (TSR) (R1003495) (Figure 3), where it is proposed that an additional gate will be installed to enable passage of stock through the fence; this is standard practice where fences cross other TSRs at sites throughout New South Wales. NPWS does not have authority over this land tenure. Discussions are currently underway with Local Land Services and the NSW Department of Industry to clarify which body needs to approve a licence application for the wing fence to cross the TSR. The wing fence and gate will only be installed across the TSR when all necessary permissions have been granted.

All fences will be constructed by a team of five to ten personnel, using the following equipment:

- one to four tray-top utilities
- a small loader or tractor with a hydraulic fence-post driver and post-hole auger
- a fencing trailer with an air compressor and pneumatic fence-clipping guns.

Grid on Dunes Scenic Drive

At the intersection of the northern wing fence and Dunes Scenic Drive (11.6km east of Cameron Corner), a cattle grid is proposed (Figure 11, Figure 12, Figure 13). A grid presents an alternative to a gate, which may create traffic issues and vehicle collision risk. At a site meeting with local NPWS staff on 14 July 2017 it was agreed the crossing would require the following specifications:

- 8m-wide grid rated for heavy road train traffic (up to 18 tonnes per axle) with closed abutments to prevent incursions of feral animals under the grid (Figure 13)
- 3m-wide weldmesh barriers on each side of the grid (Figure 11)
- placement as shown in Figure 12 to allow 260m visibility from the western approach and 170m visibility from the eastern approach (Figure 12)
- pruning of *Dodonaea viscosa* and *Acacia ligulata* shrubs on the eastern corner to increase visibility on approach (Figure 11)
- traffic detour during construction (Figure 11).

The entire swale area surrounding this intersection was surveyed during the cultural heritage surveys (Appendix 3) which determined there is no significant cultural heritage in this area which could be harmed by these activities. The grid crossing will be monitored using traffic counters and an adaptive management approach implemented in relation to traffic and potential impacts on native animals. Based on current traffic data from Dunes Scenic Drive (Table 3), the optimum timing for the installation of a grid would be in January or February, when monthly traffic is 5–15% of that recorded during winter months. Dunes Scenic Drive is a NPWS owned and maintained road, with installation and traffic management to be carried out in collaboration with local staff, who hold accreditations in preparing work-zone traffic management plans and implementing traffic control plans. NSW Roads and Maritime Services standard signage and speed limits will be followed in the installation and operation of the grid.

Table 3: Road traffic along Dunes Scenic Drive during 12-month period April 2016 – March 2017
Data courtesy of NPWS, Tibooburra, collected using a traffic counter located near the intersection of Dunes Scenic Drive and Telephone Swamp Track.

Month	Number of vehicle movements
January 2017	427
February 2017	204
March 2017	775
April 2016	765
May 2016	1,108
June 2016	1,134
July 2016	4,061
August 2016	2,464
September 2016	861
October 2016	1,157
November 2016	742
December 2016	606
Total	14,304

Figure 11: Construction details for proposed grid at intersection of the northern wing fence and Dunes Scenic Drive

a)

b)

Figure 12: The proposed intersection site of the northern wing fence and Dunes Scenic Drive, 11.6km east of Cameron Corner

Vehicle marking the grid site: a) shows the approach from the east and b) the approach from the west.

Figure 13: Example of an 8m-wide grid, rated for heavy traffic (up to 18 tonnes per axle), as proposed for Dunes Scenic Drive

This example has open abutments, whereas the proposed grid would have closed abutments to prevent feral animal incursions under the grid.

Intersection with minor watercourses

There are 10 areas where minor water courses or drainage gutters intersect the proposed fence line, at which the installation of 300mm or 600mm cement culverts will be necessary to aid water flow during heavy downpours (

Figure 14). End abutments will be enclosed with 30mm mesh to prevent feral animal incursions and will be checked during weekly fence monitoring circuits and immediately after heavy downpours for integrity and to remove build-up of water-deposited debris. In areas where smaller drainage gutters intersect the fence line, floating flood gates may be installed, using a similar design to the adjacent Dog Fence (Figure 15).

Figure 14: Example of a culvert and head wall that will be installed under the fence in areas where water is likely to flow

Figure 15: Example of a floating flood gate installed on the Dog Fence in areas where minor water courses intersect the fence line

Release pens

A 12-ha release pen will be constructed in both the northern and southern exclosures as a soft-release area for mammal reintroductions (Figure 3). Release pen fences will follow the exclosure fence design (1.8m high, with floppy top and foot netting), but will lack the electric wires. Construction will follow the same methods as the exclosure fences, however, due to the open nature of the vegetation and terrain, these will require no vegetation clearance, grading or other site preparation. Fencing will be completed using a utility and small tractor with hydraulic post driver and post-hole auger.

New all-weather access track

Exclosure placement has taken advantage of existing track infrastructure to minimise the clearance footprint of the proposed development. However, the major access tracks into the project area (Whitecatch Road, Telephone Swamp Track and Quart Pot Track) all cross major ephemeral swamp areas and become inaccessible to vehicles after heavy rain. A requirement of the project (as stipulated in the contract between OEH and UNSW) is for prompt checking of all fence lines for damage following heavy rain or strong wind. Thus, a track allowing access to the exclosure fence lines following rainfall is critical to the success of the project. As such, a new 3.6km track is proposed, linking the northern section of Whitecatch Road with the eastern corner of the southern exclosure (Figure 3). The proposed track follows areas of high ground, including a gibber rise and sand dunes, allowing bypass of the major ephemeral swamps along Whitecatch Road and access during all weather conditions. It is proposed that a single grader pass (3m) is graded along this proposed route, using a Caterpillar 12H motor grader (or similar). Given the sparse vegetation and sensitive track placement, no clearance of vegetation (other than ephemeral grasses and herbage) is required.

8.2.3. Remediation

The current project has a 10-year tenure with the potential for continued extensions, funding pending. If OEH deems the project has come to an end and no further extensions of tenure are possible, all fences are to be removed from the site.

8.3. The size of the proposed activity footprint

The size of each component of the proposed infrastructure is detailed in Table .

Table 4: Size of each infrastructure component for the Wild Deserts project

Component	Area km^2 (ha)	Perimeter (km)	Number of dune crossings
Northern exclosure	20.7 (2066)	18.0	18
Southern exclosure	22.3 (2226)	19.8	17
Northern release pen	0.1 (12)	1.4	2
Southern release pen	0.1 (11)	1.3	2
All-weather access track	0.01 (1.4)	3.5	1
Northern wing fence	0.04 (4.24)	5.3	1
Joining wing fence	0.01 (1.04)	1.3	2
Southern wing fence	0.03 (2.64)	3.3	1
Borrow pits (n=6)	0.002 (0.2)	0.18	0
Lay-down yard 1	0.01 (0.6)	0.3	0

Component	Area km² (ha)	Perimeter (km)	Number of dune crossings
Lay-down yard 2	0.01 (1.1)	0.5	0
Total	43.28 (4326)	54.9	44

8.3.1. Ancillary activities

Interpretative signage will be placed at the Fort Grey Campground, the information bay at Cameron Corner, the site where the northern wing fence crosses Dunes Scenic Drive and the Fort Grey Homestead gate. Where possible, these signs will be attached to existing information boards to provide park visitors with information about the project and direct them to sources of additional information (website, social media, etc.).

The two grader passes either side of the fence line will create a firebreak to assist with bushfire hazard reduction. The Wild Deserts project will also work with the West Region Fire Management Officer to plan for bushfire hazard reduction.

8.3.2. Operation

Maintenance of fences

A schedule of monitoring and maintenance will be established to ensure the integrity of the fenced exclosures and the wing fences. For the first month, after fence construction, the entire perimeter will be patrolled every two days from a four-wheel drive, all-terrain vehicle or on foot. Following this period, weekly fence inspections will be conducted, or more regularly following strong wind or rainfall to assess condition and remediate any damage. The fence will be maintained to eliminate, to the extent reasonably possible, the risk of incursion by feral and introduced predators and herbivores.

Removal of feral and introduced species

All feral and introduced predators and herbivores will be removed from the exclosures before the reintroduction of threatened species. To achieve this, a range of techniques will be deployed including baiting with 1080 poison baits, shooting, grooming traps, and capture using soft-jaw leg-hold or cage traps. Appropriate approvals will be sought before implementing the different control strategies. Rabbit warrens will be mapped throughout the area by walking surveys, and rabbits removed by fumigation, poisoning and shooting. In addition, it may be necessary to use trained dogs to identify remaining feral and introduced animals which cannot be eradicated through other methods. Incursion of feral and introduced species will be monitored through fence patrols, camera traps, track transects and spotlighting surveys.

The abundance of foxes and feral cats will be reduced in the wild training zone using the same methods as detailed for the exclosures, however, the aim will not be complete eradication in this area but rather to maintain reduced densities. However, any incursions of dingos and wild dogs into the wild training zone will be eradicated immediately. Data from spotlight counts, camera traps and track transects, will be used to estimate the number of foxes and feral cats in the wild training zone and control implemented accordingly, as part of the Wild Deserts Strategic Adaptive Management Framework. Recent work from the Arid Recovery Reserve found that in the absence of foxes, burrowing bettongs and bilbies were successfully reintroduced in the presence of feral cats at 0.19 cats per square kilometre (West et al. 2017). This led to significant improvements in anti-predator behaviours, which will be essential for enabling the successful reintroduction of these species into the broader Sturt Service Site (see Section 10 for further justification of this translocation approach). Releases into the wild training zone will be subject to approval of a full translocation proposal (in accordance with NPWS Policy for the Translocation of Threatened Fauna in NSW), including animal ethics approval, in which thresholds for fox and cat densities in the wild

training zone will be set and will determine when releases of the Sturt Species can take place.

Reduction in kangaroo numbers within fenced areas

Red kangaroos make up over 95% of kangaroo populations within the Sturt Service Site and are currently in densities sufficient to cause substantial impacts on vegetation, even during wet climatic periods (Morris & Letnic 2017; Rees et al. 2017). This species can become highly mobile following rainfall which creates pulses of vegetation and surface water in the arid environment (Caughley et al. 1984; Priddel et al. 1988; Robertson 1987). Although not strictly requiring water, red kangaroos benefit from the provision of artificial water sources, particularly during summer. The proposed exclosures and the wild training zone will not contain any permanent water sources. Therefore, it is important the project includes measures to remove kangaroos from the fenced areas so they are not trapped without access to water. This will ensure the project is undertaken in accordance with animal ethics standards.

Kangaroo numbers are likely to be decreasing currently given that three artificial water sources near and within the Sturt Service Site were closed in 2016 by NPWS (some still hold water at the time of writing, but once this has evaporated, modifications to these ground tanks prevent them from filling again). To remove remaining kangaroos, a slow drive by project staff will occur from one end of each exclosure to the other, leaving an open fence section of 200m for kangaroos to escape. On completion of each exclosure, previously trialled kangaroo access gates will also be installed into key locations around the perimeter to allow remaining kangaroos to pass through without damaging fencing. One such design has been used successfully at the CSIRO field station Yalanbee, Bakers Hill, for over 20 years (Figure 16) (DEC 2009). The main gate component consists of a piece of 50cm-high and 45cm-wide weldmesh panel. A 10mm internal diameter length of pipe is welded to the top of the mesh, extending it a minimum of 20mm either side. The bottom of the gate will be formed (as shown in Figure 16), with a curved piece of 8mm rod. This provides a gap with a maximum height about 10cm from the ground, which encourages kangaroos to push their nose under the gate, allowing them to open it. The gate is simply swung by a 5–7mm rod through the 10mm pipe and matching holes in the star posts. Stoppers on the inside of the posts will allow the gate to swing freely towards the outside of the exclosure only, allowing one-way passage of kangaroos from the inside to the outside. Kangaroos can smell water sources and thus will be encouraged to use the gates through the placement of temporary water troughs (supplied by portable 1000L water storage pods) positioned approximately 200m outside each gate. These gates will also be installed within the wing fences surrounding the wild training zone to allow kangaroos to leave the area.

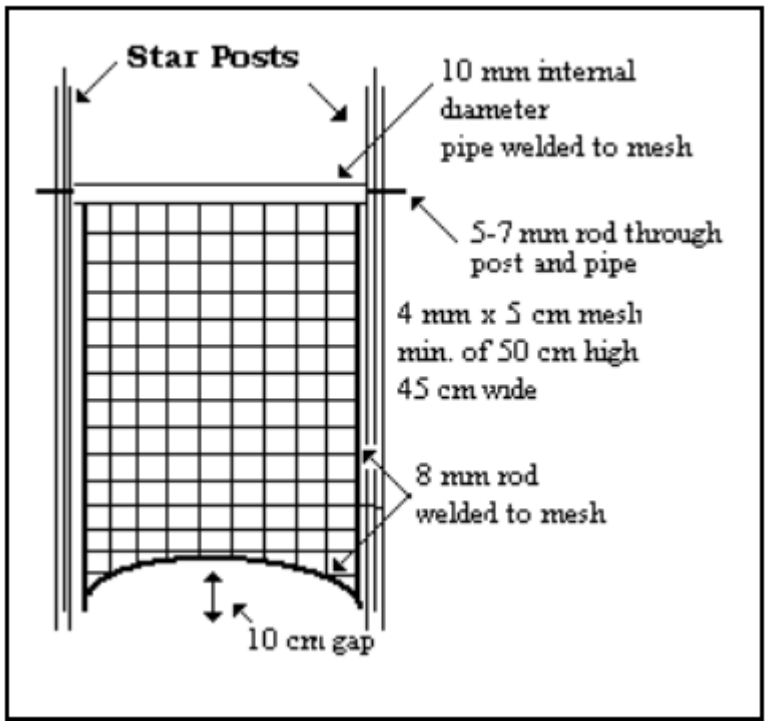

Figure 16: Specifications for the kangaroo access gate used at Yalanbee, Bakers Hill (DEC 2009) and proposed for use in this project to allow kangaroos to exit the fenced exclosures

Reintroduction of threatened species

Seven species considered extinct in New South Wales have been determined for release at the Sturt Service Site: burrowing bettong (*Bettongia lesueur*), greater stick-nest rat (*Leporillus conditor*), greater bilby (*Macrotis lagotis*), western quoll (*Dasyurus geoffroii*), crest-tailed mulgara (*Dasycercus cristicauda*), golden bandicoot (*Isoodon auratus*), and western barred bandicoot (*Perameles bougainville*) – referred to as the 'Sturt Species'. An outline of the ecological role of each species and their expected benefits and impacts on the local ecosystem is provided in Table 5.

The project aims to reintroduce each of the Sturt Species into the exclosures and beyond the fence, into the broader Sturt Service Site, via the wild training zone. The translocation approach to achieve these aims is detailed fully in the *Wild Deserts Translocation Strategy* which has been submitted to OEH for approval. As the reintroduction of each species will be dependent on the successful eradication of feral mammals from within the exclosures and the wild training zone, exact timeframes are uncertain. Full translocation proposals (in accordance with the NPWS Policy for the Translocation of Threatened Fauna in NSW), including animal ethics approvals, will be developed and submitted for each species once a timeframe for reintroduction has been finalised. All species reintroductions will be subject to necessary approvals being granted. The timing for the reintroduction of each species will also be guided by the progress of vegetation restoration within the Sturt Service Site and the successful establishment of previous species (as detailed in the Wild Deserts Translocation Strategy). In addition, a Wild Deserts Beyond the Fence Strategy will be developed to guide releases of the Sturt Species beyond the exclosures.

Table 5: The seven Sturt Species listed for reintroduction to the Sturt Service Site, their ecosystem role and potential benefits to and impacts on the local ecosystem

Species	Key threats	Ecosystem role	Diet	Benefits to local ecosystem and resident species	Potential impacts on local ecosystem and resident species
Greater bilby	Introduced predators	Engineer – burrowing, omnivorous	Seeds, bulbs, invertebrates, small vertebrates	Increase soil health – turnover & mixing, nutrients – diggings trap organic matter, soil moisture – increase water infiltration, mycorrhizal fungi, plant nutrients – increases seedling germination and establishment, creation of refuge burrows for other species	Predation of some reptiles and amphibians Soil disturbance from foraging pits and burrows Depletion of seed bank
Western barred bandicoot	Introduced predators, grazing, cropping	Engineer – digging, omnivorous	Insects, seeds, roots, herbs, small animals	Increase soil health – turnover & mixing, nutrients – diggings trap organic matter, soil moisture – increase water infiltration, mycorrhizal fungi, plant nutrients – increases seedling germination and establishment	Predation of invertebrates or small reptiles and mammals Removal or depletion of seed bank of certain plant species
Golden bandicoot	Introduced predators	Engineer – digging, omnivorous	Insects, seeds, roots, herbs, eggs	Increase soil health – turnover & mixing, nutrients – diggings trap organic matter, soil moisture – increase water infiltration, mycorrhizal fungi, plant nutrients – increases seedling germination and establishment	Predation of invertebrates
Burrowing bettong	Introduced predators, rabbits	Engineer – burrowing, omnivorous	Seeds, roots, leaves, fungi, termites	Increase soil health – turnover & mixing, nutrients – diggings trap organic matter, soil moisture – increase water infiltration, mycorrhizal fungi, plant nutrients – increases seedling germination and establishment, creation of refuge burrows for other species, warrens provide thermal protection for range of species	Grazing of chenopod species and perennial seedlings Depletion of seed bank
Stick-nest rat	Introduced predators, grazing, rabbits	Engineer – stick-nest builder, herbivore	Leaves and fruits of succulent plants	Nests provide habitat for invertebrates and small mammals and reptiles	Grazing of chenopod species
Crest-tailed mulgara	Introduced predators	Meso predator	Invertebrates, lizards, small mammals	↑ ecosystem function – meso predator currently absent from system, controls rodents or plague locusts	Predation of small mammals and reptiles
Western quoll	Introduced predators	Apex predator	Invertebrates, lizards, small mammals, birds	Native top-order predator – ↑ ecosystem function, controls overpopulation of other reintroduced species	Predation of small mammals and reptiles Predation of other reintroduced mammal species

Management of reintroduced species

Following reintroduction, each of the Sturt Species will be closely monitored to ensure the population establishes successfully. Table 6 details the short-, medium- and long-term thresholds required to determine that releases have been successful.

Table 6: Short-, medium- and long-term thresholds for successful establishment of the Sturt Species following reintroduction

Short-term **0–12 months**	**Medium term** **12 months – 2 years**	**Long term** **2–10 years**
>50% of released Sturt Species have survived	Population increase recorded First generation (F1) individuals recruited to the population	Steady population increase during first 5 years Increase in population distribution to include >50% of suitable habitat Population recovery after drought to pre-drought levels

To monitor each reintroduced population in relation to the thresholds listed in Table 5, the project will use a range of monitoring techniques including radiotracking, track transects, spotlighting and trapping. These methods are detailed in the *Wild Deserts Ecological Health and Monitoring Framework* prepared for OEH and detailed in Appendix 7. Individual species methods will be further detailed in associated translocation proposals.

While fenced exclosures have been successfully used to establish a wide variety of threatened species (Hayward et al. 2014; Moseby & Read 2006; Moseby et al. 2011b; Richards & Short 2003) they can present population management issues related to overabundance due to the absence of predators and natural dispersal (Hayward et al. 2014). Data collected from track transects, spotlighting and trapping methods will directly inform the *Wild Deserts Strategic Adaptive Management Plan*. This will enable modification of management actions should potential signs of overabundance be detected, such as:

- declines in track counts of some species while others continue to increase
- trap saturation by one particular species during trapping events
- declines in vegetation condition through over-browsing
- declines in condition and reproductive output of species that would have dietary or shelter overlap with the overabundant species.

The proposal to reintroduce a native predator, the western quoll, to the exclosures is likely to reduce the development of overabundance issues. Western quolls reintroduced to the Arid Recovery reserve preyed on mainly small mammals and some bettongs and western barred bandicoots (West & Moseby, unpublished data). However, if overabundance is detected in any of the Sturt Species the following two options will be explored:

- opening of one-way gates which allow exits from the exclosure for naturally dispersing animals but prevent incursions from feral species. One-way gates have been designed and developed at the Arid Recovery Reserve (Crisp & Moseby 2010) and used successfully to enable overabundant burrowing bettongs to leave the exclosures (Arid Recovery, unpublished data) and
- releases to the wild training zone.

The risks and benefits of both methods will be fully assessed through translocation proposals and animal ethics approvals. Implementation of these methods would require that all necessary approvals have been granted (e.g. approved translocation proposal, animal ethics approval, predator densities outside fences reduced to critical thresholds).

Figure 17: One-way gate installed within the Arid Recovery Reserve fence (Roxby Downs)

This enables dispersal of bettongs and bilbies from inside the reserve, but prevents entry from predators or rabbits. These gates would only be installed if overabundance of reintroduced species was detected.

8.3.3. Proposed construction methods, materials and equipment

As detailed above (Section 8.2.2), construction of infrastructure will require the materials and equipment listed in Table 4.

Table 4: Materials and equipment required for construction of the infrastructure

Item	Materials	Methods	Equipment
Fence line easement		Lightly grade an 8m-wide easement in areas of uneven ground (1m for fence, 3m either side for access track)	Grader Dozer with stick rake Hand tools
Dune capping		Excavate clay material from swale within 100m of dune site Deposit on dune surface and smooth	Grader Dozer with stick rake

Item	Materials	Methods	Equipment
Fences	30mm and 50mm aperture galvanised wire netting 2.4m steel droppers 2.7m steel strainer posts 2.5mm high-tensile strainer wires 2.5mm electric wire solar energisers	Install fence strainers and droppers with post driver Fit and strain high-tensile wires Roll out and clip netting to wires Install energisers and fit electric wire and insulators	Utilities Trailer with air compressor and pneumatic clip guns Small tractor or fork lift Hand tools

8.3.4. Receival, storage and on-site management for materials used in construction

Wild Deserts project staff (Coordinator and Ecologist) will be based at the Fort Grey Homestead to manage receipt and storage of construction materials. Construction materials will be stored at the designated temporary storage areas (see Figure 3 and Section 8.2.1). Storage sites have been situated close to Collins Bore, which is centrally located between the two exclosures and is already a degraded area due to historical stock impact at the waterpoint. The site is also accessible by heavy transport vehicles via Whitecatch Road, the Dog Fence service track and Diggers Tank Track which avoids crossing the tallest dunes on the road via the Kiwi Hut Road (Figure 18). Temporary storage areas were surveyed in the cultural heritage surveys (Appendix 3).

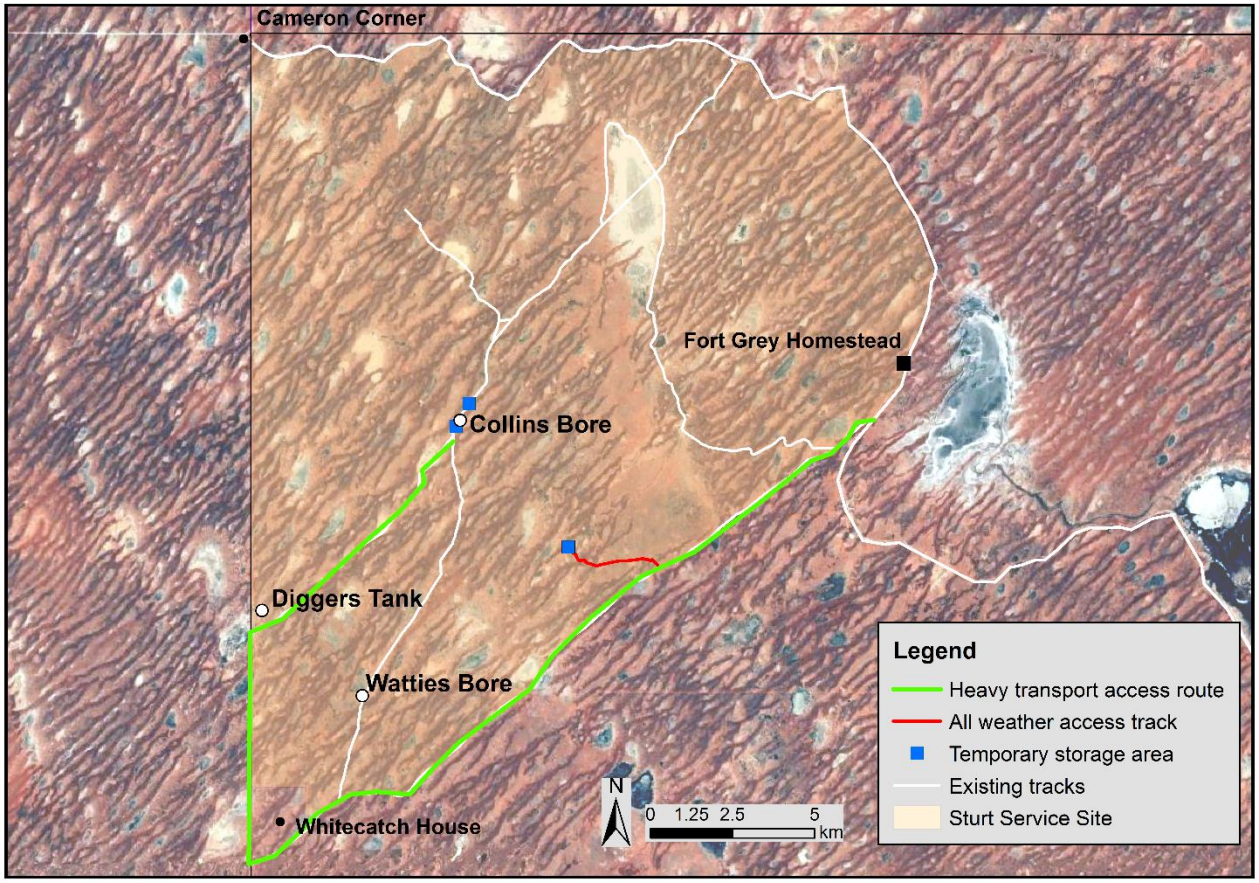

Figure 18: Map of access route to temporary storage areas suitable for heavy transport vehicles

8.3.5. Earthworks or site clearing including extent of vegetation to be removed

Full details of earthworks and site clearance methods are provided in Section 8.2.1. Table 5 details the plant community types (PCT) intersected by each infrastructure feature and the hectares to be cleared. This is presented in relation to the hectares of each plant community present in the Sturt Service Site. As can be seen from Table 5, the maximum quantity of any plant community to be cleared is only 0.3% of the total area within the Sturt Service Site. It should be noted that plant communities 149 and 150 contain no perennial vegetation, supporting ephemeral grasses and herbage after rainfall only. As such, these areas will require little grading and do not constitute vegetation clearance. This would therefore result in a total clearance footprint of 25.7ha which is 0.08 % of the Sturt Service Site area. Full details on the methods used to calculate the clearances are described in Section 11.11.

Table 5: Extent of vegetation to be cleared by plant community type

***Totals hectares in parentheses are plant community types where grading will not disturb vegetation and only result in ground disturbance. Total ground disturbance is depicted in parentheses at the bottom of the column.**

PCT ID	Community common name	Hectares to be cleared by feature					Total (ha)	Ha in Sturt Service Site	Clearance % of Sturt Service Site
		Exclosures	Wing fences	All-weather access track	Borrow pits	Temporary storage areas			
119	Sandplain mulga shrubland	1.8	0.0	0.1	0.0	0.0	1.9	1,133	0.17
124	Sandhill wattle shrubland	8.4	1.2	0.4	0.0	0.0	10.0	12,845	0.08
149	Neverfail grassland	*1.4*	*0.0*	*0.0*	*0.0*	*0.0*	(1.4)*	*1,075*	*0.13*
150	Bottlewasher – Copperburr grassland	*8.5*	*5.4*	*0.2*	*0.8*	*4.4*	(19.2)*	*6,903*	*0.28*
153	Black bluebush shrubland	0.2	0.0	0.0	0.0	0.0	0.2	223	0.10
161	Golden goosefoot shrubland	0.2	0.0	0.2	0.0	0.0	0.3	580	0.06
162	Sturts pigface forbland	1.2	0.3	0.0	0.0	0.0	1.5	583	0.26
222	Low bluebush shrubland	2.6	0.2	1.4	0.0	0.0	4.2	2,428	0.17
224	Cotton bush shrubland	1.8	0.0	0.0	0.0	0.0	1.8	790	0.23
232	Senna mulga needlewood shrubland	4.5	0.8	0.5	0.0	0.0	5.8	4,983	0.12
Totals		30.6	7.9	2.8	0.8	4.4	25.7 (46.3)*	31,543	

8.3.6. Environmental safeguards and mitigation measures

The safeguards and mitigation measures which have been and will be implemented are outlined below.

1. Impact on cultural heritage values in the project area has been mitigated by:
   - detailed consultation with the Maljangapa and Wongkumara groups and Tibooburra Local Aboriginal Land Council during fence line selection (Appendix 2 and Appendix 3)
   - employment of an archaeologist with significant experience in the local area to conduct surface surveys of the footprint for all proposed infrastructure (Appendix 3)
   - application for an Aboriginal Heritage Impact Permit (AHIP) for those sites for which disturbance could not be avoided
   - following the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010c) at all times.

2. Impact of dust and noise on adjacent areas and park users has been mitigated by:
   - selection of a site that is remote from residences and visitors to the park (Figure 1)
   - ensuring all equipment used during the construction phase is regularly maintained to ensure efficient operation
   - ensuring vehicle movements are kept to established tracks and designated fence line tracks to reduce the area of disturbance
   - using new vehicles with modern low-emission standards.

3. Soil disturbance, degradation and erosion has been mitigated by:
   - careful site selection to avoid areas with potential for high erosion and to minimise the construction footprint (Section 8.3)
   - proposed use of very light grading techniques in areas where possible
   - erosion control banks and flat-bottomed rains constructed on tracks where necessary to reduce susceptibility to erosion from surface water runoff
   - proposed capping of eight highly mobile and steep dunes within the fence corridors (Section 0and Figure 7)
   - restriction of vehicle movements to existing or new tracks to reduce area of disturbance
   - proposed re-spreading of stockpiled material at borrow pits (Section 0).

4. Potential for spills of oils, fuel and other noxious substances has been mitigated by:
   - conducting daily vehicle checks to highlight leaks and other issues
   - conducting regular services to maintain vehicles
   - refuelling vehicles at the homestead where fuel is stored as per standards
   - cleaning up spills immediately

5. Potential impact of waste has been mitigated by:
   - a proposed contract requirement that the fencing contractor will take all construction waste away from the site
   - instructing staff and visitors to deposit waste in the Fort Grey tip area and removing all recycling from the site
   - providing appropriate waste bins and sharps bins for microchip needles
   - site induction to include the importance of securing loads when driving to and from the site.

6. Potential for introduction of weeds or pathogens has been mitigated by:
    - implementation of quarterly monitoring for weeds along tracks within the project area
    - restriction of vehicles to tracks
    - hosing down of vehicles from buffel grass-infested areas before entry to the site.

7. Impact to resident native animals has been mitigated by:
    - detailed on-ground and desktop surveys (Section 11.12) in order to locate the fence lines along the best possible route to avoid impacting sensitive habitat areas (Section 10.2)
    - implementation of annual monitoring of abundance and diversity of small vertebrates to document changes
    - following the NPWS Vertebrate Pest Management Strategy to minimise non-target exposure during feral eradication programs.

8. Impact to resident native plants has been mitigated by:
    - detailed on-ground and desktop surveys (Section 11.11) in order to locate the fence lines along the best possible route to avoid impacting sensitive habitat areas (Section 10.2)
    - careful fence line selection to avoid mature trees where possible
    - minimising the construction footprint and vegetation clearance by avoiding areas with sensitive perennial vegetation where possible (Sections 8.3.5 and 11.11.2)
    - implementation of annual monitoring of vegetation within the project area including grazing pressure and recruitment

8.3.7. Sustainability measures

The Wild Deserts project plans to purchase all fencing materials from Australian suppliers to guarantee stringent environmental standards in sourcing raw materials and manufacture.

The project will work closely with expertise from the UNSW Photovoltaic and Renewable Energy Engineering Group to improve the sustainability of project activities by exploring the following ideas for implementation at the Wild Deserts project site:

- solar power and carbon neutrality for accommodation of construction workers and project staff
- use of solar power to run electric hot wires around exclosures
- solar electric power for all-terrain vehicles used for monitoring activities
- compostable toilets and greywater recycling for visiting project personnel and researcher accommodation.

It is likely the Wild Deserts project will be used to test new and innovative sustainable technologies and used as an exemplar site for sustainable outback living through collaborations on projects within the group at UNSW.

8.3.8. Construction timetable, staging and hours of operation

Total fence construction and eradication will take around 24 months and will occur in stages, detailed in Table 6. Stage 1 will involve the site preparation of the fence lines, with associated infrastructure such as the clay capping of eight steep and mobile dune crests and the establishment of the all-weather access track.

Commencement of fence construction will occur in Stage 2, with lower mesh and foot netting completed, before commencement of the second exclosure. This will enable eradication methods for rabbits to start in the first exclosure and continue concurrently while fencing contractors begin construction of the second exclosure (Stage 3).

Stage 4 will see the first reintroductions in the first exclosure, while eradication of feral species continues within the second exclosure and fencing contractors construct the wing fences. Stage 5 will see mammal reintroductions to the second exclosure, while management of feral species occurs concurrently in the wild training zone. During Stage 6, reintroductions will be conducted in the wild training zone.

Fence construction will occur during daylight hours only. Any work occurring during summer months will occur in the early morning and late evening to avoid the hottest part of the day. The construction site is more than 15km from the nearest residence and over 30km from the Fort Grey Campground so will not disturb residents or visitors.

Table 6: Construction timetable, identifying the six major stages of project development

		Stage					
		1	**2**	**3**	**4**	**5**	**6**
Site preparation	Exclosure 1						
	Exclosure 2						
	Access track						
	Wing fences						
Construction	Exclosure 1						
	Exclosure 2						
	Wing fences						
Eradication	Exclosure 1						
	Exclosure 2						
	Wild training zone						
Mammal reintroductions	Exclosure 1						
	Exclosure 2						
	Wild training zone						

9. Objectives of the proposal

The objective for the Reintroduction of Locally Extinct Mammals Project is:

> To maximize biodiversity outcomes in the park and increase community engagement with threatened species through the successful reintroduction of mammals formerly extinct in New South Wales and associated management activities.

In the initial period, the following desired outcomes are identified to help meet the objective:

1. Viable populations of reintroduced mammals are established inside fenced exclosures, or are on track to becoming established, and progress has been made towards enabling establishment of populations of reintroduced mammals outside fenced exclosures within the Service Site.

2. Successful reintroduction of locally extinct mammals leads to improved ecosystem health within fenced exclosures.

3. Reintroduction of locally extinct mammals leads to community engagement in threatened species and park management, and increased social benefit.

4. Increased knowledge leads to improved conservation outcomes.

5. Delivery of agreed park management services meets NSW Government and public expectations.

10. Reasons for the activity and consideration of alternatives

10.1. Reasons for activity

The project is funded by OEH through the *Saving our Species* program, which aims to secure the survival of NSW threatened species in the wild for the next 100 years. The Wild Deserts project site at Sturt National Park is one of three sites where extinct native mammals are to be reintroduced using predator-free fenced exclosures as a first step in re-establishing the species in New South Wales.

The impetus for this work, and the Wild Deserts project specifically, is to redress Australia's small mammal extinction record, which is the worst in the world. In New South Wales, 25 mammals are listed as extinct under the *Threatened Species Conservation Act 1995* (TSC Act), while over 50% of surviving mammal species are listed as threatened. It is expected that removing key threats, such as feral and introduced predators, combined with the beneficial activities of reintroduced mammals, will lead to improved ecosystem health and benefit other native species, ground-dwelling and ground-nesting threatened species and native vegetation. At the Sturt National Park site, it is expected that the removal of rabbits and reduction in kangaroo density will substantially lower total grazing pressure and provide substantial benefit to the local environment, including soils and native vegetation.

The *Saving our Species* program and Wild Deserts project will provide opportunities for scientific research, to learn more about ecosystem restoration, mammal reintroductions, predator–prey relationships, as well as introduced predator control, and provide opportunities to apply the lessons learnt to other sites and broader landscapes.

10.2. Alternatives

1: Do nothing

The Sturt Species are extinct in New South Wales. It is therefore impossible that the species could naturally recolonise the study area if a 'do nothing' approach was taken.

2: Releases in to Sturt National Park without fenced exclosures

There is extensive evidence of the vulnerability of reintroduced mammals in environments with feral predators (Burbidge & McKenzie 1989; Clayton et al. 2014; Fischer and Lindenmayer 2000; Hayward et al. 2014), including specific examples of some of the Sturt Species planned for reintroduction e.g. burrowing bettongs and greater bilbies (Bannister et al. 2016; Moseby et al. 2011b).

Almost every documented attempt to reintroduce critical weight-range native mammals outside fenced reserves at sites in arid Australia has failed, with predation by cats and foxes being the primary cited cause (Table 7). A single male cat killed more than half of the mala (*Lagorchestes hirsutus*) reintroduced to the Tanami Desert in 1994 and 1995 (Christensen & Burrows 1994; Gibson et al. 1995). All burrowing bettongs reintroduced to the Gibson Desert during project Desert Dreaming were killed by two to three cats within two months (Christensen & Burrows 1994). A single cat killed more than half of the young wallabies produced at a colony of unadorned rock-wallabies over a nine-month period (Spencer 1991). A single male cat killed 21% of reintroduced brush-tailed bettongs, with no more deaths once the cat was removed (Moseby et al. 2015). Further accounts are summarised in Table 7 and published in Moseby, Peacock & Read (2015). As such, there is strong evidence that achieving the aim of reintroducing the Sturt Species into the broad landscape will fail without a controlled area for intense feral and introduced predator control.

Fencing from the exclosures to the Dog Fence will allow effective control of cats and foxes over a larger area, while also allowing some exposure of the native mammals to these predators. This concept was recently tested at the Arid Recovery Reserve in South Australia, by members of the Wild Deserts team (West et al. 2017). In this project, 350 burrowing bettongs and 50 bilbies cohabitated a 26km^2 paddock, with four large satellite-collared and de-sexed male feral cats. This ongoing work demonstrates that in less than two years bettongs exposed to feral cats began showing improvements in anti-predator behaviours critical to surviving with in situ feral predators (West et al. 2017). The proposed wild training zone provides an area of sufficient size in which fox and cat numbers can be closely controlled, also allowing for research and innovation aimed at improving the ability of predator-naïve extinct mammals to avoid feral predators. This is a major focus of the project on the reintroduction of locally extinct mammals into the wider landscape of the Sturt Service Site, which incorporates the identified wild training zone (Figure 1).

The area of the proposed mammal reintroductions in Sturt National Park currently supports moderate densities of feral cats and foxes despite regular 1080 baiting undertaken by NPWS. Similarly, feral goats and pigs are abundant in New South Wales, but absent from neighbouring parts of South Australia (Newsome et al. 2001). Indeed, cat and fox densities inside Sturt National Park are higher than neighbouring areas outside the Dog Fence in South Australia (Lindon and Quinyambie stations) and cat densities are not significantly different to densities found on neighbouring NSW pastoral properties (Winathee Station) where no cat or fox management occurs (see Section 11.12.2). Baiting with 1080 meat baits is an effective control method for foxes, but much less so for cats, despite significant work and millions of dollars of investment in trialling cat-specific baits over the past two decades (Hetherington et al. 2007; Marks et al. 2006; Moseby et al. 2011a). Thus, other more labour-intensive techniques are required to suppress this predator to densities at which small mammal reintroductions can be attempted. At similar arid zone sites, intensive integrated cat control in areas outside fenced reserves has failed to control cat populations sufficiently to allow small mammals to successfully establish. At Roxby Downs, South Australia, a 200km^2 area, bounded on two sides by predator fences (the Arid Recovery Reserve and the South Australian Dog Fence) was intensively managed to eradicate predators through an intensive shooting and trapping program, including the use of cat-specific 1080 baits (Eradicat^{TM} kangaroo sausage baits) before release of burrowing bettongs and bilbies. Despite these measures, cats could not be effectively suppressed and cat predation caused reintroduction failure. In contrast, burrowing bettongs reintroduced into a fully bounded area with controlled low densities of cats successfully established, with improvements in their predator awareness and avoidance behaviour (Moseby et al. 2016; West et al. 2017).

The above evidence has led to the development of a staged translocation approach for the Wild Deserts project, whereby species will be reintroduced into exclosures and the wild training zone, prior to release to the broader Sturt Service Site. This approach is outlined further in the Wild Deserts Translocation Strategy prepared for OEH.

Table 7: Summary of previous attempts to reintroduce locally extinct mammals into unfenced areas of the arid and semi-arid zones of Australia

Location	Habitat	Year	Species	Predator control	Outcome	Reason	Reference
Gibson Desert, WA	Arid	1992	Golden Bandicoot, burrowing bettong	Fox control	Failed	Cat predation	(Burrows et al. 2003; Christensen & Burrows 1994)
Tanami Desert, NT	Arid	1994	Rufous hare-wallaby	Limited	Failed	Cat predation	(Gibson et al. 1995)
Yathong Nature Res, NSW	Semi-arid		Brush-tailed bettong	Fox control	Failed	Cat predation	(Wheeler & Priddel 2009)
Flinders Ranges, SA	Semi-arid		Brush-tailed bettong	Fox control	Failed	Cat and fox predation	(Bellchambers 2001)
Peron Peninsula, WA	Arid		Mala, bilbies	Cat and fox control	Failed	Cat predation	(Hardman 2006; Hardman & Moro 2006)
Lorna Glen, WA	Arid		Golden bandicoot	Cat and fox control	Failed	Cat predation	K Morris and C. Simms pers. comm.
Arid Recovery, SA	Arid		Bilby	Fox and cat control	Failed	Cat predation	(Moseby et al. 2011b)
Arid Recovery, SA	Arid	2008 & 2013	Burrowing bettong	Two releases	Failed	Cat, fox, dingo predation	(Bannister et al. 2016)
Wattarka National Park, NT	Arid		Bilby	No predator control	Failed	Predation	Southgate et al. pers. comm. (cited in Moseby et al. 2011b)
Scotia Sanctuary, NSW	Semi-arid		Bridled nailtail wallabies	Fox control	Failed	Predation	Australian Wildlife Conservancy pers. comm.

3: Alternative placement of fenced exclosures to proposed

In collaboration with OEH, Wild Deserts examined a number of alternative placements for the exclosures, including in stony plains country in other parts of Sturt National Park. However, these areas are dissected by numerous watercourses: landscape features which are incompatible with netting fences due to their vulnerability to flood events, which destroy them. It was therefore decided that a location for the fences within the Strzlecki Dunefields system to the west of the Fort Grey Homestead would be chosen. This area was termed the 'Sturt Service Site'.

It was decided that two paddocks would be constructed within the Sturt Service Site, which would not be joined. Two smaller exclosures in preference to one larger exclosure make feral

eradication more easily achieved and enable the introduction of different suites of species to each. Using Google Earth imagery, two possible options (A and B) (Figure 19) for the placement of the two paddocks within the Sturt Service Site were identified, based on:

- running fence lines parallel to dunes to ensure dunes could be crossed at right angles
- avoiding cutting through large clay pans or swamps
- making use of existing track networks to avoid additional clearance.

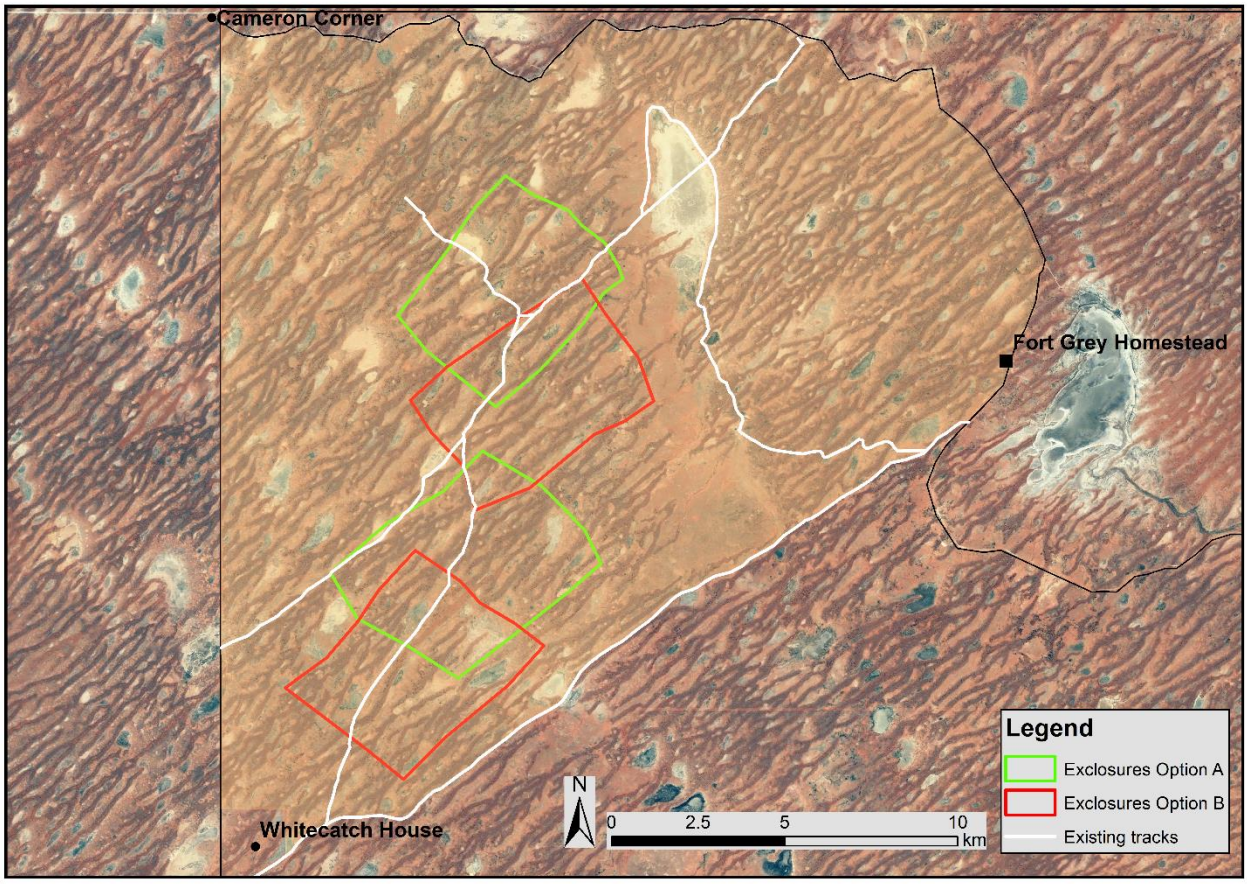

Figure 19: Initial options explored for fence placement within the Sturt Service Site

Options A and B were surveyed from 21–25 November 2016. The proposed fence line for each exclosure was followed and the below attributes recorded:

- steep and mobile dune crossings
- presence of Aboriginal stone artefacts
- presence of scalds in the swales
- erosion gutters and erosion heads (which would have potential to erode further).

Results of this survey are displayed in Figure 20.

Option A

The northern paddock intersected a number of artefact sites, particularly in the eastern corner as the paddock got closer to the gibber areas. The southern paddock was relatively problem-free and could make use of the existing Diggers Tank Track to form most the west to northern boundary of this paddock, significantly reducing vegetation clearance (Figure 20).

Option B

The northern paddock intersected an area with significant artefact scatters including some major quarry sites (eastern corner). In addition, there was a high density of scalds in the southern paddock of Option B which would be difficult to fence. There were also seven almost impassable tall dune crossings in the Option B paddocks (Figure 20).

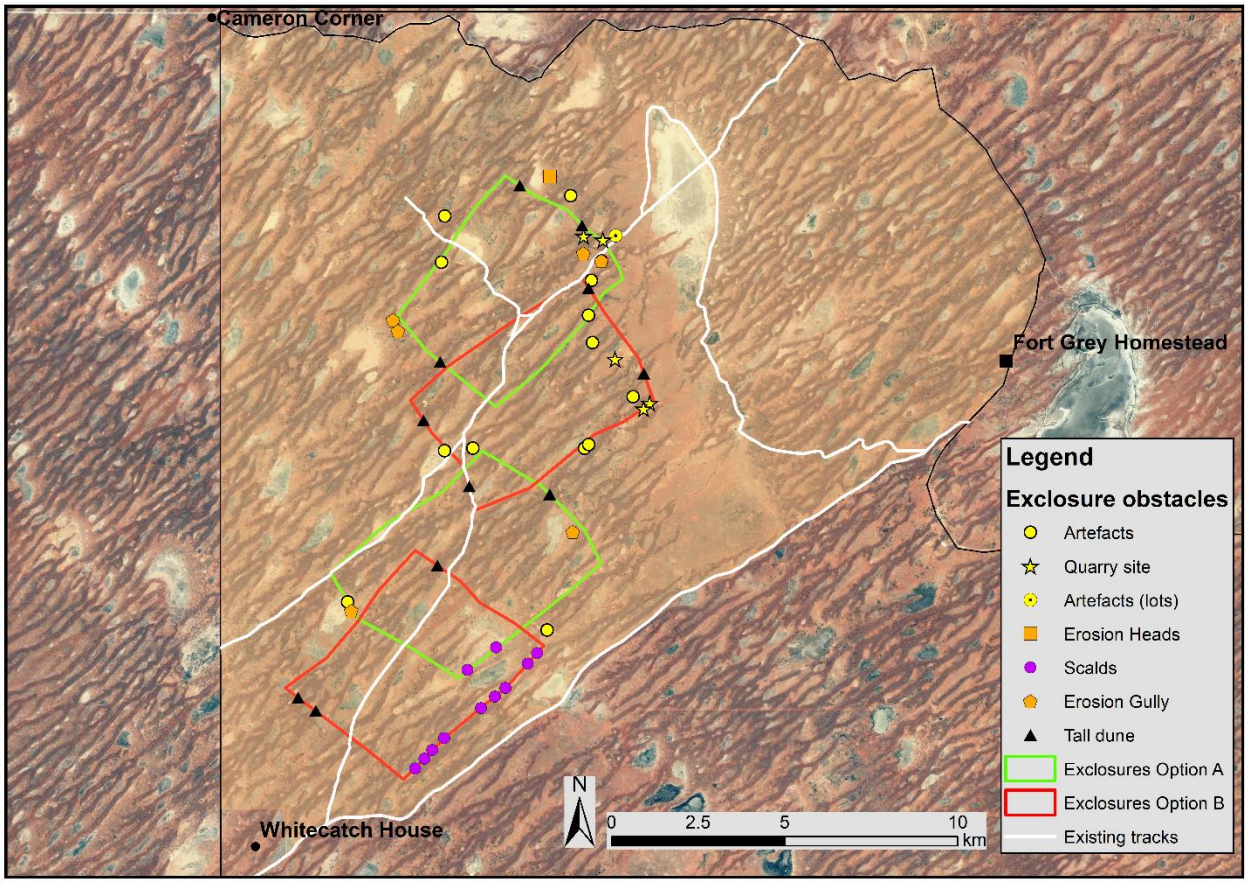

Figure 20: Results of initial survey to examine two possible placement options for the fenced exclosures

'Artefacts' refers to aboriginal stone artefacts; 'Quarry' refers to aboriginal silcrete quarries, the source **material for manufacture of stone artefacts.**

Based on the initial on-ground surveys, Option A was selected as the preferred option. A detailed refinement of the fence lines then followed over five additional surveys (Table 8).

Table 8: Details of the six surveys which took place to select the alignment for the infrastructure

Survey	Dates	Aim	Outcomes
1	21–25 November 2016	Explore two options (A and B) for fence placement within Sturt Service Site	Option A preferred
2	8–10 December 2016	Examine two fine-scale fence placement options for two exclosures in Option A configuration and wing fences	Southern exclosure version 3 completed Northern paddock requires further refinement to avoid obstacles Suitable wing fences located

Survey	Dates	Aim	Outcomes
3	16–18 January 2017	Place fence alignment points for southern exclosure	Completed southern exclosure version 4
4	6–9 February 2017	Determine fine-scale fence alignment for northern exclosure	New version completed which avoided majority of obstacles (Figure 21)
5	27 February – 3 March 2017	Place fence alignment points for northern exclosure and wing fences	Completed northern exclosure version 5. Completed wing fences version 2.
6	20–27 March 2017	Conduct Aboriginal cultural heritage surveys of fence placements and refine if necessary	Minor refinements made to fence lines

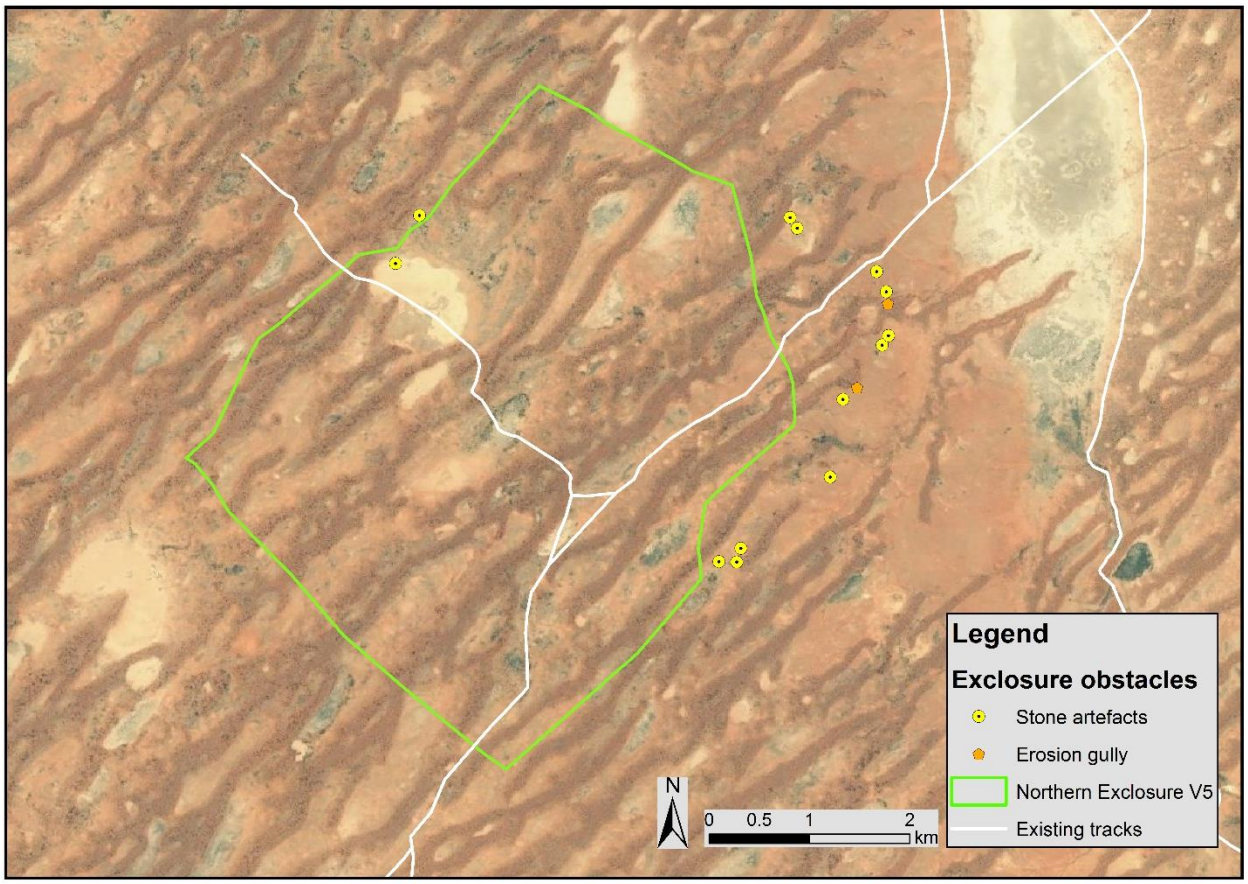

Figure 21: Results of survey 5 to refine the northern exclosure

The eastern corner contained an area of high artefact density and deep erosion gullies, so the fence line was rerouted to avoid them.

10.3. Justification for preferred option

Releases into feral-free exclosures are the only viable method for establishing the Sturt Species, as evidenced by the multiple failures of releases outside of such exclosures. The proposed fence alignment balances cultural heritage impact (see Appendix 3), environmental impact (vegetation clearance and avoidance of mature trees) and fence integrity (avoidance of tallest parts of dunes, scalded areas and swamps).

11. Description of the existing environment

11.1. Description of the existing environment

The project area (Sturt Service Site) is within Sturt National Park which covers 3253km^2 of the arid lands of western New South Wales. The Sturt Service Site is 350km^2 and situated in the west of the park where the dominant landscape feature in the area is parallel, vegetated and thus stabilised sand dunes up to 15m high which alternate with interdunal areas of varying width and character (Figure 22). The interdunal areas can be rocky plains, clay pans, swamps or a combination of the three (Figure 23). The site is currently heavily impacted by grazing of red kangaroos, with many Acacia shrubs demonstrating a browse line. Ground cover is sparse and cover of native grasses suppressed (Figure 24).

Figure 22: Sand dune area on the Kiwi Hut Road within the Sturt Service Site, overlooking the interdental swale area

Figure 23: Interdunal swale in the Sturt Service Site, with ground cover of ephemeral herbage (*Rhodanthe* spp. and *Sclerolaena* spp.) following spring and early summer rainfall

Figure 24: Typical interdunal swale in the Sturt Service Site, supporting only sparse herbage (mainly *Sclerolaena* spp.), following significant summer rainfall

11.2. Meteorological data

Rainfall statistics from the Fort Grey meteorological station (ID 046006; records 1899–2016) indicate an average annual rainfall of 175.8mm at the site with January and February the wettest months of the year. Temperature statistics are not available at Fort Grey so data from the Tibooburra Post Office station (ID 046037; records 1910–2016) 84km east was examined. Summer temperatures average 40°C, with February the hottest month on average, while winter temperatures are in the low 20s with July averaging the coolest month at 21.4°C (Figure 25). These data were taken from the Bureau of Meteorology website on 15 May 2017.

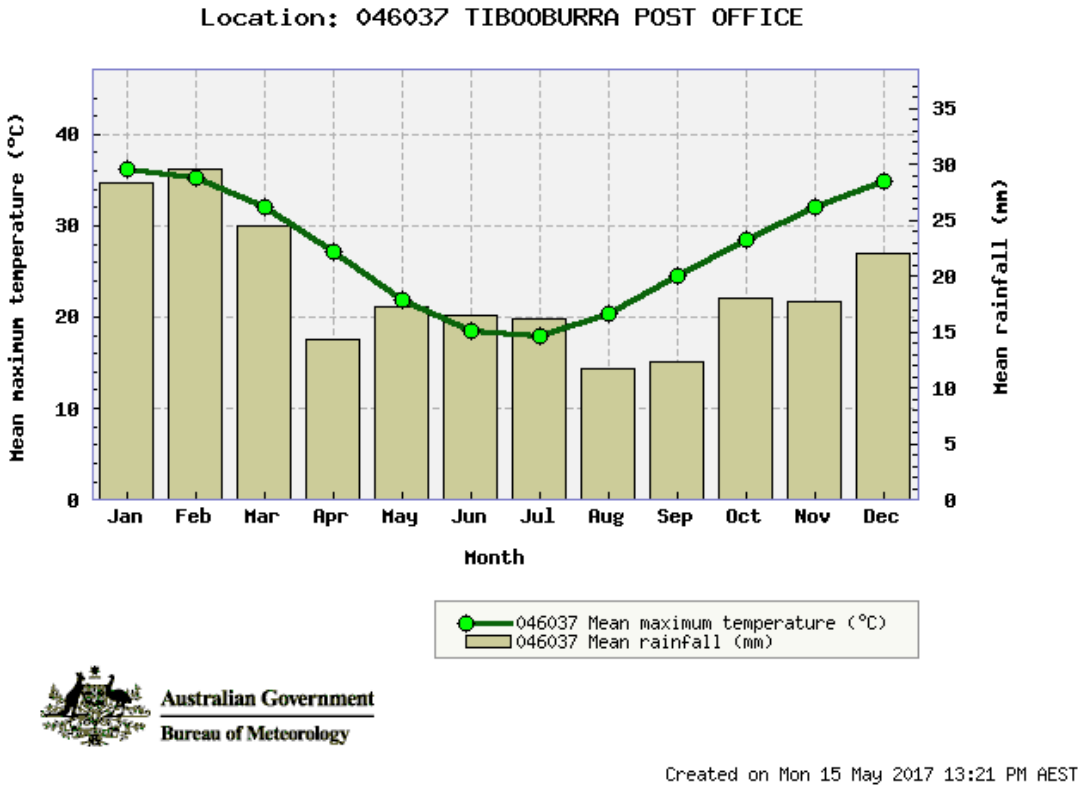

Figure 25: Climate statistics from the Tibooburra Post Office Station ID 046037

Source: Bureau of Meteorology

11.3. Topography

The project area is dominated by sand plains and red dunes averaging 10–15m in height. The dunes are vegetated and immobile. Associated interdunal features include small clay pans and run-on swamp areas.

11.4. Surrounding land uses

The land surrounding the project area is encompassed by Sturt National Park but is remote from visitor access. Surrounding properties include pastoral leases, with the nearest properties running sheep and cattle (including Lake Stewart and Waka stations, approximately 30km to the south of the project area). Areas to the north and west of the project area include large cattle grazing leases, including Ormicron Station in far south-west Queensland and Lindon Station in South Australia. Detailed discussions have been held with neighbouring landholders regarding the project's aims and objectives.

11.5. Geology and geomorphology

The project area is within the Simpson–Strzelecki Dunefields Bioregion. Four major land systems are present within the Sturt Service Site (Table 9, Figure 26) (Walker 1991).

Table 9: Description and geomorphology of the land systems present in the Sturt Service Site

Land system	Description	Geomorphology
Corner	High sand dunes alternating with scalded flats, in the far north-west corner	Dunes aligned NE; to 8km long and 500m apart; higher dunes with unstable crests; alluvial corridors with small pans; quaternary alluvium and aeolian sand
Pulgamurtie	Rolling stony uplands with breakaways, widely scattered through the Milparinka – Tibooburra – White Cliffs – Bulloo districts and south west to Corona	Silcrete-mantled undulating uplands; relief to 40m; incised dendritic drainage; weathered, flat-lying sandstone, conglomerate, and shale of Cretaceous (Rolling Downs Group) and Tertiary age, over weathered Precambrian shale (Wonominta Beds) in the south
Nundora	Stony plains with areas of low dunes, mainly west of Tibooburra but also north-west of White Cliffs	Gently undulating stony plains to 10km in extent, on steeply dipping Cretaceous sandstones and Precambrian shale (Wonominta Beds); partly overlain by parallel dune ridges of unconsolidated Quaternary sand, trending east-north-east; relief to 10m; sparse dendritic drainage
Fort Grey	Relict lakes and fringing lunettes in dune fields, mainly in the far north-west corner	Claypans or swamps forming local terminal or subterminal basins along ill-defined watercourses; margins severely scalded; lunettes poorly developed; Quaternary alluvium and aeolian sand

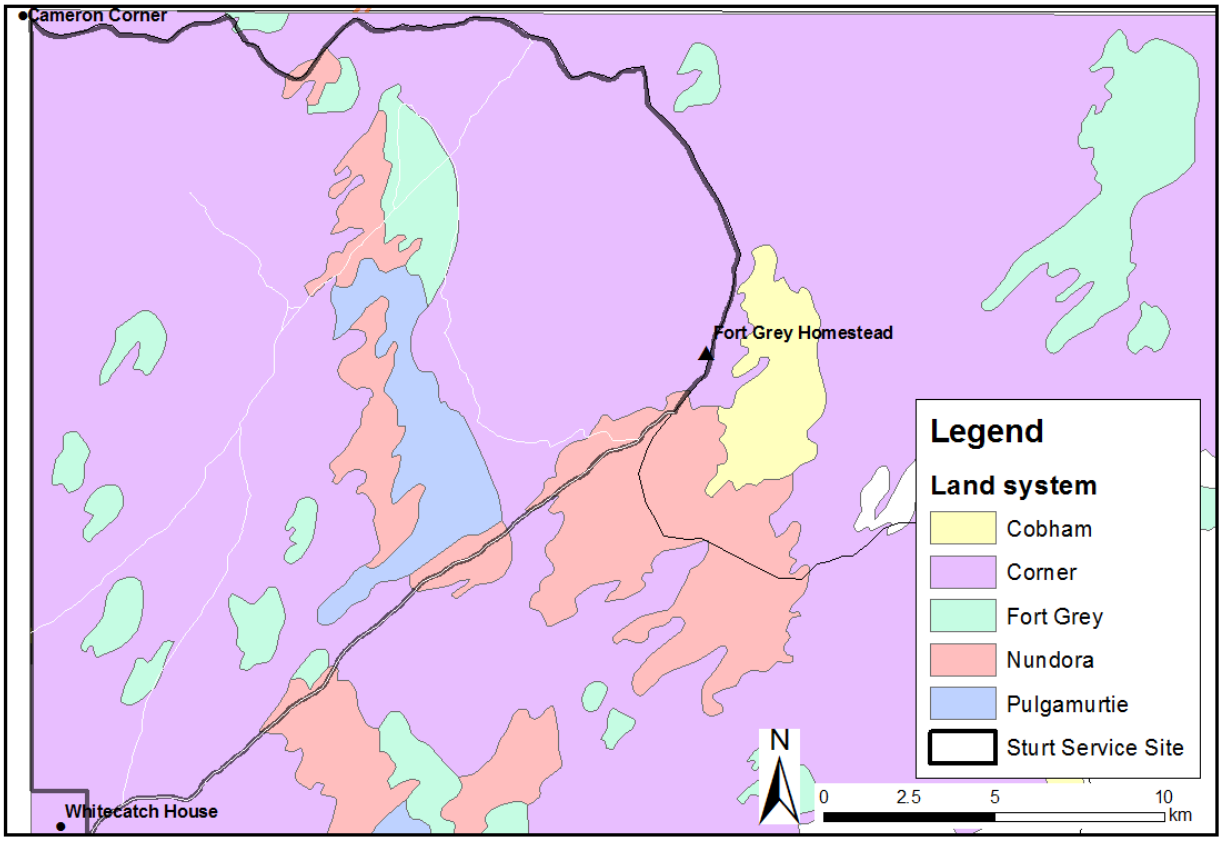

Figure 26: Map of the land systems within the Sturt Service Site

11.6. Soil types and properties

The soil types and properties for each of the land systems within the Sturt Service Site are provided in Table 10. The soils of the dune systems in the western section of the park are mainly red siliceous sands that have only limited soil profile development. Cracking brown and grey clays which retain moisture for longer occur in the drainage swales, along creeklines and in lake beds. All soils in the park are fragile, prone to erosion and generally poor in nutrients and other elements. Past agricultural practices such as grazing by introduced herbivores has contributed to large-scale scalding and gully erosion. Studies carried out within the park indicate that since the 1890s the area has lost approximately 20cm of topsoil and up to 2m in some areas (Fanning 1999). Several years of above-average rainfall are needed to support natural revegetation at erosion sites, making recovery slow and sporadic.

Table 10: Soil type and properties of the land systems within the Sturt Service Site

Land system	Soil type and properties
Corner	Red sands, sandy red earths and texture-contrast soils; prone to scalding and drift as result of dune activation
Pulgamurtie	Rolling uplands with lithosols, desert loam and red clay soils; prone to watersheeting with localised gullying
Nundora	Sandy and banded stony country with red earths, sands, desert loams and texture-contrast soils; prone to drift with dune activation; minor watersheeting

Land system	Soil type and properties
Fort Grey	Desert lake country with brown clay and texture contrast soils; subject to inundation following exceptionally heavy rainfall; negligible erosion with small areas of scalding and watersheeting

11.7. Waterways including wild and scenic rivers

There are no rivers running through the Sturt Service Site. The closest waterway is Fromes Creek which runs into Frome Swamp and then fills Lake Pinaroo (Figure 27).

11.8. Catchment values

There are a number of drainage areas throughout the Sturt Service Site (Figure 27).

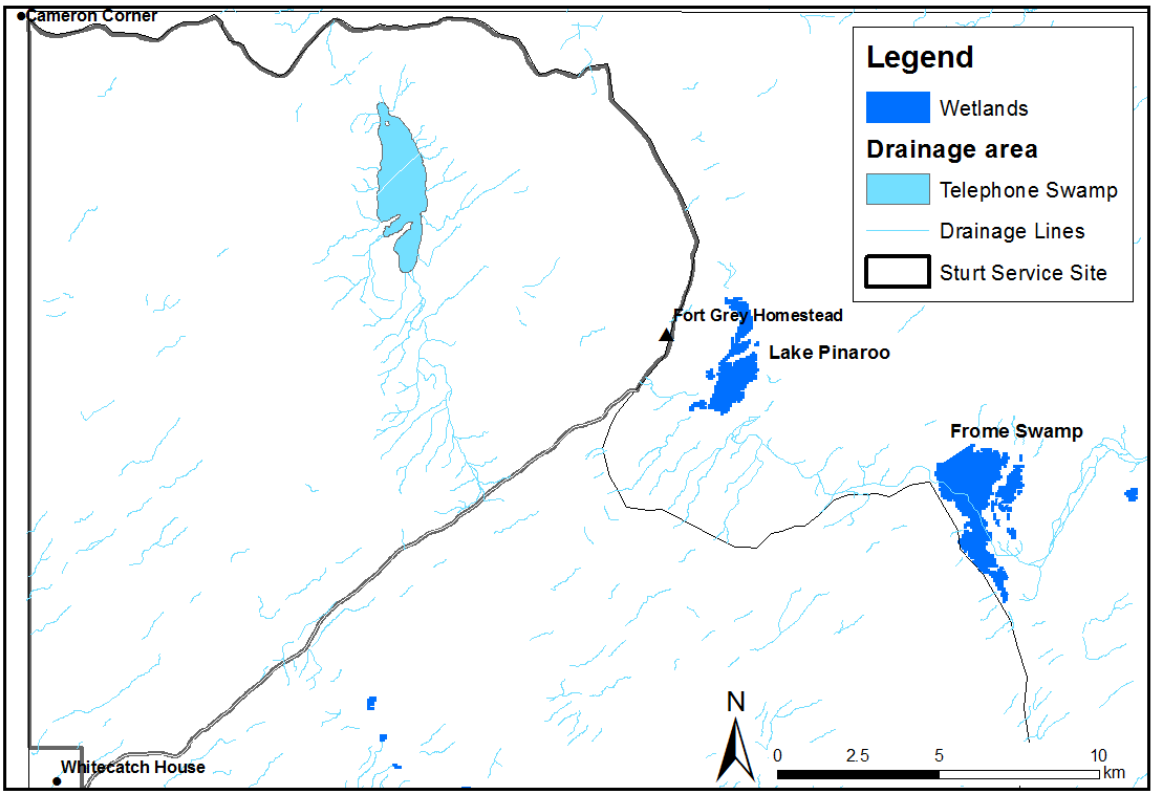

Figure 27: Wetlands and drainage areas within the Sturt Service Site with associated drainage lines

11.9. Coastal risk areas

Not applicable as the proposed site is not a coastal area or in proximity to any coastal areas.

11.10. Wetland communities including SEPP 14 wetlands

Lake Pinaroo (Fort Grey Basin) is listed as a Ramsar Wetland of International Importance and is 12km east of the exclosure locations and 2km east of the Fort Grey Homestead. The construction of the fence will not disrupt flow into this wetland so will have no negative consequences. As the site is located within Sturt National Park it is not subject to the provisions of SEPP 14 for coastal wetlands.

11.11. Plants

A comprehensive vegetation survey of the park has not been undertaken to date and there have been few botanical studies within the area (OEH 2017b). For the purposes of this REF the Wild Deserts team aimed to:

- describe the vegetation within the project area, including threatened species
- calculate the proportional area of the plant communities within each exclosure and across the Sturt Service Site
- calculate the area of each plant community that will be impacted during fence construction
- identify weeds present in the project area.

Vegetation surveys were conducted at two targeted time periods, June 2016 and March 2017, although searches for threatened plant species occurred opportunistically throughout the surveys for fence line selection (November 2016 to March 2017, see Section 10.2 for survey details). In the months before each targeted survey, the study area experienced above average to very much above average rainfall (Figure 28 and Figure 29). This provided excellent seasonal conditions for detecting plant species within the study area.

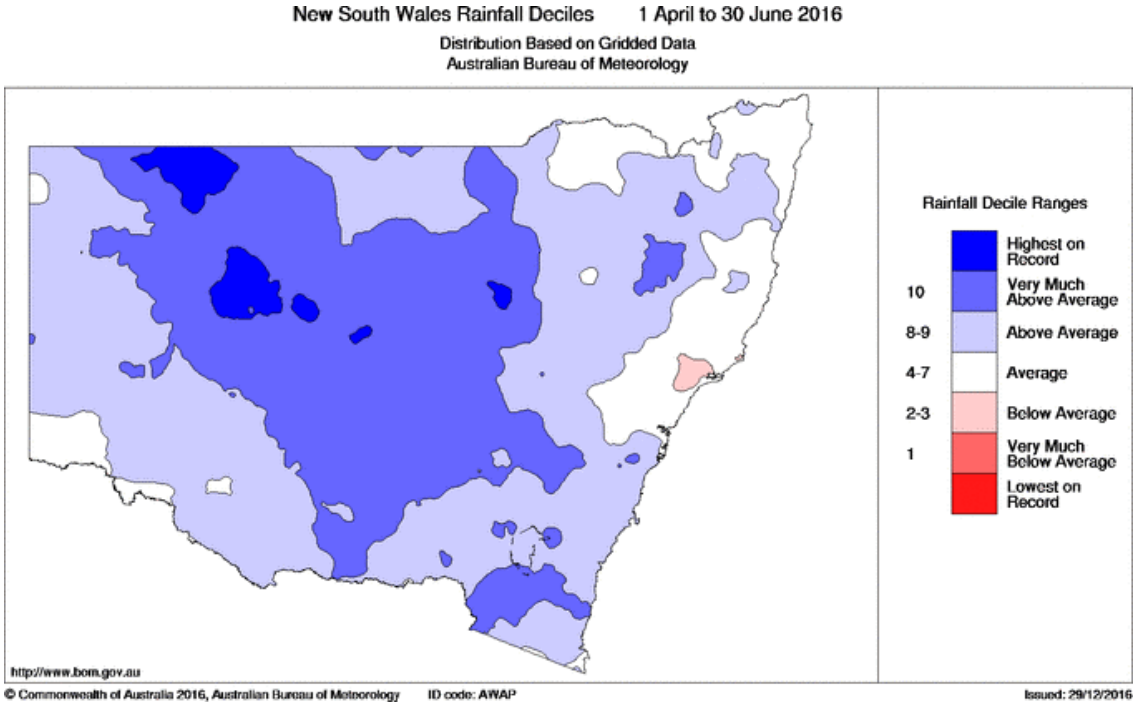

Figure 28: Rainfall deciles in the three months before the June 2016 plant survey

Source: Bureau of Meteorology

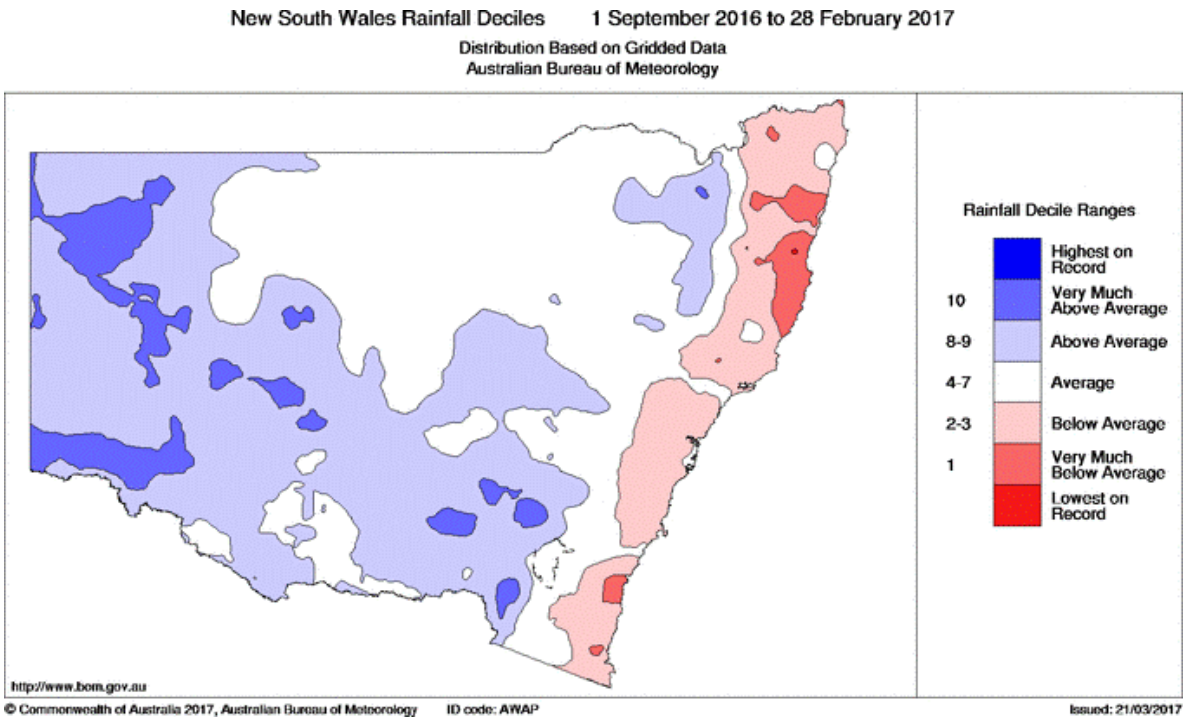

Figure 29: Rainfall deciles in the six months before the March 2017 plant survey

Source: Bureau of Meteorology

11.11.1. Native plant species

The Sturt Service Site, in the west of the park, is dominated by sand dunes and gibber plains. The sand dunes of the western half of the park are described in the Sturt National Park Draft Plan of Management (OEH 2017b) as supporting a perennial woodland community dominated by sandhill wattle (*Acacia ligulata*), mulga (*Acacia aneura*), belah (*Casuarina cristata*), needlewood (*Hakea leucoptera*), whitewood (*Atalaya hemiglauca*) and beefwood (*Grevillea striata*). These woodlands include a shrub layer principally of cassia (*Senna* spp.), turpentine bush (*Eremophila sturtii*) and narrow-leaved hop-bush (*Dodonaea* subsp. *angustissima*). A generally sparse ground layer includes poached egg daisies, copperburr (*Bassia* spp.) and wiregrasses (*Aristida* spp.*).* Areas between widely spaced sand dunes may comprise canegrass (*Eragrostis australasica*) / lignum (*Duma florenta*) swamp communities, with a variety of forbs and grasses, especially during wet years. The gibber plains support open chenopod shrublands. The dominant perennial species include saltbushes (*Atriplex* spp.*), bluebushes (Maireana* spp.) and copperburrs. In higher rainfall years, Mitchell grasses (*Astrebla* spp.), bluegrasses (*Bothriochloa* spp.) and lovegrasses (*Eragrostis* spp.) grow between the shrubs. The plains are generally treeless although some mulga occurs in scattered patches. Gilgais provide an important microhabitat and support distinct vegetation, including succulent herbs and small shrubs such as Warrigal greens (*Tetragonia tetragonioides*), twin leaf (*Zygophyllum* spp.) and crowfoot (*Erodium* spp.).

In June 2016, botanist Frank Hemmings, Curator of the John T Waterhouse Herbarium, UNSW and Charlotte Mills (Centre for Ecosystem Science, UNSW) conducted vegetation surveys at 30 sites throughout the Sturt Service Site (Figure 30) with the aim to build a herbarium and generate a plant list for the area. At each site, three 100m transects were conducted, one along the base of the dune, one along the middle of the dune and the third along the crest of the dune. Plant species identified during this survey are listed in Table 14.

A threatened species profile search on the OEH website revealed that 11 threatened plant species may occur within the Western Dunefields subregion; the New South Wales portion of the Simpson–Strzelecki Dunefields Bioregion (www.environment.nsw.gov.au/bioregions/Simpson-StrzeleckiDunefields-Climate.htm) (Table 15). Active searches for these species were undertaken by F Hemmings and C Mills at the 30 sites (June 2016, Figure 30) and R Pedler and R West along transects following the proposed lines of the fences and tracks (Figure 30) during the vegetation mapping project (see Section 11.11.2) but none were encountered. Previous records for two of the threatened plant species exist from within the project area: fleshy minuria (Kippistia suaedifolia) recorded in 2003 and Stackhousia clementii observed in 1992 (OEH 2017a), but there are no previous records for the remaining nine species. However, as possible habitat may occur for eight of these species, 7-part tests were conducted for 10 of the 11 threatened plant species (Appendix 4). The only species for which a 7-part test was not conducted is Grevillea kennedyana. This species is restricted to mesic slopes and so will not occur in the project area as there is no suitable habitat. It was therefore determined that the proposed activities would be unable to impact this threatened species within Sturt National Park.

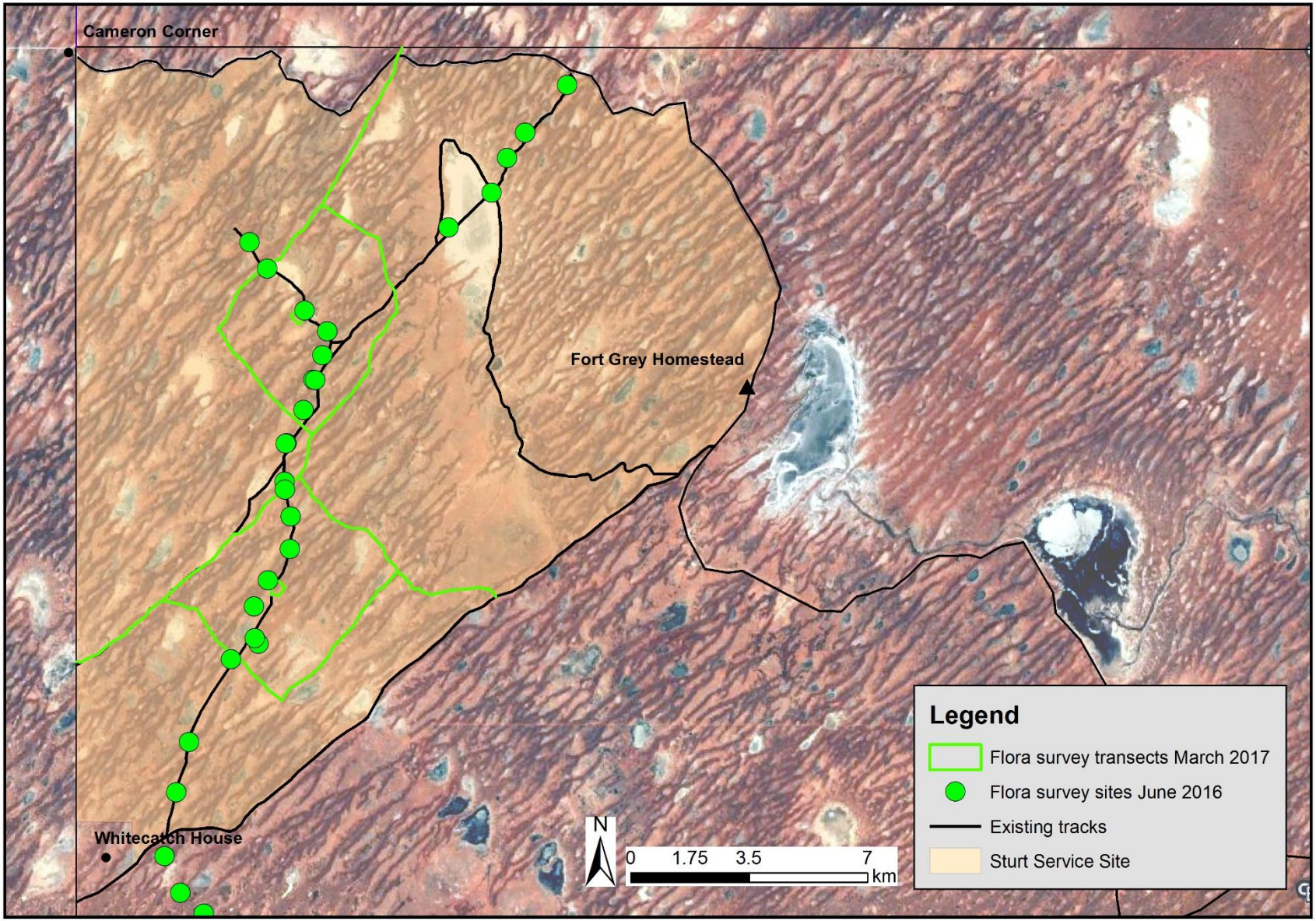

Figure 30: Location of plant surveys conducted within the Sturt Service Site for this REF

Table 11: List of plant species detected through surveys conducted by F Hemmings and C Mills within the Sturt Service Site

Abutilon otocarpum
Acacia aneura
Acacia murrayana
Acacia oswaldii
Acacia ramulosa
Acacia tetragonophylla
Alectryon oleifolius
Alternanthera angustifolia
Amaranthus grandiflorus
Amyema maidenii
Aristida contorta
Atriplex holocarpa
Atriplex limbata
Atriplex stipitata
Boerhavia dominii
Calotis erinacea
Calotis hispidula
Calotis plumulifera
Centipeda thespidioides
Crotalaria eremaea
Dactyloctenium radulans
Diplachne fusca subsp. *muelleri*
Dissocarpus paradoxus
Duma florulenta
Dysphania cristata
Einadia nutans
Enchylaena tomentosa
Enneapogon avenaceus
Eragrostis australasica
Eragrostis dielsii
Eragrostis setifolia
Eremophila duttonii
Eremophila glabra subsp. *glabra*
Eremophila longifolia
Eriochloa australiensis
Erodium aureum
Erodium crinitum
Euphorbia drummondii
Euphorbia eremophila
Fimbristylis dichotoma
Glycine canescens
Glycyrrhiza acanthocarpa
Gnephosis eriocarpa
Goodenia cycloptera
Goodenia lunata
Grevillea stenobotrya
Grevillea striata
Gunniopsis quadrifida
Hakea eyreana
Hakea leucoptera
Harmsiodoxa blennodioides
Hibiscus krichauffianus
Hypochaeris radicata
Indigofera psammophila
Lechenaultia divaricata
Lepidium oxytrichum
Lepidium phlebopetalum
Maireana aphylla
Maireana astrotricha
Maireana coronata
Maireana pyramidata
Maireana spongiocarpa
Minuria denticulata
Ophioglossum polyhyllum
Osteocarpum acropterum
Panicum decompositum
Paractaenum refractum
Phlegmatospermum cochlearinum
Phyllanthus fuernrohrii
Pimelea simplex
Plantago drummondii
Pluchea tetranthera
Portulaca oleracea
Pterocaulon sphacelatum
Ptilotus lanicuspus
Rhagodia spinescens
Rhodanthe floribunda
Rhodanthe microglossa
Rhodanthe moschata
Salsola australis
Sauropus trachyspermus
Scaevola spinescens
Sclerolaena diacantha
Sclerolaena eriacantha
Sclerolaena ventricosa
Senecio glossanthus
Senecio gregorii
Senecio lanibracterus
Senecio productus var. *productus*
Senna artemisioides subsp. *alicia*
Senna artemisioides subsp. *coriacea*
Senna artemisioides subsp. *filifolia*
Senna artemisioides subsp. *sturtii*
Senna artemisioides subsp. *zygophylla*
Senna peurocarpa
Sida ammophila
Sida filiformis
Solanum ellipticum
Solanum esuriale
Solanum oligacanthum
Sporobolus actinobolus
Stenopetalum lineare
Swainsona oliveri
Tephrosia sphaerospora
Tetragonia eremaea
Teucrium racemosum
Trachymene glaucifolia
Tragus australianus
Trianthema triquetra
Triglochin calcitrapa
Tripogon loliiformis
Triraphis mollis
Zygochloa paradoxa
Zygophyllum howittii
Zygophyllum simile

Table 12: Threatened plant species known and predicted to occur in the Simpson–Strzelecki Dunefields Bioregion

Common name	Scientific name	NSW status	Occurrence in SNP	Identified during surveys for this REF	7-part test?
Purple-wood wattle	*Acacia carneorum*	Vulnerable	Predicted	N	Y
	Atriplex infrequens	Vulnerable	Predicted	N	Y
Green bird flower	*Crotalaria cunninghamii*	Endangered	Known	N	Y
Perennial forb	*Dipteracanthus australasicus* subsp. *corynothecus*	Endangered	Known	N	Y
Prostrate forb	*Dysphania platycarpa*	Endangered	Predicted	N	Y
Flame spider flower	*Grevillea kennedyana*	Vulnerable	Known	N	No – confined to mesic slopes, no suitable habitat within project area
Silky cow-vine	*Ipomoea polymorpha*	Endangered	Known	N	Y
Fleshy minuria	*Kippistia suaedifolia*	Endangered	Known	N	Y
	Polycarpaea spirostylis subsp. *glabra*	Endangered	Predicted	N	Y
Fan flower	*Scaevola collaris*	Endangered	Predicted	N	Y
	Stackhousia clementii	Endangered	Known	N	Y

11.11.2. Vegetation mapping project

A five-day field survey was conducted in March 2017 to map the vegetation within the project area, using the NSW Master Plant Community Type Classification (PCT) System. This system has been established as the NSW standard community level vegetation classification for use in site-based planning processes and standardised vegetation mapping. The PCT system has been constructed by integrating two existing vegetation classification databases: the NSW Vegetation Classification and Assessment Database developed by the Royal Botanic Gardens and Domain Trust; and the Over-cleared BioMetric Vegetation Types Database developed for and used for the NSW Property Vegetation Planning System and BioBanking assessment processes.

The online NSW Vegetation Information System (VIS) was used to search for all PCTs within Sturt National Park which returned 163 results. Using these search results, R Pedler and R West then surveyed each swale and dune within the two exclosure boundaries, a 200m corridor along the perimeter of each exclosure (100m either side of proposed fence), the

proposed all-weather access track and a 200m corridor along the three wing fences to identify the PCTs present and their extent within the survey area.

Survey results were mapped in ArcMap (Figure 31) and used to calculate the proportional area of each PCT in the project area. These proportions were used to estimate the area of each PCT across the Sturt Service Site. The intersect feature within ArcMap was used to calculate the total area of each PCT within each exclosure. To calculate the area of each PCT which would be cleared for fence construction, the plant communities along the 8m easement for the fence were examined. The length of perimeter fence that would pass through each PCT was calculated and multiplied by 8m to give an approximate area of total clearance for each PCT. The area of clearance for each PCT was compared to the total estimated area of each PCT across the Sturt Service Site.

A total of 10,543ha of vegetation was mapped within the study site. The surveys detected 14 PCTs within the project area (Table 14) and areas of claypan which were not vegetated. Total areas covered by each PCT are displayed in Table 13. We used the proportional representation of each PCT to estimate the area of each PCT across the Sturt Service Site as it was not feasible to map the entire area of the Sturt Service Site (34,138 ha). However, examination of aerial imagery and on-ground observations suggest this is a reasonable assumption.

Table 13: Area of each plant community type (PCT) within the study site and an estimate of occurrence across the Sturt Service Site

PCT ID	Common name	Total hectares in study site	Proportion of study site	Estimated hectares in Sturt Service Site
n/a	Claypan	173	0.02	560
24	Canegrass swamp	199	0.02	644
62	Samphire shrubland	7	0.00	22
63	Spiny lignum forbland	394	0.04	1,275
119	Sandplain mulga shrubland	350	0.03	1,133
124	Sandhill wattle shrubland	3,967	0.38	12,845
137	Whitewood woodland	28	0.00	90
149	Neverfail grassland	332	0.03	1,075
150	Bottlewasher – copperburr grassland	2,132	0.20	6,903
153	Black bluebush shrubland	69	0.01	223
161	Golden goosefoot shrubland	179	0.02	579
162	Sturts pigface forbland	180	0.02	582
222	Low bluebush shrubland	750	0.07	2,428
224	Cotton bush shrubland	244	0.02	790
232	Senna – mulga – needlewood shrubland	1,539	0.15	4,983
Totals		10,543		34,132

Table 14: Plant community types (PCT) identified within the Wild Deserts project area

PCT ID	Common name (community)	Scientific name (taxon)
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	*Eragrostis australasica, Muehlenbeckia flourulenta, Sclerostegia tenuis/Chloris truncata, Disphyma crassifolium subsp. clavellatum, Eragrostis setifolia, Marsilea drummondii*
62	Samphire saline shrubland/forbland wetland of lake beds and lake margin in the arid and semi-arid (hot) zones	*Tecticornia halocnemoides, Tecticornia pergranualta, Maireana appressa, Atriplex holocarpa/Portulaca filifolia, Trianthema triquetra, Glinus orygoides, Stemodia florulenta*
63	Spiny lignum – slender glasswort open forbland saline wetland on lake edges in the semi-arid and arid climate zones	*Muehlenbeckia horrida, Sclerostegia tenuis/ Atriplex lindleyi, Atriplex leptocarpa, Sclerolaena divariacata/Osteocarpum acropterum var. deminuta, Vittadinia cuneate, Erodium crinitum*
119	Sandplain mulga tall shrubland – open shrubland of the semi-arid and arid climate zones	*Acacia aneura, Casuarina pauper/Senna form taxon ártemesioides', Acacia ligulata, Eremophila sturtii/Aristida jerichoensis, Aristida contorta, Eragrostis eriopoda*
124	Sandhill wattle open shrubland on sand ridges mainly in the arid zone	*Acacia ligulata, Acacia aneura, Dodonaea viscosa, Polycalymma stuartii, Enneapogon cylindricus, Aristida contorta, Salsola tragus*
137	Whitewood – western rosewood low woodland of the NSW north western plains	*Atalaya hemiglauca, Alectryon oleifolius, Acacia aneura, Eremophila duttonii, Eremophila deserti/Enneapogon avenaceus, Aristida contorta, Scleolaena birchii*
149	Neverfail grass – ephemeral herbaceous grassland forbland of interdune claypans mainly in the arid climate zone	*Eragrostis setifolia, Sclerolaena bicornis, Atriplex spongiosa, Osteocarpum acropterum, Marsilea drummondii, Rhodanthe floribunda*
150	Bottlewasher – copperburr grassland of the arid zone	*Enneapogon cylindricus, Enneapogon avenaceus, Dissocarpus paradoxus, Scleroleana obliquicuspis*
153	Black bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	*Maireana pyramidata, Rhagodia spinescens, Maireana georgei, Atriplex vesicaria/ Scleroleana obliquicuspis, Enchylaena tomentosa, Austrostipa nitida, Calotis hispidula*
161	Golden goosefoot shrubland wetland in swamps of the arid and semi-arid (hot summer) zones	*Chenopodium auricomum*, *Muehlenbeckia flourulenta, Eragrostis australasica/ Eragrostis setifolia, Astrebla lappacea, Atriplex holocarpa, Salsola tragus*
162	Sturts pigface sparse forbland of saline soils of the arid zone	*Gunniopsis quadrifida, Enneapogon avenaceus, Aristida contorta, Sclerolaena decurrens*
222	Low bluebush – bladder saltbush open shrubland of the arid zone	*Maireana astrotricha, Atriplex vesicaria, Maireana pyramidata/Enneapogon nigricans, Scleolaena diacantha, Sclerolaena obliquicuspis, Aristida contorta*

PCT ID	Common name (community)	Scientific name (taxon)
224	Cotton bush – copperburr open shrubland of the arid climate zone	*Maireana aphylla/Enneapogon avenaceus, Eragrostis setifolia, Sclerolaena diacantha, Sclerolaena brachyptera*
232	Senna – mulga – needlewood open shrubland on loam-clay soils in swales and on the edges of claypans in the arid zone	*Senna form taxon 'sturtii', Senna form taxon 'filifolia', Acacia aneura s. lat, Hakea leucoptera, Sclerolaena lanicuspis, Ptilotus polystachyus/Sporobolus actinocladus, Tetragonia eremaea*

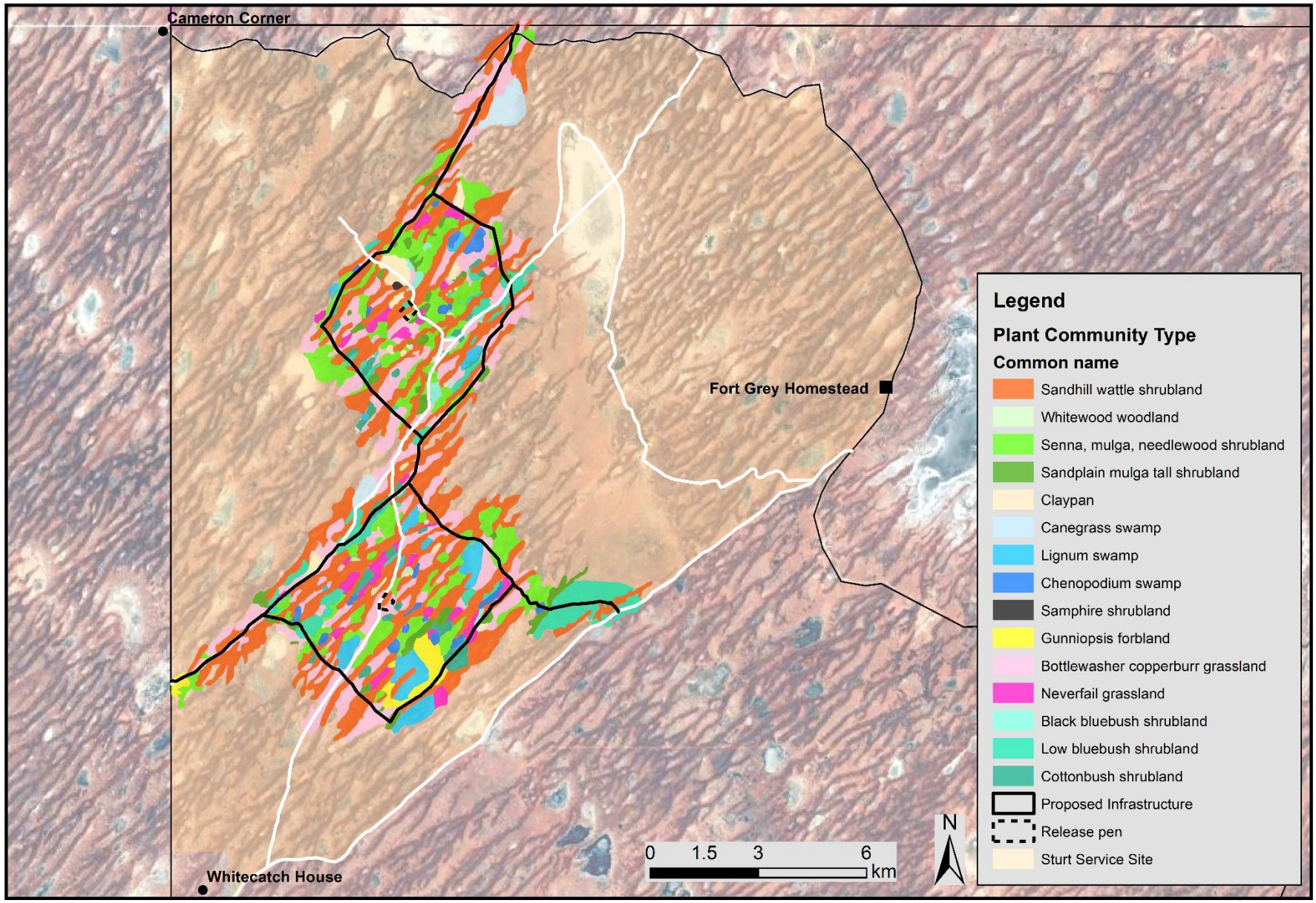

Figure 31: Area of the Sturt Service Site which was mapped for this REF and the plant community types present

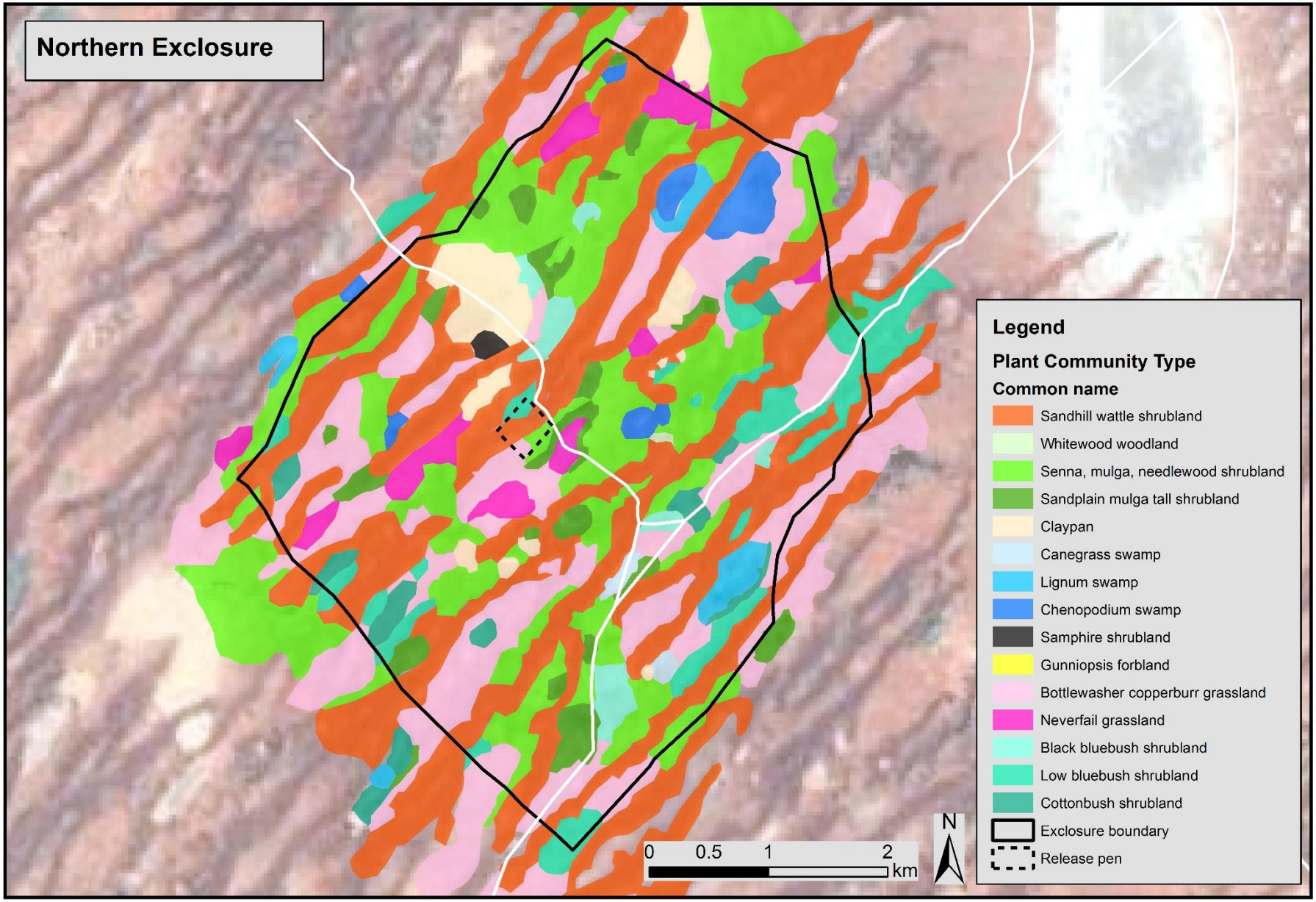

Figure 32: Plant communities observed within the proposed northern exclosure

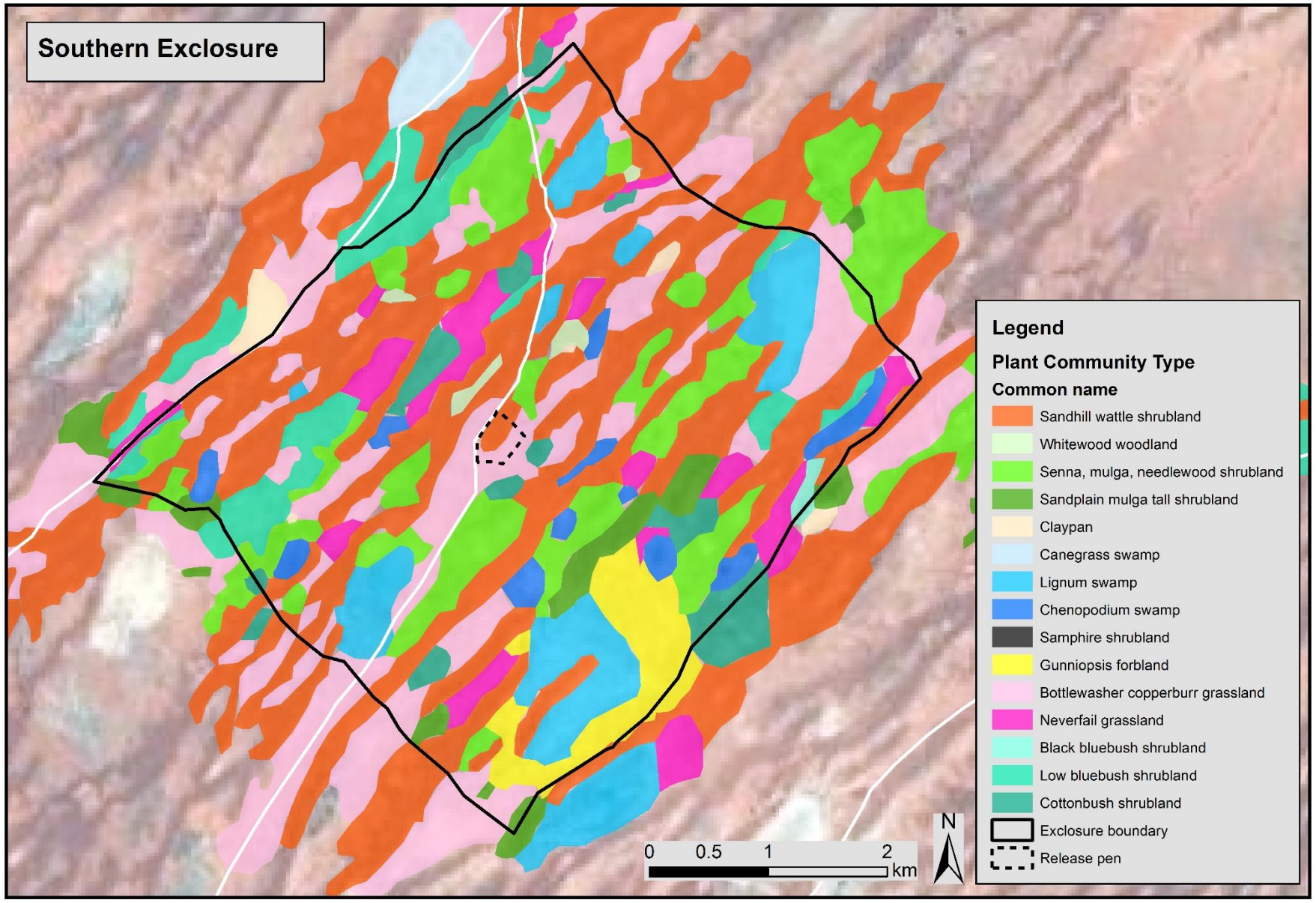

Figure 33: Plant communities observed within the proposed southern exclosure

The two exclosures will enclose similar proportions of each PCT (Table 15, Figure 32, Figure 33), providing a variety of habitats for the reintroduced mammals.

Table 15: Plant community types (PCT) by area within the proposed northern and southern exclosures

		Northern exclosure		Southern exclosure	
PCT	**Common name**	**Area (ha)**	**Percentage of total area**	**Area (ha)**	**Percentage of total area**
n/a	Claypan	83.9	4.05	6.63	0.30
24	Canegrass swamp	9.8	0.47	0	0.00
62	Samphire shrubland	5.1	0.25	0	0.00
63	Spiny lignum forbland	27.9	1.35	206.85	9.25
119	Sandplain mulga shrubland	99.69	4.81	60.16	2.69
124	Sandhill wattle shrubland	725.29	35.01	761.82	34.06
137	Whitewood woodland	1.49	0.07	17.16	0.77
149	Neverfail grassland	77.66	3.75	132.00	5.90
150	Bottlewasher – copperburr grassland	385.09	18.59	340.35	15.22
153	Black bluebush shrubland	44.15	2.13	6.28	0.28
161	Golden goosefoot shrubland	50.88	2.46	76.99	3.44
162	Sturts pigface forbland	0.00	0.00	106.68	4.77
222	Low bluebush shrubland	103.81	5.01	120.08	5.37
224	Cotton bush shrubland	48.13	2.32	79.92	3.57
232	Senna – mulga – needlewood shrubland	408.97	19.74	321.51	14.38
Totals		2072		2236	

The total hectares of vegetation to be cleared by each infrastructure feature is displayed in Table 16. Plant community types 149 and 150 currently only support annual herbage and so will not need to be cleared to construct the fence lines. This therefore brings the total clearance footprint to 25.7ha, which is 0.08 % of the area of the Sturt Service Site.

Table 16: The clearance area (ha) of each plant community type (PCT) required to establish each infrastructure feature, as a percentage of the available area of that PCT within the Sturt Service Site

***Totals hectares in parentheses are plant community types where grading will not disturb vegetation and only result in ground disturbance. Total ground disturbance is depicted in parentheses at the bottom of the column.**

PCT ID	Community common name	Hectares to be cleared by feature					Total (ha)	Ha in Sturt Service Site	Clearance % of Sturt Service Site
		Exclosures	Wing fences	All-weather access track	Borrow pits	Temporary storage areas			
119	Sandplain mulga shrubland	1.8	0.0	0.1	0.0	0.0	1.9	1,133	0.17
124	Sandhill wattle shrubland	8.4	1.2	0.4	0.0	0.0	10.0	12,845	0.08
149	Neverfail grassland	*1.4*	*0.0*	*0.0*	*0.0*	*0.0*	(1.4)*	*1,075*	*0.13*
150	Bottlewasher – Copperburr grassland	*8.5*	*5.4*	*0.2*	*0.8*	*4.4*	(19.2)*	*6,903*	*0.28*
153	Black bluebush shrubland	0.2	0.0	0.0	0.0	0.0	0.2	223	0.10
161	Golden goosefoot shrubland	0.2	0.0	0.2	0.0	0.0	0.3	580	0.06
162	Sturts pigface forbland	1.2	0.3	0.0	0.0	0.0	1.5	583	0.26
222	Low bluebush shrubland	2.6	0.2	1.4	0.0	0.0	4.2	2,428	0.17
224	Cotton bush shrubland	1.8	0.0	0.0	0.0	0.0	1.8	790	0.23
232	Senna mulga needlewood shrubland	4.5	0.8	0.5	0.0	0.0	5.8	4,983	0.12
Totals		30.6	7.9	2.8	0.8	4.4	25.7 (46.3)*	31,543	

11.11.3. Introduced plants

Eight introduced plant species (weeds) are identified as occurring within Sturt National Park (Table 17) (OEH 2017b), with a ninth species (Buffel grass, *Cenchrus ciliaris*) detected during work within the Sturt Service Site.

Table 17: Introduced plant (weed) species identified to occur within Sturt National Park and whether they were located within the Sturt Service Site

Common name	Scientific name	Comment	Found in Sturt Service Site
Noogoora burr	*Xanthium occidentale*	Scattered infestations, mainly in watercourses, outside the Sturt Service Site. Highly invasive weed. Competes against all native grass species. Has potential to create monocultures	Y
Paterson's curse	*Echium plantagineum*	Scattered infestation. Competes with all native grass species	N
Bathurst burr	*Xanthium spinosum*	Scattered infestation. Invasive agricultural weed of disturbed areas	N
Saffron thistle	*Carthamus lanatus*	Scattered infestations along roadsides	N
Athel pine	*Tamarix aphylla*	Isolated infestation. Potentials to invade sandy areas adjacent to creek lines. Outcompetes native vegetation	N
Mexican poppy	*Argemone ochroleuca*	Scattered infestations. Competes with native species. Can create monocultures	N
African boxthorn	*Lycium ferocissimum*	Isolated infestations. Provides cover for feral pigs and rabbits. Competes with native species. Has potential to create monocultures and impede wildlife	N
Tobacco bush	*Solanum mauritianum*	Isolated infestation. Competes with native species	N
Buffel grass	*Cenchrus cilliaris*	Scattered infestations. Highly invasive, with potential to increase fire intensity and frequency, affecting long-lived perennials.	N (near boundary)

None of the introduced plant species were observed along survey routes for the proposed infrastructure. However, Noogoora burr was detected on Dunes Scenic Drive (northern boundary of the Sturt Service Site) and buffel grass (*Cenchrus ciliaris*) was detected just outside the Sturt Service Site, south of Whitecatch Road. Buffel grass has been nominated as a key threatening process under the EPBC Act (DoE 2015) due to its ability to outcompete native grasses, creating monocultures and fuelling wild fires (Miller et al. 2010). Although not listed within New South Wales its potential establishment presents a threat to biodiversity within the national park.

11.12. Animals

A number of comprehensive animal surveys have taken place within the Sturt Service Site in the past ten years. Small mammal and reptile abundances have been examined through a PhD study (Klöcker 2006), and UNSW has conducted mammal and reptile trapping, spotlight surveys, camera trapping and bird surveys several times each year since June 2012 (Gordon et al. 2017; Letnic et al. 2016; Morris & Letnic 2017). The results of these studies were combined with targeted bird surveys and spotlight counts to describe the animals of the existing environment.

11.12.1. Native animals

The locations of two previous surveys for small mammals and reptiles within the Sturt Service Site are shown in Figure 34. 'Klocker' survey sites are those used during U Klocker's PhD research (Klöcker 2006). 'Letnic' refers to sites used by Associate Professor M Letnic from UNSW which have been trapped three times a year since June 2012 (data included up to November 2016). The combined survey efforts total 10,974 trap nights within the Sturt Service Site (Klocker 6048 trap nights, Letnic 4926 trap nights). A total of 7 mammal species and 26 reptile species have been recorded (Table 18). Capture rates within the Sturt Service Site are generally low suggesting the abundances of each species are low across the site.

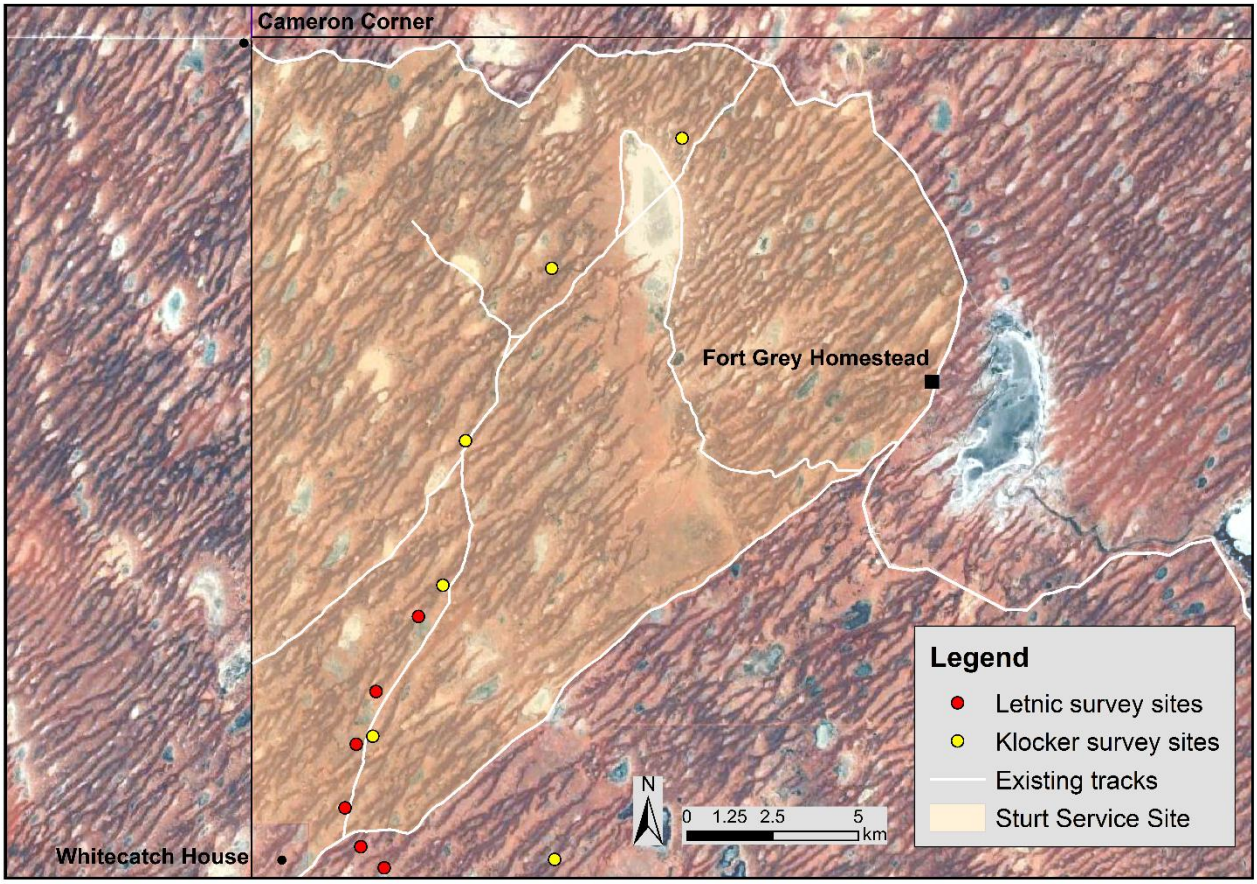

Figure 34: Map of previous pitfall survey sites within the Sturt Service Site for which data was used in the preparation of this REF

Table 18: Results of two previous small mammal and reptile surveys within the Sturt Service Site by Ulrike Klocker and Mike Letnic

'Present' indicates the species was not caught in traps but was observed at the site during trapping. Species highlighted in bold are listed threatened species in New South Wales and dealt with in Section 14.

		Klocker			Letnic		
Group	**Species**	**Number trapped**	**Capture rate**	**% total captures**	**Number trapped**	**Capture rate**	**% total captures**
Mammals	***Leggadina forresti***	1	0.0002	1.41	0	-	-
	Mus musculus	47	0.0078	66.20	0	-	-
	Notomys fuscus	1	0.0002	1.41	15	0.0030	83.33

		Klocker			Letnic		
Group	**Species**	**Number trapped**	**Capture rate**	**% total captures**	**Number trapped**	**Capture rate**	**% total captures**
	Pseudomys hermannsburgensis	17	0.0028	23.94	1	0.0002	5.56
	Pseudomys desertor	0	-	-	1	0.0002	5.56
	Sminthopsis crassicaudata	5	0.0008	7.04	0	-	-
	Sminthopsis macroura	0	-	-	1	0.0002	5.56
Reptiles	*Ctenophorus fordi*	49	0.0081	4.23	0	-	-
	Ctenophorus nuchalis	28	0.0046	2.42	1	0.0002	0.46
	Ctenophorus pictus	181	0.0299	15.62	3	0.0006	1.39
	Ctenotus regius	12	0.0020	1.04	5	0.0010	2.31
	Ctenotus schomburgkii	208	0.0344	17.95	10	0.0020	4.63
	Ctenotus taeniatus (brooksi)	323	0.0534	27.87	29	0.0059	13.43
	Diplodactylus tessellatus	0	-	-	1	0.0002	0.46
	Eremiascincus fasciolatus	40	0.0066	3.45	6	0.0012	2.78
	Gehyra variegata	2	0.0003	0.17	Present	-	-
	Heteronotia binoei	15	0.0025	1.29	Present	-	-
	Lerista aericeps	1	0.0002	0.09	0	-	-
	Lerista labialis	58	0.0096	5.00	52	0.0106	24.07
	Lerista xanthura	0	-	-	2	0.0004	0.93
	Lucasium byrnei	2	0.0003	0.17	0	-	-
	Lucasium damaeum	153	0.0253	13.20	59	0.0120	27.31
	Lucasium stenodactylum	5	0.0008	0.43	1	0.0002	0.46
	Menetia greyii	4	0.0007	0.35	44	0.0089	20.37
	Morethia adelaidensis	1	0.0002	0.09	0	-	-
	Nephrurus levis	31	0.0051	2.67	0	-	-
	Pogona vitticeps	8	0.0013	0.69	1	0.0002	0.46
	Pygopus nigriceps	0	-	-	1	0.0002	0.46
	Ramphotyphlops (Anilios) endoterus	0	-	-	1	0.0002	0.46
	Rhynchoedura ornata	31	0.0051	2.67	Present	-	-
	Strophurus ciliaris	0	-	-	1	0.0002	0.46
	Tiliqua rugosa	0	-	-	Present	-	-
	Varanus gouldii	7	0.0012	0.60	Present	-	-

A total of nine threatened animal species were detected during surveys within the Sturt Service Site (Table 18). A threatened species profile search on the OEH website revealed that an additional 26 threatened animal species may occur within the Western Dunefields subregion of the Simpson–Strzelecki Dunefields Bioregion (Appendix 4, Table 1). In addition, the plains mouse (*Pseudomys australis*) was recently rediscovered in New South Wales on Fowlers Gap Station (~300km south of the project area). Although not listed within the subregion at present, it is predicted to occur within the project area, giving a total of 36 threatened animal species that may occur within the area. Seven-part tests were conducted for 31 of the 36 threatened species as there is no suitable habitat for 5 of the species predicted to occur in the subregion (see Table 1, Appendix 4 for rationale). Appendix 4 details the results of the 31 7-part tests for threatened animals. The tests concluded the proposed activities would not significantly impact any threatened animals in the project area but rather be likely to provide significant positive benefits contributing to the recovery of the species (see Appendix 4 for further details).

Spotlighting counts were conducted on five nights from November 2016 to May 2017 to gain estimates of macropod and predator densities within the Sturt Service Site (predators are reported in Section 11.12.2). Four transects were counted within the Sturt Service Site (Figure 35). All transects were counted on the same night from the left-hand side of the vehicle while travelling in a southerly direction along each track. Estimates of density per square kilometre of each species were calculated based on the assumptions that kangaroos, cats, foxes and pigs could be accurately identified and counted within 100m of the vehicle, rabbits within 50m of the vehicle and hopping mice within 20m of the vehicle.

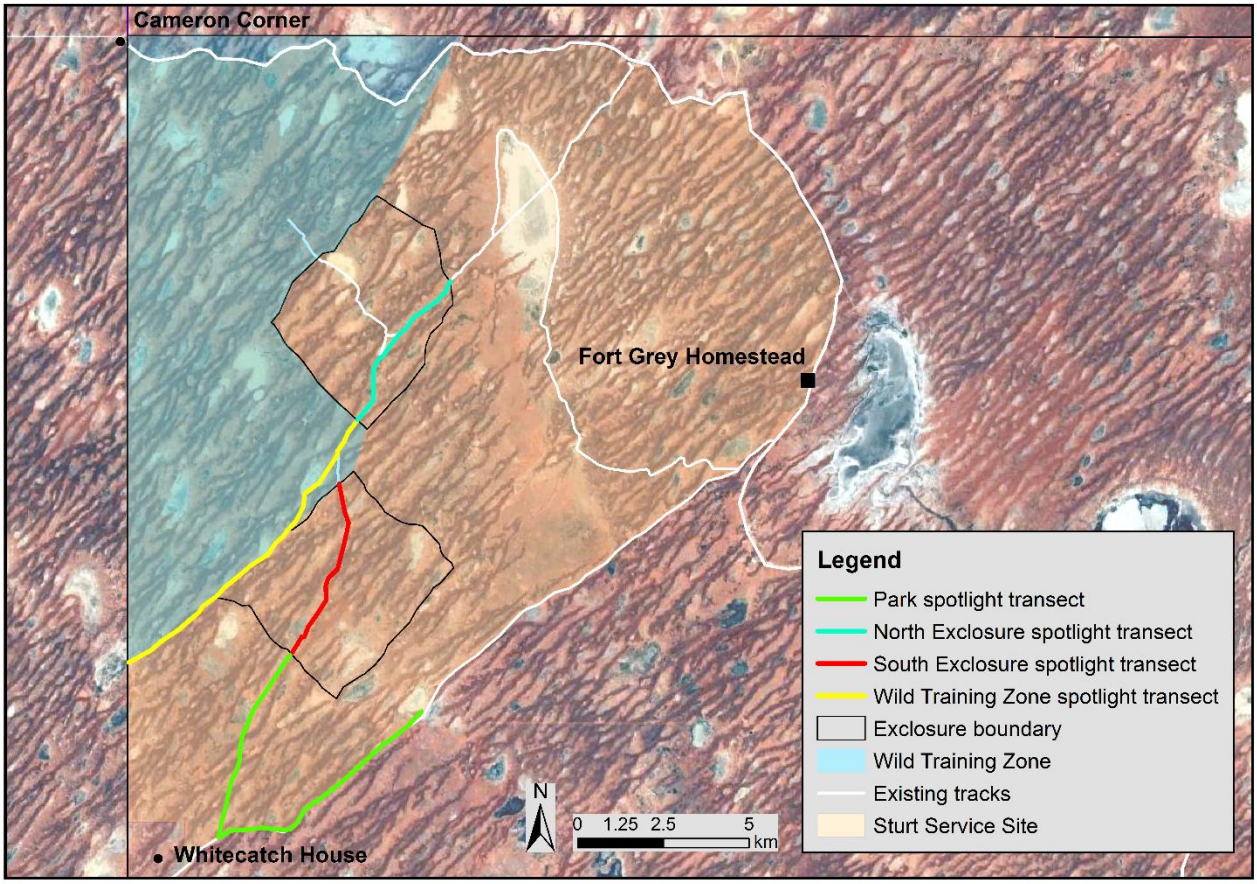

Figure 35: Locations of spotlight transects within the Sturt Service Site

Only red kangaroos (*Macropus rufus*) were observed on nocturnal spotlight counts although small numbers of western grey kangaroos (*Macropus fuliginosus*) and euros (*Macropus robustus*) were observed during the day within the Sturt Service Site. Red kangaroos

averaged 90.7 kangaroos/km^2 (range 3.2–245/km^2) and numbers fluctuated significantly between transects and between sessions, reflective of the species' wide roaming habits to travel to areas of water and green pick (Caughley et al. 1984; Priddel et al. 1988) (Figure 36). Dusky hopping-mice (*Notomys fuscus*) were sighted during each session, averaging 4.9 hopping mice/km^2 across the five counts. These counts corroborate pitfall trapping data which suggests this species is present in the area but in low abundance (Klöcker 2006). One fat-tailed dunnart (*Sminthopsis crassicaudata*) and two stripe-faced dunnarts (*Sminthopsis macroura*) were also observed during spotlight counts.

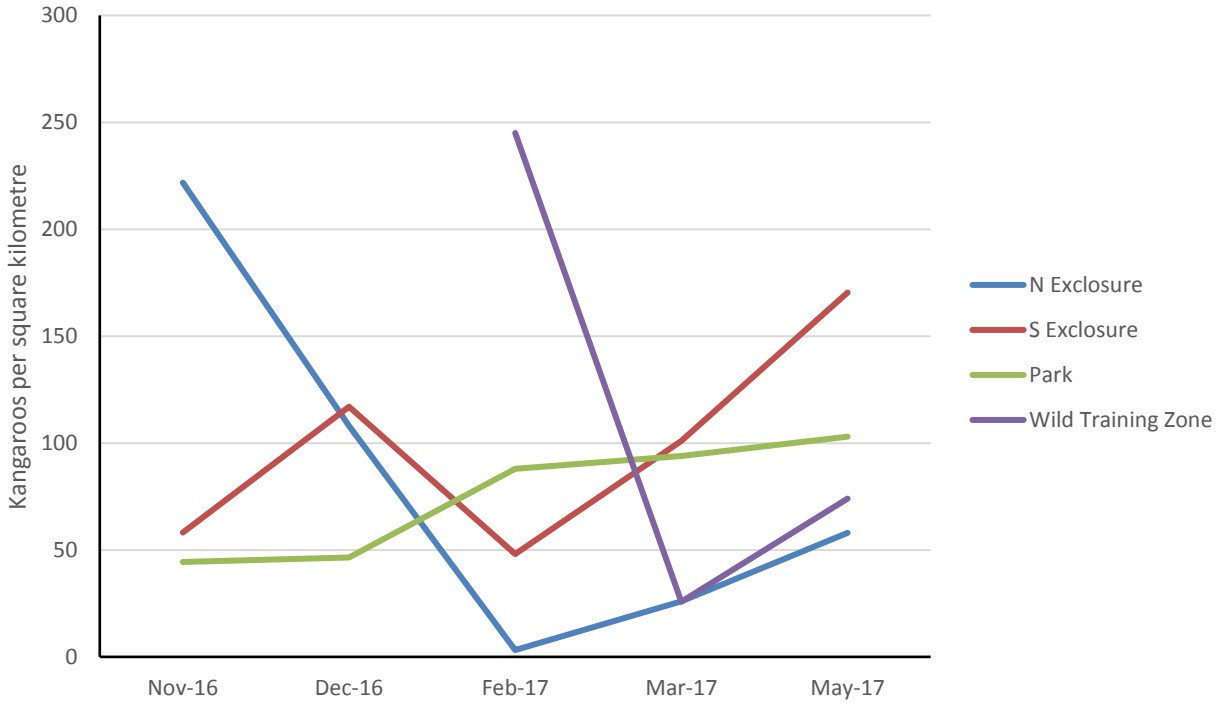

Figure 36: Red kangaroo density estimates (individuals per km^2) from four spotlight transects within the Sturt Service site conducted between November 2016 and May 2017

Between June 2016 and May 2017 opportunistic bird observations were made during eight trips to the Sturt Service Site. Observations were made by the following experienced ornithologists: R Pedler, J Rees, J Read and R Kingsford. Bird records were compiled in relation to three areas: the Sturt Service Site, neighbouring parts of Sturt National Park and the Fort Grey Homestead (

Table **19**). A total of 83 bird species were recorded, including 71 species in the Sturt Service Site and an additional 13 species at Fort Grey Homestead or within the surrounding area of Sturt National Park (including Lake Pinnaroo, Frome Swamp and along major road corridors). Significant species (listed under the EPBC or NPW Acts) include the grey falcon (one individual observed flying over the proposed exclosure site, February 2017), black-breasted buzzard (one individual observed over Frome Swamp in December 2016 and one over the Fort Grey Homestead, February 2017), little eagle (two individuals observed at Frome Swamp, February 2017), flock bronzewing (one male bird drinking at Oy Tank, November 2016) and pied honeyeater (dozens of individuals observed in the project area during November and December visits, which followed widespread rainfall).

Table 19: Bird species observed within the Sturt Service Site, Fort Grey Homestead and neighbouring areas of Sturt National Park from November 2016 to May 2017

Species in bold text are listed as threatened species in New South Wales (or nationally)
***denotes introduced species**

Species name	Sturt Service Site	Fort Grey Homestead	Neighbouring areas of Sturt NP
Emu	✓	✓	✓
Great crested grebe	✓		
Australasian grebe	✓		
Hoary-headed grebe	✓		
White-necked heron	✓	✓	
White-faced heron	✓	✓	
Grey teal	✓		
Pink-eared duck	✓		
Musk duck	✓		
Black kite	✓		
Whistling kite	✓		
Brown goshawk		✓	
Wedge-tailed eagle	✓		
Little eagle			✓
Black-breasted buzzard		✓	✓
Grey falcon	✓		
Brown falcon	✓		
Australian kestrel	✓		
Australian bustard	✓		
Banded lapwing	✓		
Inland dotterel	✓		
Black-winged stilt	✓		
Red-necked avocet	✓		
Australian pratincole	✓		
Little buttonquail	✓		
Gull-billed tern	✓		
Peaceful dove	✓		
Diamond dove	✓		
Flock bronzewing	✓		

Species name	Sturt Service Site	Fort Grey Homestead	Neighbouring areas of Sturt NP
Crested pigeon	✓	✓	
Galah	✓		
Little corella	✓	✓	
Cockatiel	✓		
Budgerigar	✓	✓	
Blue bonnet	✓		
Bourke's parrot	✓	✓	
Pallid cuckoo	✓	✓	
Horsfield’s bronze-cuckoo		✓	
Red-backed kingfisher	✓	✓	
Rainbow bee-eater	✓	✓	
Fork-tailed swift		✓	
White-backed swallow	✓		
Welcome swallow	✓		
Fairy martin		✓	
Australian pipit	✓		
White-winged triller	✓		
Red-capped robin	✓		
Crested bellbird	✓	✓	
Magpie-lark		✓	
Willie wagtail	✓	✓	
Chirruping wedgebill	✓		
Chestnut-crowned babbler	✓	✓	
Cinnamon quailthrush	✓		
Rufous whistler	✓		
Brown songlark	✓		
Rufous songlark	✓		
Variegated fairy-wren	✓	✓	
White-winged fairy-wren	✓		
Yellow-rumped thornbill	✓		
Chestnut-rumped thornbill	✓		
Southern whiteface	✓	✓	
Spiny-cheeked honeyeater	✓	✓	

Species name	Sturt Service Site	Fort Grey Homestead	Neighbouring areas of Sturt NP
Singing honeyeater	✓	✓	
Yellow-throated miner		✓	
White-plumed honeyeater		✓	
White-fronted honeyeater	✓		
Pied honeyeater	✓		
Black honeyeater	✓		
Crimson chat	✓		
Orange chat	✓		
Red-browed pardalote		✓	
House sparrow*		✓	
Zebra finch	✓	✓	
White-breasted woodswallow	✓	✓	
Masked woodswallow	✓		
White-browed woodswallow	✓		
Black-faced woodswallow	✓	✓	
Australian magpie	✓	✓	
Australian raven	✓	✓	
Little crow	✓	✓	
Restless flycatcher		✓	
Mistletoebird		✓	

11.12.2. Introduced animals

Six pest species (introduced animals) are known to occur within Sturt National Park (OEH 2017b). The presence of introduced animals within the project area was assessed through spotlight counts (monthly, November 2016 to May 2017), observations of tracks, spoor and previous data from NPWS and M Letnic UNSW.

Table 20: Introduced animals (pest species) known to occur in the Sturt Service Site, their status within Sturt National Park and whether they were recorded during surveys for this REF

Common name	Scientific name	Status within Sturt National Park as detailed in SNP Plan of Management (OEH 2017b)	Detected within the Sturt Service Site?
Wild dog	*Canis lupus* subspecies	Low densities	Y
European fox	*Vulpes*	Widespread moderate densities	Y
Feral cat	*Felis catus*	Widespread moderate densities	Y
European rabbit	*Oryctolagus cuniculus*	Widespread moderate densities	Y

Common name	Scientific name	Status within Sturt National Park as detailed in SNP Plan of Management (OEH 2017b)	Detected within the Sturt Service Site?
Feral goat	*Capra hircus*	Scattered. More common in eastern parts of the park	N
Feral pig	*Sus scrofa*	Widespread when surface water present	Y

Dingos

Wild dogs, including dingos, are a declared pest under the *Local Land Services Act 2013* due to their impacts on livestock. Feral dogs (*Canis lupus familiaris*) are listed as a key threatening process under the TSC Act (NSW SC 2009). Native dingos (*Canis lupus dingo*) are also known to occur within the park in very low densities. The movement of dingos and wild dogs into the park from the north and west is prevented by the Dog Fence which was constructed along the Queensland and South Australian borders in the 1880s and now extends for a total distance of 5614km. Dingos are not protected in New South Wales by the NPW Act as they are regarded as a wild dog under the Local Lands Services Act. A single dingo was detected within the Sturt Service Site during spotlighting in May 2017; other than this sighting no further evidence of dingos was collected during surveys.

Foxes

Predation by the European red fox is a key threatening process under both the TSC Act and the EPBC Act (NSW SC 1998; DoE 2009). The fox is also a declared pest species in New South Wales under the Local Land Services Act. Longer term data collected by M Letnic (UNSW) suggests that fox numbers are low at present but have been historically higher (Figure 37).

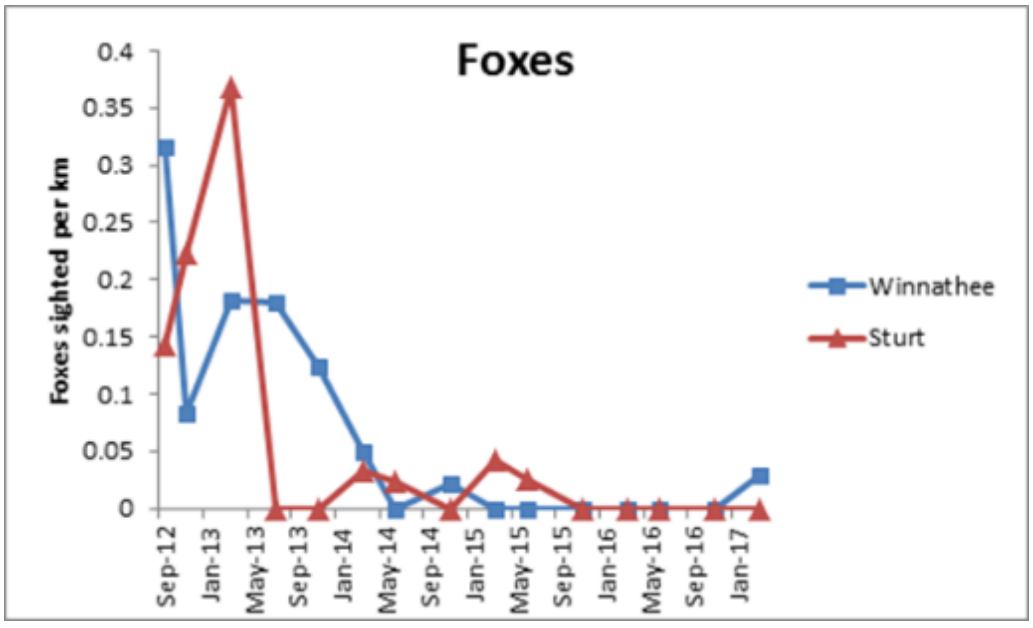

Figure 37: Foxes sighted per km during spotlight transects collected by M Letnic, UNSW, from 2012 to 2017

Cats

Predation by feral cats is listed as a key threatening process under both the TSC Act and the EPBC Act (NSW SC 2000; DoE 2009). Nocturnal spotlight counts estimated cat densities to

be 0.3 cats/km^2 within the Sturt Service Site. Cat tracks were seen regularly during fence line and vegetation surveys and a number of cats were also flushed during the day. Longer term spotlight counts conducted by Associate Professor Mike Letnic's team within Sturt National Park suggests that cat densities fluctuate significantly within this environment (Figure 38).

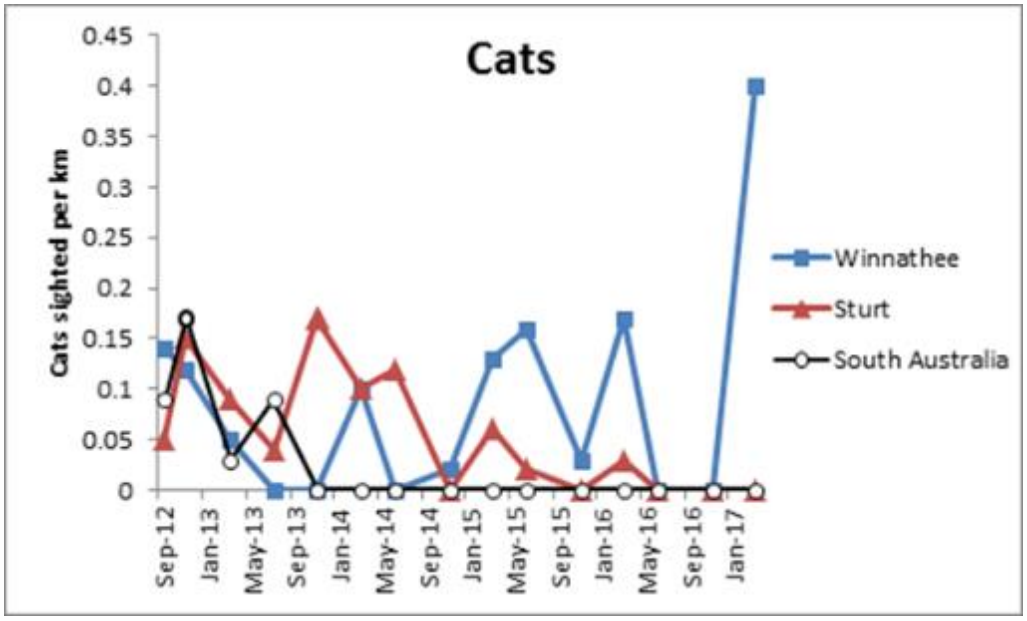

Figure 38: Cats sighted per km on 30km spotlight transects conducted by M Letnic, UNSW, from 2012 to 2017

Rabbits

Rabbits are listed as a key threatening process under both the TSC Act and the EPBC Act (NSW SC 2002; DoE 2009). Spotlighting counts indicated that rabbit densities within the Sturt Service Site (0.6 rabbits/km^2) are much lower than some other similar arid environments and much lower than historical averages, before the release of rabbit haemorrhagic disease virus (RHDV). For instance, rabbit densities at Roxby Downs, South Australia, fluctuated between 100–400 rabbits/km^2 before RHDV and 20–100 rabbits/km^2 since (Pedler et al. 2016). Spotlight counts of rabbits following high rainfall conditions in 1974 on Quinyambie Station (immediately south-west of the project area) were around 5 rabbits per ha (500 rabbits/km^2) and 1–2 rabbits per ha (100–200 rabbits/km^2) at adjacent sites in western New South Wales (Cooke & Soriguer 2016).

Feral goats

Competition and habitat degradation by feral goats is a key threatening process under the TSC Act and EPBC Act (NSW SC 2004a; DoE 2009). No evidence of feral goats was collected within the Sturt Service Site although there are regularly sighted and controlled in the eastern of the park (NPWS, pers comm).

Feral pigs

Predation, habitat degradation, competition and disease transmission by feral pigs is listed as a key threatening process under both the TSC Act and the EPBC Act (NSW SC 2004b; TSSC 2001). Spotlight estimates suggest pig densities within the Sturt Service Site are low (0.04 pigs/km^2) although evidence of their diggings were found throughout the area.

11.13. Ramsar wetlands

The proposed site lies 12km west of Lake Pinaroo (Fort Grey Basin), which is listed as a Ramsar wetland. Due to the remoteness from this site, the proposed activity is not likely to have any impact on any waterbird species or affect the Ramsar site in any way.

11.14. Ecological communities

There are no listed threatened ecological communities or regionally significant communities within the Sturt Service Site. The sand dune habitat at the proposed site has been significantly altered through grazing by livestock, introduction of predators and rabbits and very high densities of kangaroos. The proposed activity aims to re-establish the full trophic structure in this ecosystem which will provide multiple benefits to the ecological community, e.g. the reintroduction of ecosystem engineers such as bilbies. With improved trophic structure and improved vegetation communities, we predict that other process such as runoff and nutrient cycling will be improved within the landscape, increasing the number of fertile patches and refuges, critical for self-maintaining populations of reintroduced mammals.

11.15. Critical habitat declared under the TSC Act

There are four critical habitat declarations within New South Wales: Gould's petrel, little penguin population in Sydney's North Harbour, Mitchell's rainforest snail in Stott's Island Nature Reserve and the Wollemi pine, however, none of these occur within the Sturt Service Site.

11.16. SEPP 26 littoral rainforest

Not applicable as the proposed activity does not occur in SEPP 26 littoral rainforest habitat.

11.17. SEPP 44 koala habitat

Not applicable. The proposed activity does not occur in SEPP 44 koala habitat.

11.18. Wilderness (either nominated or declared)

Not applicable as the proposed activity does not fall within a declared or nominated wilderness area.

11.19. Aboriginal cultural heritage

An Aboriginal Heritage Information Management System (AHIMS) search revealed no previously recorded items within the Sturt Service Site, due to no specific investigations within the area. As a result, an Aboriginal cultural heritage assessment report specific to the proposal was prepared by Australian Cultural Heritage Management (Appendix 3). The assessment report was conducted in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010b). The assessment report details a process of Aboriginal community consultation in accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW 2010a).

The archaeological survey assessed a 30m corridor (15m either side of the proposed fence lines) and the areas for borrow pits, temporary storage areas and release pens. The survey resulted in the discovery of 42 previously unrecorded surface stone artefact distributions. Sites were recorded in seven distinct landscape contexts but were most commonly found on

the interface between the scalded dune base and swale, with 28 of the 42 recorded sites occurring in this landscape context. The scalded character of these areas presents excellent surface visibility for the detection of stone artefacts.

The condition (spatial integrity) of all sites was assessed as poor. The project area has experienced significant historical and ongoing soil disturbance. The pastoral land use of the area has led to extensive erosion of sediment. The impacts of this are still evident today with the widespread presence of scalding throughout the project area. Historically, hard-hoofed livestock loosened the sediment, which has in turn resulted in erosion. Stone artefacts have become displaced from their original contexts due to fluvial and aeolian processes, the effects of which are exacerbated by the weakened land surface.

In addition, a number of sites such as those along the southern exclosure and southern wing fence have been directly impacted by the creation (long ago) of formal management tracks. The creation and ongoing maintenance of these tracks has also contributed to the poor spatial integrity of the sites.

The 42 sites recorded during the survey were assessed as being of low scientific and cultural significance. This assessment was undertaken with the input of the Aboriginal representatives who participated in the survey.

Harm (either complete or partial) may potentially occur to all 42 sites (surface stone artefact scatters) recorded during the survey. A number of the sites extend beyond the boundaries of the survey area; therefore, these may be impacted only partially. Where harm is unavoidable, it is proposed to collect and relocate stone artefacts. These will be relocated to adjacent areas outside the disturbance footprint. This strategy was endorsed by the Aboriginal representatives consulted during the cultural heritage assessment (Appendix 2 and Appendix 3).

The report recommended that an Aboriginal Heritage Impact Permit (AHIP) is required for the proposal to proceed. An AHIP will be submitted in conjunction with this REF.

The full heritage report is provided in Appendix 3.

11.20. National, State, local natural or cultural heritage values

There are no listed national heritage places or World Heritage properties within the proposed project area. However, a total of 34 European cultural heritage sites are listed in the OEH Historic Heritage Information Management System (HHIMS) database, nine sites within the Sturt Service Site (Figure 39) and the remainder within the Fort Grey Precinct and surrounding area. The sites include some of the earliest signs of European exploration in the arid interior (Table 21). Many of these sites are in disrepair and their function has not been maintained (Figure 40). None of the sites will be affected by the proposed project.

Explorer Charles Sturt established a depot, ‘Fort Grey’ at Lake Pinnaroo in 1845 during his expedition to Central Australia to locate the fabled inland sea. In the 1870s the area was taken up by pastoralists, with Fort Grey Station Homestead established on the shore of Lake Pinnaroo. The ruins of this stone homestead form an information point on the Fort Grey Campground walking trail, approximately 1km to the north-east of the ‘new’ Fort Grey Homestead, established in the 1930s and rebuilt to its current form in the 1950s. Most other listed cultural heritage sites in the area relate to the pastoral history of the Fort Grey pastoral lease, which from the late 1890s was part of Yandama Station (which included 3000 square miles and the leases: Fort Grey, Boulka, Tilcha, Warratta and Mokely). During these early years, the area supported unsustainably large numbers of stock. For instance, in 1899 Yandama Station shore 52,568 sheep and sent 5383 sheep and 1500 head of cattle to market. At the time of Yandama Station’s sale to S Norton and Company in 1912 it carried 11,000 cattle and 21,000 sheep. By 1918, Yandama was sold to Sidney Kidman, adding to

his empire of over a dozen properties in the district and many others in Queensland and South Australia.

Following World War II, Yandama Station and others in the district were broken up into component leases as ‘soldier settler’ blocks for returned servicemen. Many of the European cultural heritage sites listed in the HHIMS database relate to this more recent pastoral history of the Fort Grey lease. During the 1950s a number of new pastoral bores were established within the area now identified as the Sturt Service Site, including Devis Bore (sunk 1952; failed 1968), Collins Bore (sunk 1955) and Watties Bore (sunk 1960).

Table 21: European cultural heritage sites listed within the HHIMS database for the Fort Grey area of Sturt National Park

Site ID	Description	Datum	Zone	Easting	Northing
8767	Corner Paddock Hut/Kiwi Hut	AGD	54	506100	6780100
8867	Corner Paddock Hut/Kiwi Hut	AGD	54	506100	6780100
8868	Corner Paddock Hut/Kiwi Hut yards	AGD	54	506100	6780100
8769	Fort Grey Homestead	GDA	54	521241	6782511
8888	Fort Grey Homestead canegrass shed	AGD	54	521500	6782200
8881	Fort Grey Homestead Collins Bore	AGD	54	506100	6780200
8878	Fort Grey Homestead Corner Bore	AGD	54	505600	6786500
8879	Fort Grey Homestead Devis Bore	AGD	54	513200	6788900
8894	Fort Grey Homestead Diggers Tank	AGD	54	500800	6774500
8887	Fort Grey Homestead fencing	AGD	54	519500	6782000
8890	Fort Grey Homestead garage and workshop	AGD	54	519500	6782000
8880	Fort Grey Homestead House Bore	GDA	54	519733	6782181
8877	Fort Grey Homestead Kelos Bore	AGD	54	516700	6777800
8885	Fort Grey Homestead Kelos bore yards	AGD	54	516500	6777800
8889	Fort Grey Homestead laundry and engine room shed	AGD	54	519500	6782000
8893	Fort Grey Homestead Oy Tank	AGD	54	508500	6772200
8872	Fort Grey Homestead Quartpot Tank	GDA	54	512934	6780174
8882	Fort Grey Homestead ruin	GDA	54	521241	6782511
8892	Fort Grey Homestead shearers’ quarters	GDA	54	520574	6780966
8891	Fort Grey Homestead shearing shed	GDA	54	520492	6780908
8873	Fort Grey Homestead Sollies Tank	AGD	54	512100	6788100
8874	Fort Grey Homestead Telephone Tank	AGD	54	511100	6788100
8876	Fort Grey Homestead Watties Bore	AGD	54	503200	6771800
8883	Fort Grey Homestead Watties Bore	AGD	54	506300	6780500
8886	Fort Grey Homestead woolshed yards	GDA	54	520373	6780874
8875	Fort Grey Homestead Yelona Bore	AGD	54	506100	6763400
8884	Fort Grey Homestead Yelona Bore yards	AGD	54	506200	6763400
8871	Fort Grey House	GDA	54	519739	6782169

Site ID	Description	Datum	Zone	Easting	Northing
8865	Fort Grey Stockade; Sturt's exploration sites	AGD	54	522732	6780483
8861	Fort Grey Well	AGD	54	522500	6781000
8862	Fort Grey Well Bore	AGD	54	522500	6781000
8764	Fort Grey Well site	AGD	54	522500	6781000
8863	Fort Grey Well yards	AGD	54	522500	6781000

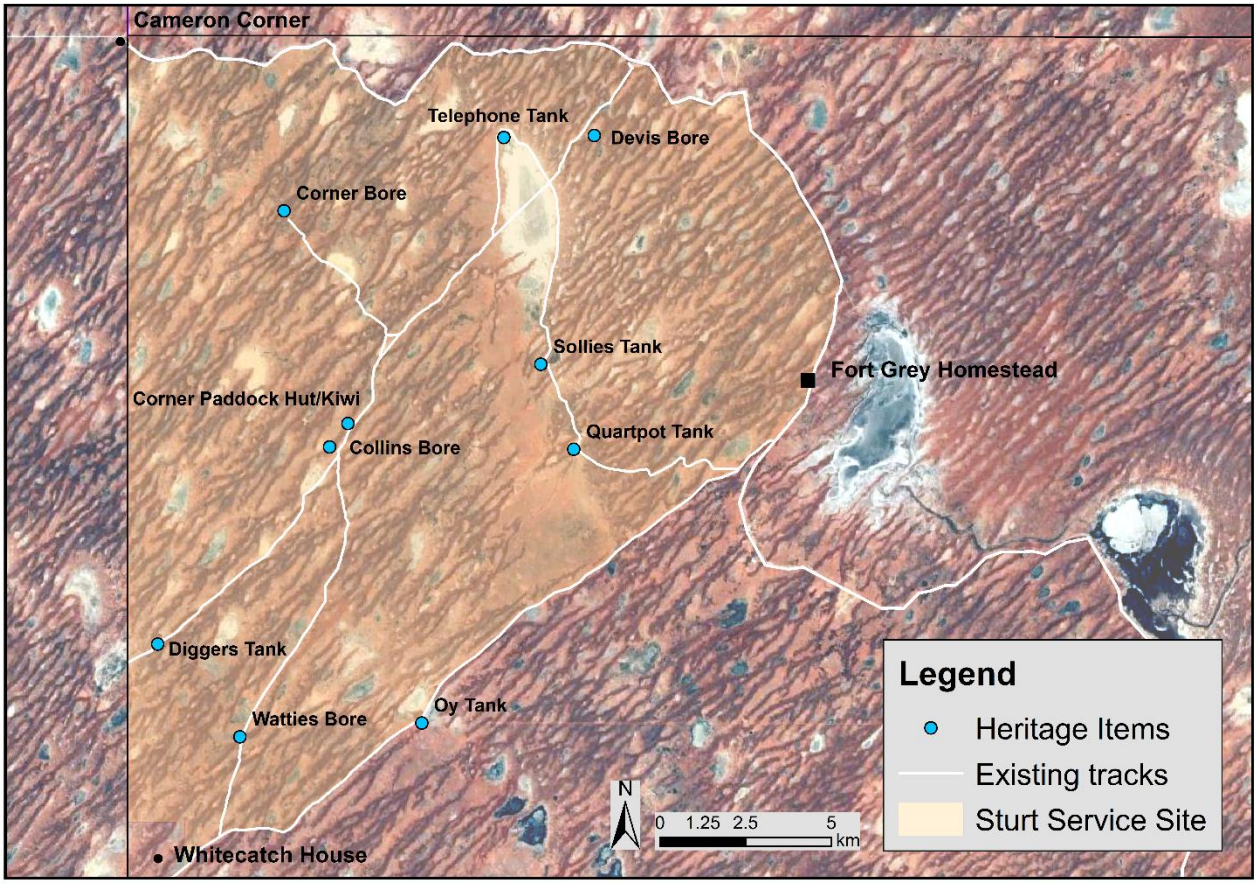

Figure 39: Heritage sites within the Sturt Service Site listed on the HHIMS database

Figure 40: Defunct windmill, tank and trough at Corner Bore

This is one of the heritage sites within the Sturt Service Site which is listed on the HHIMS database.

11.21. Vegetation of cultural landscape value

There is no vegetation of cultural or landscape value in the project area. All vegetation is natural and non-exotic.

11.22. Other cultural heritage values

In addition to the Aboriginal stone artefact sites identified within the Sturt Service Site (Section 11.19), the local surrounding region includes a high density and variety of Aboriginal cultural heritage, including hearths, middens, ceremonial sites, quarries and abundant stone objects which bear testament to the long Aboriginal occupation history and connection with this area.

Much of the pastoral infrastructure forms reminders of the European land-use history, including relations between Aboriginal and non-Aboriginal communities. The iconic Dog Fence (or Dingo Fence) borders the Sturt Service Site. Constructed in the 1880s with the original purpose of stopping the spread of a major rabbit plague, the fence was later heightened and expanded to restrict the movement of wild dogs. Today it is maintained as the longest fence in the world, stretching from eastern Queensland to the South Australian coastline.

11.23. Recreation values

Sturt National Park forms one of the well-recognised remote tourist and travel routes between the west Darling River country of New South Wales and Cooper Creek, Innamincka and the Flinders Ranges in South Australia. The area provides opportunities to observe arid land ecosystems of the Australian outback and the striking contrasts caused by occasional rain in the desert environment. Currently, the Fort Grey Campground provides an opportunity

for visitors to camp under the shade of coolabah trees on the shore of Lake Pinnaroo and to take advantage of walking tracks and self-guided drives that showcase the unique landscapes of the park, and the Aboriginal and European cultural heritage of the area.

11.24. Scenic and visually significant areas

The area provides a remote, sparsely populated and visually scenic area for tourists and other visitors in an increasingly overpopulated world. These remote regions are particularly popular with tourists wanting to experience the untamed outback, for stargazers and astronomers looking for areas of low light pollution and overseas backpackers searching for vast horizons.

11.25. Education and scientific values

The area presents teaching and educational opportunities for tourists and visitors, such as school groups. There are opportunities for researching natural and cultural values including ecological, geomorphological, geological, historic and archaeological research.

11.26. Interests of external stakeholders

External stakeholders in this area include neighbouring pastoralists, who undertake rangeland grazing of sheep and cattle on adjoining leases in New South Wales, South Australia and Queensland. Multiple tourist operators either travel through the park with groups of visitors and others maintain hotels, roadhouses and associated accommodation facilities in Tibooburra, Cameron Corner and Innamincka. The Wild Dog Destruction Board maintains the Dog Fence around the perimeter of the Sturt Service Site and has fence maintenance staff stationed at nearby Whitecatch House and Toona Gate.

11.27. Matters of national environmental significance under the EPBC Act

An EPBC Protected Matters Search was conducted for the project area (Appendix 5). The matters relevant to the Sturt Service Site include wetlands of international importance (1), threatened species and ecological communities (5), and migratory and marine species (8) (Appendix 5).

Species were assessed against the relevant criteria within *Matters of National Environmental Significance: Significant impact guidelines 1.1* Environment Protection and Biodiversity Conservation Act 1999 (DEWHA 2013). Full details of the tests and results can be found in Appendix 6 and are summarised in Table 25.

The results indicated that the proposed activity was not expected to have any significant impacts on any of the matters protected under the EPBC Act. For some species, the proposed activity will contribute significantly to listed recovery actions for the species (see Appendix 6).

Table 22: Matters of national environmental significance known or with potential to occur within the project area

EPBC protected matter	Name	Status	Impact assessment
Wetland of international importance	Lake Pinaroo	Ramsar wetland	No significant impact

EPBC protected matter	Name	Status	Impact assessment
Threatened species	Sea heath *Frankenia plicata*	Endangered	No significant impact
	Dusky hopping-mouse *Notomys fuscus*	Vulnerable	No significant impact
	Painted snipe *Rostratula australis*	Endangered	No significant impact
	Curlew sandpiper *Calidris ferruginea*	Critically endangered	No significant impact
	Night parrot *Pezoporus occidentalis*	Endangered	No significant impact
Migratory/marine species	Grey wagtail *Motacilla cinerea*		No significant impact
	Yellow wagtail *Motacilla flava*		No significant impact
	Latham's snipe *Gallinago hardwickii*		No significant impact
	Curlew sandpiper *Calidris ferruginea*	Critically endangered	No significant impact
	Cattle egret *Ardea ibis*		No significant impact
	Great egret *Ardea alba*		No significant impact
	Rainbow bee-eater *Merops ornatus*		No significant impact
	Painted snipe *Rostratula australis*	Endangered	No significant impact
Locally extinct mammal species proposed for reintroduction	Burrowing bettong *Bettongia lesueur*	Vulnerable	No significant impact
	Greater bilby *Macrotis lagotis*	Vulnerable	No significant impact
	Western barred bandicoot *Perameles bougainville*	Endangered	No significant impact
	Golden bandicoot *Isoodon auratus*	Vulnerable	No significant impact
	Greater stick-nest rat *Leporillus conditor*	Vulnerable	No significant impact
	Crest-tailed mulgara *Dasycercus cristicauda*	Vulnerable	No significant impact
	Western quoll *Dasyurus geoffroii*	Vulnerable	No significant impact

12. Impact assessment

12.1. Physical and chemical impacts

Physical and chemical impacts				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Is the proposal likely to impact soil quality or land stability?	☒	Negligible – negative High – positive	The 46.3 ha fence line easement will require some soil disturbance for grading and site preparation, including excavation of borrow pits and clay capping of up to 8 steep/mobile dune crests. This relatively small area of negative impact is offset by restoring extinct mammal species in the larger 4300ha exclosures. At other arid zone sites, reintroduction of these native mammals has been demonstrated to increase ground level vegetation cover, with diggings increasing soil water infiltration and nutrient cycling (James et al. 2009; James et al. 2010). These species, including the greater bilby and burrowing bettong are recognised as 'ecosystem engineers' for their positive role in soil nutrient, chemical and physical cycles. Thus, the proposed activities are likely to have a positive impact on soil quality, function and land stability. In circumstances of overabundance, it is possible that diggings from these species could increase soil erosion, however, this has not been previously documented in other fenced reserves and is of negligible consequence in comparison to the positive benefits to soil quality and land stability that have been documented in these species (James et al. 2009; James et al. 2010).	The following safeguards and mitigation measures have already been or are to be implemented: • careful site selection to avoid areas with erosion potential • minimisation of construction footprint though utilisation of previously disturbed areas for fence line easements and access, including existing roads and previously disturbed fence lines • proposed use of light grading techniques (or no grading) in areas of high erosion potential or clay flats where gradient and soil surface is sufficiently level • erosion control banks, whoa-boys and flat-bottomed gutters to be used along fence line easement tracks to slow runoff and prevent soil erosion • restriction of vehicles to designated tracks to reduce area of disturbance • proposed clay capping of 8 steep and mobile dune crests within the fence line corridors • proposed re-spreading of stockpiled topsoil material at borrow pits, and construction of erosion control bund around pit wall • overabundance of reintroduced mammals will be prevented through reintroduction of a native

Physical and chemical impacts				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
				predator (western quoll) and releases to the wild training zone.
2. Is the activity likely to affect a waterbody, watercourse, wetland or natural drainage system?	☒	Negligible – negative High – positive	The project site is remote from major wetlands of high conservation value. However, a number of ephemeral claypans and swamps lie within the project footprint. 0.3ha of the fence line easement crosses the margin of an ephemeral claypan (following an existing graded vehicle track), with negligible negative impact on this site. Overall, the project will protect 340ha of ephemeral wetland habitat (claypans, lignum/canegrass swamp, samphire shrubland), with eradication of rabbits providing opportunity for recruitment of perennial wetland-dependent species, and removal of cats and foxes allowing safe havens for visiting wetland-dependent and ground-nesting birds. Improved soil function and increased ground cover and water infiltration will reduce flash flooding of small ephemeral wetlands, reducing silt deposition.	The following safeguards and mitigation measures have already been or are to be implemented: • careful site selection to avoid areas with erosion potential • avoidance of wetland habitats in disturbance footprints (except along existing disturbance corridors) • avoidance of restriction to surface water flow.
3. Is the activity likely to change flood or tidal regimes, or be affected by flooding?	☐ No	NA	The proposed activities are 1200km from the coast and remote from any major river systems.	NA
4. Is the activity likely to affect coastal processes and coastal hazards, including those projected by climate change (e.g. sea level rise)?	☐ No	NA	The proposed activities are 1200 km from the coast.	NA

Physical and chemical impacts				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
5. Does the activity involve the use, storage, or transport of hazardous substances or the use or generation of chemicals, which may build up residues in the environment?	☒	Negligible – negative	The project requires the use of 4WD and all-terrain vehicles and associated fuels, lubricants and emissions. Poisons used in the control of vertebrate pests (e.g. 1080 for control of foxes and wild dogs) will be used in line with the strict NPWS regulations on storage, administration and disposal. Some selective herbicides will be used for the control of noxious weeds, should infestations occur. These practices are consistent with those already used at this site by NPWS and adherence to mitigation measures will ensure negligible impact.	The following safeguards and mitigation measures have already been or are to be implemented: • conducting daily vehicle checks • conducting regular services and preventative vehicle maintenance • fuel storage, servicing and waste storage at existing NPWS-compliant facilities at Fort Grey Homestead • provision and maintenance of chemical spill kits.
6. Does the activity involve the generation or disposal of gaseous, liquid or solid wastes or emissions?	☒	Negligible – negative	The project requires the use of 4WD vehicles and associated emissions. Fence construction will involve the use of portable welders, angle grinders and oxy-acetylene cutting tools and pneumatic tools, which will generate some solid wastes (spent cutting wheels, flux etc.). Fencing materials will be packaged on wooden pallets with strapping material. Residents and visitors to the project will generate rubbish, which is to be disposed of in the Fort Grey Homestead waste management facility, including the recently developed recycling depot.	The following safeguards and mitigation measures have already been or are to be implemented: • the project has already prepared and implemented an environmental management plan to guide the usage and disposal of waste materials • the project and contractors will use new vehicles with modern low-emission standards • contract requirements will enforce fencing contractors to collect and remove all construction waste (offcuts, cutting wheels, etc.) from site • the fence material order has specified that all netting for fence lines is to be packaged without plastic wrapping, to avoid breakdown and disposal of this material • the Wild Deserts team has recently taken on management of the Fort Grey Homestead waste management facility and instated a recycling depot for all glass, aluminium, plastics and cardboard, which are transported to Broken Hill recycling

Physical and chemical impacts				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
				stations (this includes all waste from the nearby Fort Grey Campground) • oil, paints and other liquid wastes will be stored at appropriate facilities at Fort Grey Homestead and transported to safe disposal centres at Broken Hill.
7. Will the activity involve the emission of dust, odours, noise, vibration or radiation in the proximity of residential or urban areas or other sensitive locations?	☒	Negligible – negative	The project will generate small amounts of dust and noise during construction activities, but all will be extremely remote from residential or urban areas, park visitors or sensitive areas. Thus the impact will be negligible.	The following safeguards and mitigation measures have already been or are to be implemented: • the proposed site is remote from residences and visitors to Sturt National Park • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner • accredited safety standards will be used for construction activities involving welding, cutting and pneumatic tools

12.2. Biological impacts

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Is any vegetation to be cleared or modified? (includes vegetation of conservation significance or	☒	Low – negative	The 8m fence line easement will require grading of 48km of fence line, totalling a 46.3ha disturbance corridor. Within this corridor, large areas are sufficiently flat and level to not need grading, with 20.6ha situated in interdunal clay flats supporting plant community types that have no perennial	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise vegetation clearance; this included the use of existing cleared area (tracks and old fence lines)

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
cultural landscape value)			vegetation. In these areas, no trees or shrubs will be cleared and the impacts from fence construction activities lower. Thus clearing or modification of perennial vegetation will be restricted to 25.7ha. This relatively small clearance footprint has been further reduced by selecting existing management tracks and previously cleared fence lines when siting infrastructure. In all, this disturbance corridor will protect 4300ha within feral-proof exclosures, where vegetation impacts from feral and overabundant herbivores will be eliminated and extinct animals that are beneficial to vegetation and soil function will be reinstated.	• environmentally sensitive placement of fences has led to avoidance of significant vegetation such as long-lived trees or wetland vegetation. In particular, long-lived hollow-bearing trees such as beefwood, *Grevillea striata,* and whitewood, *Atalaya hemiglauca,* trees are totally avoided by the fence line. This action required careful rerouting of several sections of fence and adjustment of angles and post sites • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner • a key component of the Wild Deserts project is a strategic adaptive management plan (currently in draft form). This approach safeguards against potential problems such as overgrazing by reintroduced mammals (e.g. burrowing bettongs) through effective planning and identification of mechanisms and trigger points to avoid such issues.
2. Is the activity likely to have a significant effect on threatened plant species, populations, or their habitats, or critical habitat (refer to threatened species assessment of significance [7-part test])?	☒	Negligible – negative	11 threatened plant species were identified as potentially occurring in or near the project site (Appendix 4), however, none were detected during plant surveys. 46.3ha of the total 35,000ha project site will be disturbed through fence construction, allowing for 4,300ha to be protected from grazing by introduced and overabundant native herbivores. Thus the project is expected to have a negligible, if any, effect on threatened plant species.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise vegetation clearance; this included the use of existing cleared tracks and fence lines • 7-part tests of significance were conducted for all threatened plant species with potential to occur in the project area. The results suggest there will be no significant impacts on any of the threatened plant species • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health*

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
				Monitoring Framework (Appendix 7), which sets out annual vegetation monitoring methods which will be used to document and describe changes to vegetation, plus detect new species, including threatened plants.
3. Does the activity have the potential to endanger, displace or disturb animals (including animals of conservation significance) or create a barrier to their movement?	☒	Low – negative High – positive	The project's explicit aims are to reintroduce extinct animals, thus improving their plight and restoring ecosystem processes which are also of benefit to other threatened species found in the area (e.g. threatened native rodents, ground-nesting birds etc.). The project's proposed actions are closely aligned with many of the NSW Government management actions for key threatened species such as providing safe havens from feral predators and reducing total grazing pressure, and thus are expected to benefit most, if not all threatened animal species which have been identified from the project area. During construction, 46.3ha of the total 35,000ha project site will be disturbed through fence construction (allowing for 4,300ha to be protected). It is possible that some negative impact may occur for some animals. However, the 7-part test of significance performed on all 31 threatened animal species known or possibly occurring in the project area suggested no significant impact to any species. Ecological monitoring at a similar arid-zone, feral-free reserve at which medium-sized native mammals have been reinstated has demonstrated major benefits and population recovery for threatened animals, including small native rodents (Moseby et al. 2009). Overall, the project has potential to provide low negative impact to animals, with the broader aim of	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance for threatened animals; this included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • 7-part tests of significance were conducted for all threatened animal species with potential to occur in the project area. The results suggest there will be no significant impacts on any of these species • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual animal monitoring methods which will be used to document and describe changes to threatened species abundance and populations, plus detect new species that may visit or establish • care has been taken in fence design and layout to mitigate the potential impacts on macropods and emus from fenced barriers. One-way exit gates, fence intersections and angles and other infrastructure has been designed with these welfare considerations in mind. Any activities to exclude macropods from fenced areas will be undertaken in accordance with animal ethics guidelines and approvals.

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			significantly improving the conservation outcomes and ecological function relevant to a range of animal species, including a number of threatened species.	
4. Is the activity likely to have a significant effect on threatened animal species, populations, or their habitats, or critical habitat (refer to threatened species assessment of significance [7-part test])?	No ☒	Low – negative High – positive	The project specifically aims to restore threatened animal and ecosystem processes, with the proposed actions closely aligned with many of the NSW Government management actions for key threatened species. These include providing safe havens from feral predators, reducing total grazing pressure and thus are expected to benefit most, if not all, threatened animal species which have been identified from the project area. During construction, 46.3ha of the total 35,000ha project site will be disturbed through fence construction (allowing for 4,300ha to be protected). It is possible that some negative impact may occur for some threatened animals through disturbance to habitat. However, the 7-part test of significance performed on all 31 threatened animal species known or possibly occurring in the project area suggested no significant impact to any species. Ecological monitoring at a similar arid-zone, feral-free reserve at which medium-sized native mammals have been reinstated has demonstrated major long-term benefits and population recovery for threatened animals, including small native rodents and ground-nesting birds (Moseby et al. 2009). Overall, the project is likely to have short-term negligible negative impact to some threatened animals, to achieve the longer term aim of significant benefit and population recovery for a range of threatened species.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance for threatened animals; this included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • 7-part tests of significance were conducted for all threatened animal species with potential to occur in the project area. The results suggest there will be no significant impacts on any of these species • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual animal monitoring methods which will be used to document and describe changes to threatened species abundance and populations, plus detect new species that may visit or establish • a key component of the Wild Deserts project is a strategic adaptive management plan (currently in draft form). This approach safeguards against potential problems such as overgrazing by reintroduced mammals (e.g. burrowing bettongs) through effective planning and identification of mechanisms and trigger points to avoid such issues.

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
5. Is the activity likely to impact an ecological community of conservation significance?	☐ No	NA	No ecological communities rated being 'of conservation significance' were identified within the project site. The project specifically aims to improve ecosystem condition and function by addressing threatening processes and restoring extinct species. Great care has been taken avoid impacts to sensitive landscape features, vegetation types and significant animals.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance; this included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • 7-part tests of significance were conducted for all threatened species with potential to occur in the project area. The results suggest that will be no significant impacts on any of these species • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual animal monitoring methods which will be used to document and describe changes to threatened species abundance and populations, plus detect new species that may visit or establish.
6. Is the activity likely to have a significant effect on an endangered ecological community or its habitat (refer to threatened species assessment of significance [7-part test])?	☐ No	NA	No endangered ecological communities are located within the study area, nor are any predicted to occur.	NA
7. Is the activity likely to cause a threat to the biological diversity or ecological integrity of an	☒	High – positive	The project specifically aims to restore threatened animals and ecosystem processes, with the proposed actions closely aligned with many of the NSW Government management actions for key threatened species. These include providing safe	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance for threatened animals; this

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
ecological community?			havens from feral predators, reducing total grazing pressure and thus are expected to benefit threatened species, biological diversity and the ecological integrity of the local ecological communities. Some localised, short-term disturbance is inherent from construction activities, affecting a small portion of the total project area. The detailed ecological monitoring regime has been outlined in the Wild Deserts Ecological Health Monitoring Framework and the Strategic Adaptive Management Plan will allow any changes in biological diversity, ecological integrity and changes to species or ecosystems to be detected, monitored, compared between management regimes and adaptively managed over the long tenure of the project.	included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • 7-part tests of significance were conducted for all threatened animal species with potential to occur in the project area. The results suggest there will be no significant impacts on any of these species. • the strategic adaptive management plan and *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7) allow any changes in biological diversity, ecological integrity and changes to species or ecosystems to be detected, monitored, compared between management regimes and adaptively managed over the long tenure of the project.

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
8. Is the activity likely to introduce noxious weeds, vermin, feral species or genetically modified organisms into an area?	☒ No	High – positive	The proposed activities will involve soil disturbance along access tracks, fence easements and borrow pits, potentially creating sites for weed invasion. Specific measures to prevent the transportation of weed seeds (vehicle hygiene and wash-down) and to detect and eradicate new infestations (should they occur) have been included in the environmental management plan. This covers both fence construction activities and ongoing project work. One of the key aims of the project is to eradicate rabbits, cats and foxes and wild dogs from the two large exclosures and to tightly control fox and cat densities in the larger wild training zone while also eradicating wild dogs from this area. Thus feral species management is core business and there is no risk of introductions or uncontrolled vermin species resulting from the proposed actions. No genetically modified organisms are to be used.	The following safeguards and mitigation measures have already been or are to be implemented: • the project has already prepared and implemented an environmental management plan to guide vehicle hygiene and wash-down procedures relating to noxious weeds • weeds and feral species that occur in the project site and surrounding local area are the focus of control and eradication activities for the project • the strategic adaptive management plan and *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7) allow any changes in feral species and detection of noxious weeds to be detected, monitored and controlled.
9. Is the activity likely to affect critical habitat?	☒ No	NA	7-part tests conducted for all threatened species did not detect listed critical habitat within the project area (see Appendix 4).	NA
10. Is the activity consistent with any applicable recovery plans or threat abatement plans?	☒ Yes	High – positive	The project directly addresses and contributes to NSW Government management actions for threatened species recovery in New South Wales (see 7-part tests of significance in Appendix 4) and relevant national recovery plans for a range of threatened species.	The following safeguards and mitigation measures have already been or are to be implemented: • 7-part tests of significance were conducted for all threatened species with potential to occur in the project area. The results suggest the activities are consistent with recovery plans or threat abatement plans for the tested threatened species.

Biological impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
11. Is the activity likely to affect any joint management agreement entered into under the TSC Act?	☐ No	NA	No management agreements under the TSC Act are relevant to the project site or proposed actions.	NA

12.3. Community impacts

Community impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Is the activity likely to affect community services or infrastructure?	☒	Negligible – negative	The project activities include the construction of two 20km^2 feral-proof exclosures and a larger 104km^2 wild training zone. This infrastructure is largely remote from any community infrastructure and is located in sections of Sturt National Park that are away from visitor access. However, one of the fences that forms the eastern boundary of the wild training zone is proposed to intersect with Dunes Scenic Drive (a NPWS-owned and maintained road), ~11km east of Cameron Corner. At this site, a cattle grid and warning signage is to be installed to allow free, safe passage for road users (see Section 8.2.3).	The following safeguards and mitigation measures have already been or are to be implemented: • the project has prepared a fence design and layout plan in consultation with OEH and NPWS, which identified the process used to determine the location of infrastructure and to deal with mitigation measures • local NPWS staff were consulted on the specific design of the fence-crossing site on Dunes Scenic Drive, with an on-site meeting held in July 2017 to discuss traffic management and road safety requirements • NSW Roads and Maritime Services standards will be adhered to in the construction and operation of the fence crossing on Dunes Scenic Drive

Community impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
				• the grid will only be installed only when relevant approvals have been granted to ensure the installation meets the relevant standards for signage, approach visibility and speed limits.
2. Does the activity affect sites of importance to local or the broader community for their recreational or other values or access to these sites?	☒	Negligible – negative	The project activities include the construction of two 20km^2 feral-proof exclosures and a larger 104km^2 wild training zone. This infrastructure is largely remote from any community infrastructure and is located in sections of Sturt National Park that are away from visitor access. However, one of the fences that forms the eastern boundary of the wild training zone is proposed to intersect with Dunes Scenic Drive (a NPWS-owned and maintained road), ~11 km east of Cameron Corner. At this site, a cattle grid and warning signage is to be installed to allow free, safe passage for road users (see Section 8.2.3). The proposed activity does not in any way affect access to sites currently available to park users.	The following safeguards and mitigation measures have already been or are to be implemented: • the project has prepared a fence design and layout plan in consultation with OEH and NPWS, which identified the process used to determine the location of infrastructure and to deal with mitigation measures • local NPWS staff were consulted on the specific design of the fence-crossing site on Dunes Scenic Drive, with an on-site meeting held in July 2017 to discuss traffic management and road safety requirements • NSW Roads and Maritime Services standards will be adhered to in the construction and operation of the fence crossing on Dunes Scenic Drive.
3. Is the activity likely to affect economic factors, including employment, industry and property value?	☒	High – positive	The project is expected to have benefit to local communities through: • opportunities for local businesses and contractors in construction and other services and products • the fencing material is to be manufactured in Australia, purchased through local supply agents and delivered and constructed by local businesses • increased visitation, with flow-on effects to local businesses in surrounding towns, including Tibooburra, Cameron Corner and Broken Hill.	The following safeguards and mitigation measures have already been or are to be implemented: • a community information session was held in February 2017 to inform key local business owners and community members about the project • a communication and community engagement strategy has been developed to guide activities relating to local community involvement, engagement and employment.

Community impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
4. Is the activity likely to have an impact on the safety of the community?	☒	Neglible – negative	The project infrastructure is largely remote from visitor access. However, one of the fences that forms the eastern boundary of the wild training zone is proposed to intersect with Dunes Scenic Drive (a NPWS-owned and maintained road), ~11km east of Cameron Corner. At this site, a cattle grid and warning signage is to be installed to allow free, safe passage for road users (see Section 8.2.3).	The following safeguards and mitigation measures have already been or are to be implemented: • the project has prepared a fence design and layout plan in consultation with OEH and NPWS, which identified the process used to determine the location of infrastructure and to deal with mitigation measures • local NPWS staff were consulted on the specific design of the fence-crossing site on Dunes Scenic Drive, with an on-site meeting held in July 2017 to discuss traffic management and road safety requirements • NSW Roads and Maritime Services standards will be adhered to in the construction and operation of the fence crossing on Dunes Scenic Drive • the grid will be installed only when relevant approvals have been granted to ensure the installation meets the relevant standards for signage, approach visibility and speed limits, ensuring the safety of the community using the road.
5. Is the activity likely to cause a bushfire risk?	☒	Negligible – negative Medium – positive	The proposed activities are unlikely to lead to bushfires. The area is in the lowest rainfall environment in NSW, with very low fuel loads, except following periods of sustained above-average rainfall conditions over a 12 to 24-month period. During construction: • work will comply with all relevant fire ban regulations, including cessation of use of machinery that presents a fire risk during days of total fire ban	The following safeguards and mitigation measures have already been or are to be implemented: • during construction, risk assessments will be undertaken before the use of machinery or tools presenting a fire hazard, with safeguards and mitigation measures to include: cessation of works during total fire bans or other local conditions deemed hazardous, and works to be accompanied by a Category 9 fire unit where risk assessment identifies this need

Community impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			• risk will be assessed in relation to fuel loads and fire break width and presence of fire suppression units, before the use of machinery that presents a fire risk. Ongoing project activities: • The reduction in grazing pressure may lead to some increases in fuel load inside the proposed exclosures and wild training zone. • The installation of project infrastructure and associated fence line easements with access tracks will increase the number of maintained fire breaks within the area and allow more efficient access during fire events, should they occur. • Wild Deserts staff members have already undertaken training to become fire crew members and will have a Category 9 fire unit based on site at all times during the fire season.	• the project has prepared a fence design and layout plan in consultation OEH and NPWS, which examined fire risk and fire access. This determined the project will increase fire breaks and maintain access routes relevant to fire suppression and response • on-site staff have been trained as fire crew members through a NPWS accredited course • a compliant Category 9 fire unit will be based permanently on site for quick response to fire events, under the direction of the local crew leader • in the event of an extreme bushfire event, where one of the proposed fences is preventing access for a fire crew, it has been agreed with NPWS the fences should be cut to enable access and will be repaired after the event.
6. Will the activity affect the visual or scenic landscape? This should include consideration of any permanent or temporary signage (e.g. signs advertising an event and related sponsorship).	☒	Negligible – negative High – positive	The project activities will largely be remote from areas accessible to park visitors or neighbouring landholders. The proposed exclosure sites are ~4km from the nearest public road or neighbouring landholder and will thus have no visual impact. The wing fence infrastructure will cross Dunes Scenic Drive – a public road in Sturt National Park. Although this fence will be visible, the area where a ~200m section of this fence will be visible to the public is on a tourist drive that follows the Dog Fence for ~18km. Thus this fence and associated road safety signage will have a negligible visual impact compared to similar netting fences that already exist in the local landscape.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to locate fences in areas such that visual amenity impact would be minimised • the wing fence road crossing site is located along a section of tourist drive that follows the Dog Fence for ~18km. Thus the proposed new fence and associated road safety signage will have a negligible visual impact compared to similar netting fences that already exist in the local landscape and are a feature for park visitors.

Community impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			This public road crossing of the fence line presents a positive opportunity to raise awareness of the project activities and the conservation challenges facing arid-zone, threatened species. Similar road crossing sites of feral-proof fence are a visitor attraction. (e.g. the Peron Peninsula, Shark Bay, Western Australia.	
7. Is the activity likely to cause noise, pollution, visual impact, loss of privacy, glare or overshadowing to members of the community, particularly adjoining landowners?	☒	Negligible – negative	The project activities will largely be remote from areas accessible to park visitors or neighbouring landholders and will cause no (or negligible) noise or visual impact in any form. The wing fence infrastructure will cross Dunes Scenic Drive at a site where it is visible for ~200m on a section of tourist drive that follows the Dog Fence for ~18km. Thus this fence and associated road safety signage will have a negligible visual impact compared to similar netting fences that already exist in the local landscape and are a drawcard for park visitors.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to locate fences in areas such that visual amenity impact would be minimised • the wing fence road crossing site is located along a section of tourist drive that follows the Dog Fence for ~18km. Thus the proposed new fence and associated road safety signage will have a negligible visual impact compared to similar netting fences that already exist in the local landscape and are a feature for park visitors.

12.4. Natural resource impacts

Natural resource impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Is the activity likely to result in the	☒	Negligible – negative	The project will require soil and vegetation disturbance to a relatively small clearance footprint	The following safeguards and mitigation measures have already been or are to be implemented:

Natural resource impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
degradation of the reserve or any other area reserved for conservation purposes?		High – positive	(46.3ha), which has been further reduced through selection of existing management tracks and previously cleared fence lines when siting infrastructure. In all, this disturbance corridor will protect 4,300ha within feral-proof exclosures, where vegetation impacts from feral and overabundant herbivores will be reduced and predation from feral predators eliminated. Moreover, a 10,400ha (104km^2) wild training zone will also reduce grazing pressure and feral predation. Overall, the project activities are specifically aimed at improving the conservation value, ecological function and status of threatened species in a large area of Sturt National Park.	• great effort was made in site selection to minimise vegetation clearance. This included the use of existing cleared area (tracks and old fence lines) • environmentally sensitive placement of fences has led to avoidance of significant vegetation such as long-lived trees or wetland vegetation • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner • a key component of the Wild Deserts project is a strategic adaptive management plan (currently in draft form). This approach safeguards against potential problems such as overgrazing by reintroduced mammals (e.g. burrowing bettongs) through effective planning and identification of mechanisms and trigger points to avoid such issues.
2. Is the activity likely to affect the use of, or the community's ability to use, natural resources?	☐	NA	The project site is remote from public access and will not restrict access to any natural resources currently used by the community.	NA
3. Is the activity likely to involve the use, wastage, destruction or depletion of natural resources including water, fuels, timber or extractive materials? This should include opportunities to	☒	Negligible – negative,	The project is specifically designed to conserve and protect natural resources, through increased opportunities for recruitment of long-lived perennial plants, improved soil physical and chemical properties and function through the restoration of mammals beneficial to soil processes in arid environments. However, project fences will be built using steel products. Project fences will utilise recycled bore casing as posts. The project has already instated a	The following safeguards and mitigation measures have already been or are to be implemented: • construction materials will be sourced from Australian suppliers to ensure stringent environmental standards in mining and manufacture • fence posts will be made from recycled bore casing to reduce use of new mined materials

Natural resource impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
utilise recycled or alternative products.			recycling depot at the Fort Grey waste management facility, taking materials from the Fort Grey Campground and other project visitors and staff. Fence construction will involve some usage of clay material for clay capping of up to 8 unstable dune crests. This is to be sourced from the site to minimise haulage distances and to confine impacts to the capping site.	• the fence material order has specified that all netting for fence lines is to be packaged without plastic wrapping, to avoid breakdown and disposal of this material • The Wild Deserts team has recently taken on management of the Fort Grey Homestead waste management facility and instated a recycling depot for all glass, aluminium, plastics and cardboard, which are transported to Broken Hill recycling stations (this includes all waste from the nearby Fort Grey Campground).
4. Does the activity provide for the sustainable and efficient use of water and energy? Where relevant to the proposal, this should include consideration of high-efficiency fittings, appliances, insulation, lighting, rainwater tanks, hot water and electricity supply.	☒	High – positive	The Fort Grey Homestead is already powered 100% by solar energy. In addition, the project is partnering with the UNSW Photovoltaic and Renewable Energy Engineering Group to trial new sustainable technologies. The project will use Australian-made steel products and recycled bore casing and other materials in fence infrastructure.	The following safeguards and mitigation measures have already been or are to be implemented: • the Fort Grey Homestead will continue to be powered by solar energy • the project will explore other sustainable technologies in partnership with the UNSW Photovoltaic and Renewable Energy Engineering Group • larger rainwater collection tanks will be installed at the Fort Grey Homestead for project use • the electric fence for the exclosures will be powered by a solar battery and energiser system.

12.5. Aboriginal cultural heritage impacts

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Will the activity disturb the ground surface or any culturally modified trees?	☒	Low – negative	Sturt National Park contains high concentrations of surface stone artefacts across the landscape (Fanning 1999; Holdaway et al. 2004). Thus construction of the fenced exclosures and maintenance tracks will involve soil disturbance activities that have the potential to cause some harm to cultural heritage, including stone artefacts, these include: • grading • vegetation removal • track maintenance • fence construction. The heritage assessment report (Appendix 3) details 42 sites where partial or complete harm may occur to surface stone artefact scatters recorded during an on-site archaeological survey. Given the density of surface stone artefacts scatters in Sturt National Park, some disturbance of artefacts is unavoidable. However, great effort was made in fence site selection to minimise impact to surface stone artefacts. Additionally, local traditional owner representatives were consulted during the process of fence line selection, including through a 5-day archaeological field survey, supervised by Dr Justin Shiner of Australian Cultural Heritage Management and with the participation of traditional owner representatives from the Wongkumara and Maljangapa groups and the Tibooburra Local Aboriginal Land Council.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise impact to surface stone artefacts; this included the use of existing cleared area (tracks and old fence lines) and identification and avoidance of areas where surface artefacts were present • a 5-day archaeological field survey was completed by Dr Justin Shiner of Australian Cultural Heritage Management, with the participation of traditional owner representatives from the Wongkumara and Maljangapa groups and the Tibooburra Local Aboriginal Land Council • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
2. Does the activity affect known Aboriginal objects or Aboriginal places? Include all known sources of information on the likely presence of Aboriginal objects or places, including AHIMS search results.	☒	Low – negative	Sturt National Park contains high concentrations of surface stone artefacts across the landscape (Fanning 1999; Holdaway et al. 2004). An AHIMS search revealed no previously recorded sites within the project area. The project has sought wherever possible to minimise the potential to cause harm to cultural heritage. In accordance with this objective, four distinct measures were taken to avoid harming Aboriginal cultural heritage in the project area: 1. Proposed fences and maintenance tracks were aligned as closely as possible to pre-existing areas of disturbance such as former pastoral tracks and NPWS maintenance tracks. 2. Before the archaeological survey, the Wild Deserts team, in consultation with Dr Justin Shiner, used the results of the background assessment and predictive model to adjust the location of the fences and new access track to avoid areas of the landscape with high archaeological potential. 3. This area was then ground checked by the Wild Deserts team before the survey to ensure that landforms and areas of high archaeological potential were avoided. These tasks were undertaken to proactively reduce the potential of harm to arise from the activity. The outcome of this is that the fence line was adjusted several times before the survey to avoid areas identified as being of high archaeological potential. 4. The final location was then surveyed by an experienced archaeologist and traditional owner	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise impact to surface stone artefacts; this included the use of existing cleared area (tracks and old fence lines) and identification and avoidance of areas where surface artefacts were present • a 5-day archaeological field survey was completed by Dr Justin Shiner of Australian Cultural Heritage Management, with the participation of traditional owner representatives from the Wongkumara and Maljangapa groups and the Tibooburra Local Aboriginal Land Council • where avoidance or minimisation of harm has not been possible it is proposed harm be mitigated through the implementation of the salvage (community collection) of artefacts within the 8m corridor of potential disturbance. Traditional owners will be present during the grading of the fence lines to ensure no harm to artefacts. This approach has been endorsed by Aboriginal community representatives (Appendix 2 and Appendix 3) and an AHIP has been prepared for these sites • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			representatives during the surface survey, and the fence line location fine-tuned further.	
3. Is the activity located within, or will it affect, areas: • within 200m of waters* • within a sand dune system* • on a ridge top, ridge line or headland • within 200m below or above a cliff face, or • within 20m of or in a cave, rock shelter or a cave mouth?	☒	Low – positive	The project is located within a sand dune system, the Strzelecki Dunefields system in the west of Sturt National Park. The project will exclude significant grazers in the landscape (rabbits, kangaroos) which will likely have a positive impact on the dune system thorough increase in vegetation and cover on the dunes, thus increasing stability and returning nutrient cycling processes to the system through the return of fossorial mammals.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise impact on the landscape; this included avoidance of sensitive landscape features and the use of existing cleared area (tracks and old fence lines) • where possible the proposed fence and track alignments have been aligned to avoid areas of the landscape that are of higher archaeological potential. This especially includes areas of potential silcrete outcropping where quarry sites may be present. The Aboriginal community representatives who participated in the cultural heritage assessment stated they regard quarry sites as being of high significance. The realignment of the proposed fence lines and access tracks was informed by the predictive model. In addition, grading will only be undertaken when it is necessary and to a depth no greater than 20cm • Aboriginal community representatives will be present during grading activities to ensure no harm to aboriginal artefacts • a key component of the Wild Deserts project is a strategic adaptive management plan and *Ecological Health Monitoring Framework* (Appendix 7). This approach will allow for effective planning, monitoring and identification of mechanisms and trigger points to avoid issues such as soil erosion or vegetation impacts affecting soil stability.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
4. If Aboriginal objects or landscape features are present, can impacts be avoided?	☒	Negative – low	As above, the project has sought wherever possible to minimise the potential to cause harm to cultural heritage. In accordance with this objective, four distinct measures have been taken to avoid harming Aboriginal cultural heritage in the broader project area. 1. Proposed fences and maintenance tracks were aligned as closely as possible to pre-existing areas of disturbance such as former pastoral tracks and NPWS maintenance tracks. 2. Before the archaeological survey, the Wild Deserts Team, in consultation with Dr Justin Shiner, used the results of the background assessment and predictive model to adjust the location of the fences and new access track to avoid areas of the landscape with high archaeological potential. 3. This area was then ground checked by the Wild Deserts team before the survey to ensure landforms and areas of high archaeological potential were avoided. These tasks were undertaken to proactively reduce the potential of harm to arise from the activity. The outcome of this is the fence line was adjusted several times before the survey to avoid areas identified as being of high archaeological potential. 4. The final location was then surveyed by an experienced archaeologist and traditional owner representatives during the surface survey and the fence line location fine-tuned further. Where avoidance or minimisation of harm has not been possible it is proposed that harm be mitigated through the implementation of the salvage (community collection) of artefacts within the 8m	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise impact to surface stone artefacts; this included the use of existing cleared area (tracks and old fence lines) and identification and avoidance of areas where surface artefacts were present • a 5-day archaeological field survey was completed by Dr Justin Shiner of Australian Cultural Heritage Management, with the participation of traditional owner representatives from the Wongkumara and Maljangapa groups and the Tibooburra Local Aboriginal Land Council • where avoidance or minimisation of harm has not been possible, it is proposed that harm be mitigated through the implementation of the salvage (community collection) of artefacts within the 8m corridor of potential disturbance. This approach has been endorsed by Aboriginal community representatives and an AHIP has been prepared for these sites • Aboriginal community representatives will be present during grading activities to ensure no harm to Aboriginal artefacts • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			corridor of potential disturbance. This approach has been endorsed by Aboriginal community representatives and an AHIP has been prepared for these sites.	
5. If the above steps indicate that there remains a risk of harm or disturbance, has a desktop assessment and visual inspection^ been undertaken (refer to the Due Diligence Code)? ^ *For activities proposed by OEH, at a minimum, this should be undertaken by an OEH employee with Aboriginal site awareness training and relevant practical experience, as approved by an Area Manager.*	☒	Low	As above, the project has sought wherever possible to minimise the potential to cause harm to cultural heritage. In accordance with this objective four distinct measures have been taken to avoid harming Aboriginal cultural heritage in the broader project area. 1. Proposed fences and maintenance tracks were aligned as closely as possible to pre-existing areas of disturbance such as former pastoral tracks and NPWS maintenance tracks. 2. Before the archaeological survey, the Wild Deserts team, in consultation with Dr Justin Shiner, used the results of the background assessment and predictive model to adjust the location of the fences and new access track to avoid areas of the landscape with high archaeological potential. 3. This area was then ground checked by the Wild Deserts Team before the survey to ensure that landforms and areas of high archaeological potential were avoided. These tasks were undertaken to proactively reduce the potential of harm to arise from the activity. The outcome of this is that the fence line was adjusted several times before the survey to avoid areas identified as being of high archaeological potential. 4. The final location was then surveyed by an experienced archaeologist and traditional owner	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise impact to surface stone artefacts; this included the use of existing cleared area (tracks and old fence lines) and identification and avoidance of areas where surface artefacts were present • a 5-day archaeological field survey was completed by Dr Justin Shiner of Australian Cultural Heritage Management, with the participation of traditional owner representatives from the Wongkumara and Maljangapa groups and the Tibooburra Local Aboriginal Land Council • where avoidance or minimisation of harm has not been possible it is proposed that harm be mitigated through the implementation of the salvage (community collection) of artefacts within the 8m corridor of potential disturbance. This approach has been endorsed by Aboriginal community representatives and an AHIP has been prepared for these sites • fence line grading and soil disturbance will be very limited in its extent and conducted in an environmentally sensitive low-disturbance manner.

Aboriginal cultural heritage impacts during construction and operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			representatives during the surface survey and the fence line location fine-tuned further. Where avoidance or minimisation of harm has not been possible it is proposed that harm be mitigated through the implementation of the salvage (community collection) of artefacts within the 8m corridor of potential disturbance. This approach has been endorsed by Aboriginal community representatives and an AHIP has been prepared for these sites.	
6. Is the activity likely to affect wild resources or access to these resources, which are used or valued by the Aboriginal community?	☒	High – positive	The activity is unlikely to affect wild resources or access to the area by the Aboriginal community. Aboriginal community representatives who were consulted or participated in the archaeological survey expressed their support for the proposed return of extinct native mammals to the area. These mammals hold great cultural and personal importance to the Aboriginal community, representing species that were previously held as totems or food resources. The project seeks to involve Aboriginal community in meaningful opportunities, through participation in releases of threatened species and employment opportunities in construction and maintenance of infrastructure. It is hoped these actions will increase local Aboriginal community access to the area.	The following safeguards and mitigation measures have already been or are to be implemented: • consultation with relevant Aboriginal community members from project inception • the *Wild Deserts Communication and Community Engagement Strategy* identifies ways in which the Aboriginal community can be involved in the project through engagement and employment opportunities.

12.6. Other cultural heritage impacts

Other cultural heritage impacts during construction or operation				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. What is the impact on places, buildings, landscapes or moveable heritage items? Attach relevant supporting information where required, such as a heritage impact statement.	☒	Negligible	A search of the HHIMS database was conducted to determine sites of cultural heritage value. This identified 10 pastoral infrastructure sites within the project area, including old fence lines (with hand-cut mulga posts), the foundations of the Kiwi Hut ruins and now defunct tanks, troughs, ground tanks and windmills at six sites. These heritage sites have been avoided in the placement of project infrastructure and will not be affected by the proposed activities in any way. None of these sites are currently accessible to the public, thus the project will not impact public access.	The following safeguards and mitigation measures have already been or are to be implemented: • the HHIMS database was consulted for sites of cultural heritage • great effort was made in site selection to identify and avoid cultural heritage sites with the proposed infrastructure.
2. Is any vegetation of cultural landscape value likely to be affected (e.g. gardens and settings, introduced exotic species, or evidence of broader remnant land uses)?	☐ NA	NA	No vegetation of cultural or landscape value has been identified or is predicted to occur at the project site.	NA

12.7. Matters of national environmental significance impacts

Matters of national environmental significance under the EPBC Act				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
1. Is the proposal likely to impact on matters of national environmental significance under the EPBC Act, as follows:	☒	Negligible – negative High – positive	The project's explicit aims are to reintroduce extinct animals, thus improving their plight and restoring ecosystem processes which are also of benefit to other threatened species found in the area (e.g. threatened native rodents, ground-nesting birds etc.). The project's proposed actions are closely aligned with the measures to reduce the impacts of key threatening processes listed under the EPBC Act. These include providing safe havens from feral predators and reducing total grazing pressure, and thus are expected to benefit most, if not all, threatened species which have been identified from the project area. During construction, 46.3ha of the total 35,000ha project site will be disturbed through fence construction (allowing for 4,300ha to be protected). It is possible (but unlikely) that some localised negative impact may occur for some threatened species. However, the assessment of matters of national environmental significance (Appendix 6) identified no significant impacts to any of the species assessed. Overall, the project will have negligible short-term negative impact to some threatened species, countered by the long-term positive effects that are the specific aim of the work proposed.	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance for threatened species; this included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • the Protected Matters Search Tool, literature sources and government databases were used in combination with on-ground survey data to determine the species occurring or potentially occurring at the project site • impact assessment using the matters of national environmental significance criteria was performed for all identified species, suggesting no significant impacts (Appendix 6) • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual monitoring methods which will be used to document and describe changes to threatened species abundance and populations, plus detect new species that may visit or establish.
• listed threatened species or ecological communities	☒	Low – negative High – positive	The project's explicit aims are to reintroduce extinct native animals, thus improving their plight and restoring ecosystem processes which are also of benefit to other threatened species found in the area	The following safeguards and mitigation measures have already been or are to be implemented: • great effort was made in site selection to minimise habitat disturbance for threatened species; this

Matters of national environmental significance under the EPBC Act				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
			(e.g. threatened native rodents, ground-nesting birds etc.). The project's proposed actions are closely aligned with the measures to reduce the impacts of key threatening processes listed under the EPBC Act. These include providing safe havens from feral predators and reducing total grazing pressure, and thus are expected to benefit most, if not all, threatened species which have been identified from the project area. During construction, 46.3ha of the total 35,000ha project site will be disturbed through fence construction (allowing for 4,300ha to be protected). It is possible (but unlikely) that some localised negative impact may occur to some threatened species. However, the assessment of matters of national environmental significance (Appendix 6) identified no significant impacts to any of the species assessed. Overall, the project has potential to provide negligible short-term negative impact to some threatened species, countered by the long-term positive effects that are the specific aim of the work proposed.	included utilisation of existing cleared tracks and fence lines in preference to disturbing new areas • the Protected Matters Search Tool, literature sources and government databases were used in combination with on-ground survey data to determine the species occurring or potentially occurring at the project site • impact assessment using the matters of national environmental significance criteria was performed for all identified species, suggesting no significant impacts (Appendix 6) • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual monitoring methods which will be used to document and describe changes to threatened species abundance and populations, plus detect new species that may visit or establish.
• migratory species protected under international agreements	☒	NA	Some migratory species protected under international agreements occur or are predicted to occur at the project site. However, the proposed activities do not pose any threat of impact to these species.	The following safeguards and mitigation measures have already been or are to be implemented: • impact assessment using the matters of national environmental significance criteria was performed for all identified species, suggesting no significant impacts (Appendix 6) • a detailed ecological monitoring regime has been outlined in the *Wild Deserts Ecological Health Monitoring Framework* (Appendix 7), which sets out annual monitoring methods which will be used to

Matters of national environmental significance under the EPBC Act				
	Applicable?*	**Impact level** (negligible, low, medium or high; negative or positive; or NA)	**Reasons** (Describe the type, nature and extent of impact, taking into account the receiving environment & proposed safeguards which will limit the impact)	**Safeguards/mitigation measures**
				document and describe changes to the ecosystem, threatened and migratory species. This will allow any changes in protected migratory species populations or abundance to be measured, documented and mitigation measures implemented if necessary.
• Ramsar wetlands	☒	NA	Lake Pinaroo, lies 12km to the east of the project site and was therefore indicated in the EPBC Protected Matters Search Tool (Appendix 5). However, it is not expected to be impacted in any way by the proposed activities.	The following safeguards and mitigation measures have already been or are to be implemented: • an impact assessment using the matters of national environmental significance criteria was performed for Lake Pinaroo and suggested no significant impact (Appendix 6).
• Commonwealth marine environment	☒	NA	Eight listed marine species were identified in the EPBC Protected Matters Search Tool (Appendix 5) as potentially occurring within the project area. However, this is due to the proximity to Lake Pinaroo (12km east of the project area). Impact assessments were conducted using the matters of national environmental significance criteria and determined there would be no significant impact on these marine species and therefore no significant impact on a Commonwealth marine environment.	The following safeguards and mitigation measures have already been or are to be implemented: • an impact assessment using the matters of national environmental significance criteria was performed for the listed marine species and suggested no significant impact on Commonwealth marine environments (Appendix 6).
• World Heritage properties or National Heritage places.	☐	NA	No World Heritage properties or National Heritage places occur within the vicinity of the project.	NA

13. Proposals requiring additional information

This proposal does not require additional information as it is not:

- a lease or licence proposal under s.151 of the NPW Act
- for telecommunications facilities, under s.153D of the NPW Act or
- for activities within the Sydney drinking water catchment.

14. Threatened species assessment of significance (7-part test)

Animal and plant surveys conducted in the project area for this REF detected 15 threatened species (Table 23). A total of 46 threatened species are known or predicted to occur within the Western Dunefields subregion of the Simpson–Strzelecki Dunefields Bioregion. In addition, the plains mouse (*Pseudomys australis*) was recently rediscovered in New South Wales on Fowlers Gap Station (~300km south of the project area). Although not listed within the subregion at present, it is predicted to occur within the project area and thus was included. A summary of the 47 species can be found in Appendix 4, Tables 1 and 2. Seven-part tests were conducted for the 15 species listed in Table 23, plus an additional 24 species that had previous records from within the project area (OEH 2017a), or for which suitable habitat may occur (Appendix 4, Tables 1 and 2). In total, 40 species were assessed through 7-part tests (Appendix 4). The results of the tests concluded the proposed activities would not significantly impact any of the threatened species known or predicted to occur in the project area. In most cases, the proposed activities would have significant positive benefits on the status of the threatened species and likely result in an increased number of individuals in the local population.

See Appendix 4 for full details of the 7-part tests and results.

Table 23: List of threatened species detected within the project area during surveys for this REF

Common name	Scientific name	Type	NSW status	EPBC status
Australian bustard	*Ardeotis australis*	Bird	Endangered	Not listed
Grey falcon	*Falco hypoleucos*	Bird	Endangered	Not listed
Black-breasted buzzard	*Hamirostra melanosternon*	Bird	Vulnerable	Not listed
Little eagle	*Hieraaetus morphnoides*	Bird	Vulnerable	Not listed
Flock bronzewing	*Phaps histrionica*	Bird	Endangered	Not listed
Pied honeyeater	*Certhionyx variegatus*	Bird	Vulnerable	Not listed
Forrest's mouse	*Leggadina forresti*	Mammal	Vulnerable	Not listed
Dusky hopping-mouse	*Notomys fuscus*	Mammal	Endangered	Vulnerable
Desert mouse	*Pseudomys desertor*	Mammal	Critically endangered	Not listed
Sandy inland mouse	*Pseudomys hermannsburgensis*	Mammal	Vulnerable	Not listed
Stripe-faced dunnart	*Sminthopsis macroura*	Mammal	Vulnerable	Not listed
Yellow-tailed plain slider	*Lerista xanthura*	Reptile	Vulnerable	Not listed
Crowned gecko	*Lucasium stenodactylum*	Reptile	Vulnerable	Not listed
Interior blind snake	*Anilios endoterus*	Reptile	Endangered	Not listed
Wedgesnout ctenotus	*Ctenotus brooksi / Ctenotus taeniatus*	Reptile	Vulnerable	Not listed

15. Summary of impacts

This section of the REF summaries the impacts identified and considers the cumulative impacts of the works in accordance with OEH guidelines. It considers *Is an EIS required? best practice guidelines for Part 5 of the Environmental Planning and Assessment Act 1979* (DUAP 1999), and assists in deciding whether proposal are likely to have significant environmental impacts. Table 24 summarises and considers the cumulative impacts of the works based on the classification of individual impacts as negligible, low, medium or high, negative or positive.

Table 24: Summary of the significance of impacts associated with the proposal

Category of impact	**Significance of impacts**		
	Extent of impact	**Nature of impact**	**Environmentally sensitive features**
Physical and chemical	Medium	Positive	Medium – positive
Biological	High	Positive	High – positive
Natural resources	High	Positive	High – positive
Community	Medium	Positive	N/A
Cultural heritage	Low Medium	Negative Positive	Low – negative Medium – positive

Based on the summary present in Table 24, an environmental impact statement (EIS) is not required. This REF includes a range of impact amelioration measures designed specifically to mitigate any adverse effect of the proposal on threatened biota (see Section 12). This REF assumes that the amelioration measures detailed would be fully implemented should the proposal be approved.

16. Conclusions

In conclusion indicate if:

- there is likely to be a significant effect on the environment and an environmental impact statement is required

  ☒ No

  ☐ Yes

Reason(s):

The outcome of this assessment indicates that, although there will be some impact on the environment as a result of the proposed activity, the scale of the impact, with implementation of the proposed mitigation measures, will not be of such significance that an environmental impact statement is required. In fact, the proposed activities are likely to have significant positive benefits to the environment.

- there is likely to be a significant effect on threatened species, populations, ecological communities or their habitats and a species impact statement is required

  ☒ No

  ☐ Yes

Reason(s):

The outcome of this assessment is that there are 41 threatened species known or predicted to occur within the project area. The results of the 7-part tests for these 41 species indicate that any likely impacts will not be of significance to require a species impact statement. In many cases, the proposed activities are likely to address key threatening processes for threatened species within the area, thus contributing towards recovery plans and threat abatement strategies.

- the activity is in respect of land that is, or is part of, critical habitat and a species impact statement is required

  ☒ No

  ☐ Yes

- the activity will require certification to the *Building Code of Australia*, *Disability (Access to Premises – Buildings) Standards 2010*, or Australian Standards in accordance with the OEH construction assessment procedure.

  ☒ No

  ☐ Yes

17. Supporting documentation

A number of documents should be read in association with this proposal; these are listed in Table 25.

Table 25: Details of supporting documentation for the proposal

Document title	Author	Date
Appendix 1. Details of the professional expertise of the Wild Deserts team members who prepared this Review of Environmental Factors	Wild Deserts team	July 2017
Appendix 2. Record of consultation for the Wild Deserts project Review of Environmental Factors	R Pedler and R West, Wild Deserts	July 2017
Appendix 3. Heritage Assessment Report: Project to reintroduce extinct mammals to Sturt National Park	Dr Justin Shiner, Australian Cultural Heritage Management	May 2017
Appendix 4. Threatened Species Assessment of Significance (7-part tests)	R Pedler and R West, Wild Deserts	July 2017
Appendix 5. EPBC Act Protected Matters Report	Australian Government, Department of Environment and Energy	Oct 2017
Appendix 6. Matters of National Environmental Significance Impact Assessment	R Pedler and R West, Wild Deserts	July 2017

18. Fees

Proponents are required to pay an initial fee of $170 (a final fee is also required before determination of the REF).

If the activity consists of environmental remediation and/or the proponent is a community group, OEH may waive the fees on request.

☐	$170 payment/cheque for initial fee is enclosed
☒	A waiver of fees is requested. Please provide reasons:
	The proponent is OEH.

19. Signature of proponent

Signature		Signature	
Name (printed)		Name (printed)	
Position		Position	
Date		Date	

References

Bannister HL, Lynch CE & Moseby KE 2016, Predator swamping and supplementary feeding do not improve reintroduction success for a threatened Australian mammal, *Bettongia lesueur*. *Australian Mammalogy* 38(2), 177-187.

Bellchambers K 2001, Brush-tailed bettong re-introduction and monitoring in the Flinders Ranges National Park and bushbird and emu monitoring in the Flinders Ranges and Gammon Ranges National Parks. Department for Environment and Heritage, South Australia.

Burbidge AA & McKenzie N 1989, Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* 50(1-4), 143-198.

Burrows N, Algar D, Robinson A, Sinagra J, Ward B & Liddelow G 2003, Controlling introduced predators in the Gibson Desert of Western Australia. *Journal of Arid Environments* 55(4), 691-713.

Caughley J, Bayliss P & Giles J 1984, Trends in kangaroo numbers in western New South Wales and their relation to rainfall. *Wildlife Research* 11(3), 415-422.

Christensen P & Burrows N 1994, Project desert dreaming: experimental reintroduction of mammals to the Gibson Desert, Western Australia. In: Serena M., (ed) *Reintroduction Biology of Australian and New Zealand Fauna*. Surrey Beatty & Sons, Chipping Norton, pp. 199-207.

Clayton JA, Pavey CR, Vernes K & Tighe M 2014, Review and analysis of Australian macropod translocations 1969–2006. *Mammal Review* 44(2), 109-123.

Cooke BD & Soriguer RC 2016, Do dingoes protect Australia's small mammal fauna from introduced mesopredators? Time to consider history and recent events. *Food Webs*.

Crisp H & Moseby K 2010, One-way gates: Initial trial of a potential tool for preventing overpopulation within fenced reserves. *Ecological Management & Restoration* 11(2), 139-141.

DEC 2009, *Fauna Note 32. Fencing and gates to reduce kangaroo damage*. Department of Environment and Conservation, Perth, WA

DECC 2009, *Operational Policy: Protecting Aboriginal Cultural Heritage*. Department of Environment and Climate Change NSW, Sydney.

DECCW 2010a, *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. Department of Environment, Climate Change and Water NSW, Sydney.

DECCW 2010b, *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales.* Department of Environment, Climate Change and Water NSW, Sydney.

DECCW 2010c, *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.* Department of Environment, Climate Change and Water NSW, Sydney.

DEWHA 2013, *Matters of National Environmental Significance: Significant impact guidelines 1.1* Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia, Canberra.

DoE 2009, Listed Key Threatening Processes, Department of the Environment, Canberra.

DoE 2015, *Threat abatement advice for ecosystem degradation, habitat loss and species decline in arid and sem-arid Australia due to the invasion of Buffel Grass* (Cenchrus

ciliaris and C. pennisetiformis). Australian Government Department of the Environment, Canberra.

DUAP 1999, *Is an EIS required? best practice guidelines for Part 5 of the Environmental Planning and Assessment Act 1979.* Department of Urban Affairs and Planning, Sydney.

Fanning PC 1999, Recent landscape history in arid western New South Wales, Australia: a model for regional change. *Geomorphology* 29(3), 191-209.

Fischer J & Lindenmayer DB 2000, An assessment of the published results of animal relocations. *Biological Conservation* 96(1), 1-11.

Gibson D, Johnson K, Langford D, Cole J & Clarke D 1995, The rufous hare-wallaby *Lagorchestes hirsutus*: a history of experimental reintroduction in the Tanami Desert, Northern Territory. In: Serena M, (ed) *Reintroduction Biology of Australian and New Zealand Fauna*. pp. 171-176.

Gordon CE, Moore BD & Letnic M 2017, Temporal and spatial trends in the abundances of an apex predator, introduced mesopredator and ground-nesting bird are consistent with the mesopredator release hypothesis. *Biodiversity and Conservation* 1-18.

Hardman B 2006, Reintroduction ecology of mala *(Lagorchestes hirsutus)* and merrnine (*Lagostrophus fasciatus*) at Shark Bay, Western Australia. PhD Thesis. Edith Cowan University.

Hardman B & Moro D 2006, Importance of diurnal refugia to a hare-wallaby reintroduction in Western Australia. *Wildlife Research* 33(5), 355-359.

Hayward MW, Moseby K & Read JL 2014, The role of predator exclosures in the conservation of Australian fauna. *Carnivores of Australia* (Eds AS Glen and CR Dickman) pp. 355-371.

Hetherington CA, Algar D, Mills H & Bencini R 2007, Increasing the target-specificity of ERADICAT® for feral cat (*Felis catus*) control by encapsulating a toxicant. *Wildlife Research* 34(6), 467-471.

Holdaway S, Shiner J & Fanning P 2004, Hunter-gatherers and the archaeology of the long term: An analysis of surface, stone artefact scatters from Sturt National Park, New South Wales, Australia. *Asian Perspectives* 43(1), 34-72.

James AI, Eldridge DJ & Hill BM 2009, Foraging animals create fertile patches in an Australian desert shrubland. *Ecography* 32(5), 723-732.

James AI, Eldridge DJ & Moseby KE 2010, Foraging pits, litter and plant germination in an arid shrubland. *Journal of arid environments* 74(4), 516-520.

Klöcker US 2006, Management of the terrestrial small mammal and lizard communities in the dune system of Sturt National Park, Australia: Historic and contemporary effects of pastoralism and fox predation. PhD Thesis. The University of New South Wales.

Letnic M, Feit A, Mills C & Feit B 2016, The crest-tailed mulgara (*Dasycercus cristicauda*) in the south-eastern Strzelecki Desert. *Australian Mammalogy* 38(2), 241-245.

Marks CA, Johnston MJ, Fisher PM, Pontin K & Shaw MJ 2006, Differential particle size ingestion: promoting target-specific baiting of feral cats. *Journal of Wildlife Management* 70(4), 1119-1124.

Miller G, Friedel M, Adam P & Chewings V 2010, Ecological impacts of buffel grass (Cenchrus ciliaris L.) invasion in central Australia – does field evidence support a fire-invasion feedback? *The Rangeland Journal* 32(4), 353-365.

Morris T & Letnic M 2017, Removal of an apex predator initiates a trophic cascade that extends from herbivores to vegetation and the soil nutrient pool. *Proceedings of the Royal Society B* 284(1854).

Moseby K, Hill BM & Read JL 2009, Arid Recovery – A comparison of reptile and small mammal populations inside and outside a large rabbit, cat and fox-proof exclosure in arid South Australia. *Austral Ecology* 34(2), 156-169.

Moseby K, Peacock D & Read J 2015, Catastrophic cat predation: a call for predator profiling in wildlife protection programs. *Biological Conservation* 191 331-340.

Moseby K & Read J 2006, The efficacy of feral cat, fox and rabbit exclusion fence designs for threatened species protection. *Biological Conservation* 127(4), 429-437.

Moseby K, Read J, Galbraith B, Munro N, Newport J & Hill B 2011a, The use of poison baits to control feral cats and red foxes in arid South Australia II. Bait type, placement, lures and non-target uptake. *Wildlife Research* 38(4), 350-358.

Moseby K, Read J, Paton D, Copley P, Hill B & Crisp H 2011b, Predation determines the outcome of 10 reintroduction attempts in arid South Australia. *Biological Conservation* 144(12), 2863-2872.

Moseby KE, Blumstein DT & Letnic M 2016, Harnessing natural selection to tackle the problem of prey naïveté. *Evolutionary applications* 9(2), 334-343.

Newsome A, Catling P, Cooke BD & Smyth R 2001, Two ecological universes separated by the dingo barrier fence in semi-arid Australia: interactions between landscapes, herbivory and carnivory, with and without dingoes. *The Rangeland Journal* 23(1), 71-98.

NPWS 2001, *Policy and Procedure Statement no. 9: Policy for the Translocation of Threatened Fauna in NSW*. NSW National Parks and Wildlife Service, Sydney.

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.

NSW SC 2000, *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.

NSW SC 2002, *Final Determination to List Competition and Grazing by the Feral European Rabbit* Oryctolagus cuniculus (L.) *as a Key Threatening Process on Schedule 3 of the TSC Act*, NSW Scientific Committee.

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.

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.

NSW SC 2009, *Final Determination to List Predation and Hybridisation by Feral Dogs,* Canis lupus familiaris *as a Key Threatening Process on Schedule 3 of the TSC Act*, New South Wales Scientific Committee.

OEH 2011, *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*, Office of Environment and Heritage, Sydney.

OEH 2012a, *Living with Fire in NSW National Parks: A strategy for managing bushfires in national parks and reserves 2012–2021*. Office of Environment and Heritage, Sydney.

OEH 2012b, *Regional Pest Management Strategy 2012–17, Far West Region: a new approach for reducing impacts on native species and park neighbours*. Office of Environment and Heritage, Sydney.

OEH 2016, *Guidelines for preparing a Review of Environmental Factors*, Office of Environment and Heritage, Sydney.

OEH 2017a, *NSW BioNet, Atlas of NSW Wildlife*. Office of Environment and Heritage, Sydney.

OEH 2017b, *Sturt National Park Draft Plan of Management*. Office of Environment and Heritage, Sydney.

Pedler RD, Brandle R, Read JL, Southgate R, Bird P & Moseby KE 2016, Rabbit biocontrol and landscape-scale recovery of threatened desert mammals. *Conservation Biology* 30(4), 774-782.

Priddel D, Wellard G & Shepherd N 1988, Movements of Sympatric Red Kangaroos, *Macropus rufus*, and Western Grey Kangaroos, *Macropus fuliginosus*, in Western New-South-Wales. *Wildlife Research* 15(3), 339-346.

Rees JD, Kingsford RT & Letnic M 2017, In the absence of an apex predator, irruptive herbivores suppress grass seed production: Implications for small granivores. *Biological Conservation* 213 13-18.

Richards J & Short J 2003, Reintroduction and establishment of the western barred bandicoot Perameles bougainville (Marsupialia: Peramelidae) at Shark Bay, Western Australia. *Biological Conservation* 109(2), 181-195.

Robertson G 1987, Effect of drought and high summer rainfall on biomass and comsumption of grazed pastures in western New South Wales. *The Rangeland Journal* 9(2), 79-85.

Spencer P 1991, Evidence of predation by a feral cat, *Felis catus* (Carnivora: Felidae) on an isolated rock-wallaby colony in tropical Queensland. *Australian Mammalogy* 14 143-144.

TSSC 2001, *Commonwealth Listing Advice on Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs*, Threatened Species Scientific Committee.

Walker PJ 1991, *Land systems of western New South Wales*. Soil Conservation Service of NSW, Sydney.

West R, Letnic M, Blumstein DT & Moseby KE 2017, Predator exposure improves anti-predator behaviour in a threatened mammal. *Journal of Applied Ecology,* doi 10.1111/1365-2664.12947.

Wheeler R & Priddel D 2009, The impact of introduced predators on two threatened prey species: a case study from western New South Wales. *Ecological Management & Restoration* 10(s1), S117-S123.