Review of Environmental Factors

Quorn Park 132kV Switching Station and Powerline Augmentation Work

Project No. 799764

June 2023

Revision History	
Version	**Nature of Revision**
Draft01	Draft prepared for Essential Energy's Environmental Services peer review.
Draft02	Draft prepared for Essential Energy's Environmental Services Manager review.
Final01	Final prepared for Essential Energy's determination.

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Acronyms and Abbreviations

AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
ADSS	All-dielectric self-supporting. A type of fibre optic cable which is nonconductive, self-supporting and is capable of being erected under tension between supports.
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASS	Acid Sulfate Soils
AASS	Actual Acid Sulfate Soils
AEMO	Australian Energy Market Operator
BDAR	Biodiversity Development Assessment Report
CEMP	Construction Environmental Management Plan
Consequence	The outcome of an event expressed qualitatively or quantitatively, being a loss, injury, disadvantage or gain.
dB(A)	Decibels (A) weighted
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DPE	Department of Planning and Environment
DP	Deposited Plan
EMF	Electric and Magnetic Fields
Environmental Aspect	Any element of an organisation's activities, products or services that can interact with the environment.
Environmental Impact	Any change in the environment whether adverse or beneficial, wholly or partially resulting from organisation activities, products or services.
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Reg	*Environmental Planning and Assessment Regulation 2021*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPIs	Environmental Planning Instruments
ES Act	*Electricity Supply Act 1995*
ESD	Ecologically Sustainable Development
EWP	Elevated Work Platforms
FSC	Field Service Centre (Essential Energy)
FM Act	*Fisheries Management Act 1994*
GHG	Greenhouse Gas

Ha	Hectare
IPC	Independent Planning Commission
kV	Kilovolts
LALC	Local Aboriginal Land Council
Likelihood	A qualitative description of probability or frequency
LEP	Local Environmental Plan
LG Act	*Local Government Act 1993*
LGA	Local Government Area
mG	Milligauss
MVA	Mega Volt Amps
NES	National Environmental Significance
NO_x	Oxides of Nitrogen
NPW Act	*National Parks and Wildlife Act 1974*
PASS	Potential Acid Sulfate Soils
POEO Act	*Protection of the Environment Operations Act 1997*
REF	Review of Environmental Factors
RF Act	*Rural Fires Act 1997*
Roads Act	*Roads Act 1993*
RMS	Roads and Maritime Service
SCADA	Supervisory control and data acquisition. A computer-based system for gathering and analysing real-time data to monitor and control equipment that deals with critical and time-sensitive materials or events.
SEE	Statement of Environmental Effects
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
SHR	State Heritage Register
SIS	Species Impact Statement
SVTM	State Vegetation Type Mapping
SWMP	Soil and Water Management Plan
T&I SEPP	*State Environmental Planning Policy (Transport and Infrastructure) 2021*
WM Act	*Water Management Act 2000*

Review of Environmental Factors Approval Form

REF name	Quorn Park 132kV Switching Station and Powerline Augmentation Work Project No. 499119
REF prepared by	Nathan Hegerty
Title	Senior Environmental Engineer
Qualifications	Bachelor of Environmental Science Master of Environmental Law
Proponent Name	Essential Energy
Proponent Address	8 Buller St Port Macquarie NSW 2444

This Review of Environmental Factors (REF) assesses the potential impacts that may result from the proposed and associated activities as outlined in “Description of the Proposal” section of this report.

Essential Energy is a state-owned corporation and is a determining authority as defined in the *Environmental Planning and Assessment Act 1979* (EP&A Act). The proposal satisfies the definition of an ‘activity’ under the EP&A Act, and as such Essential Energy must assess and consider the environmental impacts of the proposal before determining whether to proceed. This REF has been prepared in accordance with section 5.5 of the EP&A Act and clause 171 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Reg). The EP&A Act requires Essential Energy to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity. The EP&A Reg sets out environmental factors to be considered in making that assessment. If the activity is considered likely to significantly affect the environment, additional assessment requirements under the EP&A Act would be required.

Section 5.7 of the EP&A Act states that a determining authority shall not carry out an activity, or grant an approval in relation to an activity, that is likely to significantly affect the environment (including critical habitat) or threatened species, populations or ecological communities, or their habitats, unless the determining authority has examined and considered an Environmental Impact Statement or Species Impact Statement in respect of the activity.

The REF has addressed the matters that are required to be considered by Part 5 of the EP&A Act, with the conclusion that if the activity is carried out as described, it is not likely to have a significant effect on the environment (including critical habitat) or threatened species, populations, ecological communities or their habitats, and accordingly an Environmental Impact Statement is not required. The mitigation strategies forming part of the activity are fully considered and discussed in the REF.

The activity was also assessed against the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). As the proposed activity will not have, and is not likely to have, a significant impact on matters of national environmental significance, a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) is not required.

The proposed activity is permissible under all relevant state and federal legislation, including the EPBC Act and the *Biodiversity Conservation Act 2016* (NSW).

Under *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) the activity is classified as development for the purpose of an electricity transmission or distribution network undertaken by or on behalf of a public authority, and is hence permitted on the land without the requirement for development consent.

Declaration

The Review of Environmental Factors for the proposed activity has been assessed by Essential Energy.

Considering the assessment of the impacts, including sections 1.7 and 5.5 of the *Environmental Planning and Assessment Act 1979* and clause 171 of the *Environmental Planning and Assessment Regulation 2021*, it is concluded that:

- there is not likely to be a significant environmental effect as a result of the construction, operation and maintenance of the activity, and an Environmental Impact Statement is not required; and
- a Species Impact Statement (SIS), or Biodiversity Development Assessment Report (BDAR) is not required.

Site and Assessment Review – I affirm that the information provided within this assessment is accurate to the best of my knowledge, belief and information.

Nathan Hegerty Digitally signed by Nathan Hegerty Date: 2023.06.29 14:35:54 +10'00' Nathan Hegerty Senior Environmental Engineer (Author) Date:	Chris Dunn Digitally signed by Chris Dunn Date: 2023.06.29 14:43:29 +10'00' Chris Dunn Environmental Engineer (Peer Review) Date:

The assessment has been reviewed and it is recommended that the Activity may now proceed subject to the implementation of the recommendations and mitigation measures contained in the REF documentation.

Adam Hawke
Project Manager
Date:

Adam Hawke
Digitally signed by Adam Hawke
Date: 2023.07.03 08:12:53 +10'00'

1. Considering the assessment of the impacts, including sections 1.7 and 5.5 of the *Environmental Planning and Assessment Act* 1979 and clause 171 of the *Environmental Planning and Assessment Regulation* 2021, it is determined that there is not likely to be a significant environmental effect as a result of the construction, operation and maintenance of the Quorn Park 132kV Switching Station and augmentation of the existing 132kV powerline network. Neither an Environmental Impact Statement (EIS), nor SIS, nor BDAR is required.

2. The Activity may now proceed subject to obtaining and complying with the relevant approvals as identified in the REF and subject to the implementation of the recommendations and mitigation measures contained in the REF documentation.

Brett Hayward
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Date: 2023.07.07 16:18:04 +10'00'

Brett Hayward
Environmental Services Manager
Date:

Executive Summary

Background / Justification

Essential Energy has received connection requests from several new major customers, including a solar farm, a mine, and the Parkes Special Activation Precinct (Parkes SAP), to connect to Essential Energy's existing 132 kilovolt (kV) network in the Parkes region. In order to facilitate the connection of these new major customers, Essential Energy is proposing to design, construct, operate and maintain a new 132kV Switching Station (SS), located off Back Trundle Road, as well as augment the existing powerline network in the area.

Construction and operation of the new 132kV SS and augmentation of the existing powerline network will ensure the local electricity infrastructure meets the current and future needs for the new customers. The proposed work will also strengthen Essential Energy's existing electricity network in the broader area, as well as increase its capacity, which will help support future electricity connections.

The Proposal

Essential Energy is proposing to design, construct, operate and maintain a new 132kV SS, and augment the existing powerline network. The scope for the new SS includes construction of internal and external access roads; site bench and drainage system; equipment footings for underground pits and conduits; an earth grid; fencing; erection of a tilt panel design control room; installation of various pieces of switchgear and electrical equipment; and installation of an on-site wastewater system. Powerline augmentation works include construction of two new sections of 132kV powerlines between the proposed new SS site and an existing 132kV powerline (feeder 300) approximately 1.2 kilometres (km) west. Each new section of 132kV powerline will comprise an overhead and underground component. In addition, it is proposed to realign approximately 1.16km of existing 66kV powerline, 750m of which will be co-located on the southern arm of the new 132kV powerlines.

Project Alternatives

One option would be to refrain from undertaking any further development of the network in the area. The consequences of Essential Energy doing nothing would be that, as years passed, supply interruptions would occur more frequently and affect more people, and there would be insufficient capacity within the existing electricity supply network to enable the connection of the new major customers. Due to Essential Energy's network licence obligations, the 'do nothing' option is not a viable alternative to the proposed activity.

In response to several new major new customer connection requests, Essential Energy has been considering and investigating several 132kV network augmentation options for the Parkes region. The preferred option, subject to assessment in this REF, was chosen as it meets the needs of the major customers, strengthens Essential Energy's existing electricity network in the broader area, and increases its capacity, which will help support future electricity connections, while having the least societal and environmental impacts.

Statutory Planning and Legislation

Clause 2.44 of *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) applies to electricity transmission and distribution activities undertaken by an energy supply authority. Clause 2.44 states that development for the purpose of a transmission or distribution network may be carried out by or on behalf of an electricity supply authority or public authority without consent on any land, with additional requirements for land reserved under the *National Parks and Wildlife Act 1974*.

As the activity does not require development consent, Essential Energy is the designated determining authority. Additionally, whilst Essential Energy does not require development consent to undertake the proposed activity, it has an obligation under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to consider the environmental impacts of the activity.

Specifically, Essential Energy has a statutory obligation to examine and take into account, to the fullest extent possible, all matters affecting or likely to affect the environment by reason of this

activity. This REF has been prepared to facilitate the determination through consideration of the relevant factors specified in section 5.5 of the EP&A Act and clause 171 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Reg).

Environmental Impact Assessment

This REF has been prepared in accordance with Part 5, Division 5.1 of the EP&A Act to assess the environmental impacts associated with the construction, operation and maintenance of the proposed activity. The REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the project.

A number of potential environmental impacts associated with the project have been avoided or reduced to acceptable levels during the design development and assessment stages. However, the project may still result in some impacts including air quality (dust), noise, vegetation, traffic, waste generation, and visual amenity during construction and operation, as outlined in **Section 6**. Management and mitigation measures to alleviate these impacts have been developed as part of this REF and would be implemented during construction and operation of the proposal.

Considering the assessment of the impacts detailed in this REF, it is concluded that the proposed activity is not likely to have a significant impact on the environment. On balance, the project is justified on the basis of supporting major customer connections and strengthening Essential Energy's electricity network in the broader area, whilst minimising potential environmental impacts.

1. Introduction

1.1 The Proposal

This Review of Environmental Factors (REF) assesses the potential environmental impacts associated with the construction, operation and maintenance of the proposed Quorn Park 132 kilovolt (kV) Switching Station (SS) and augmentation of the existing powerline network, approximately 10 kilometres northwest of Parkes, New South Wales (NSW) (refer **Figure 1-1**). The significance of impact has been determined and appropriate mitigation measures recommended.

1.2 Context and Justification of the Proposal

Essential Energy has received connection requests from several new major customers, including a solar farm, a mine, and the Parkes Special Activation Precinct (Parkes SAP), to connect to Essential Energy's existing 132kV network in the Parkes region. In order to facilitate the connection of these new major customers, Essential Energy is proposing to design, construct, operate and maintain a new 132kV SS, located off Back Trundle Road, as well as augment the existing powerline network in the area.

Construction and operation of the new 132kV SS and augmentation of the existing powerline network will ensure the local electricity infrastructure meets the current and future needs for the new customers. The proposed work will also strengthen Essential Energy's existing electricity network in the broader area, as well as increase its capacity, which will help support future electricity connections.

1.3 Network Investment Criteria

Network asset investment by Essential Energy is generally required to:

- Meet Essential Energy's duty of care
- Connect customers to the supply network
- Provide a satisfactory standard of supply to customers.

The overall performance of the network is driven by the reliability of individual network components and the redundancy provided by the network to enable maintenance of supply at times when critical parts of the network are out of service (due to maintenance or repair requirements). To maintain acceptable standards of customer service it is necessary to ensure:

- Infrastructure performance (reliability) is maintained at acceptable levels
- The network design provides adequate security (redundancy).

The reliability performance of equipment and infrastructure is managed through maintenance and replacement of that infrastructure. For Essential Energy, the decision to replace infrastructure is based on an assessment of equipment condition and consideration of the strategic replacement needs of the network.

1.4 Proposal Objectives

The primary objective of the project is to design, construct, operate and maintain a new 132kV SS, and augment the existing powerline network, to service several new major customer connections, while also strengthening Essential Energy's existing electricity network in the broader area. Secondary objectives associated with the project are to:

- Maximise social and economic benefits
- Minimise the environmental and social impacts.

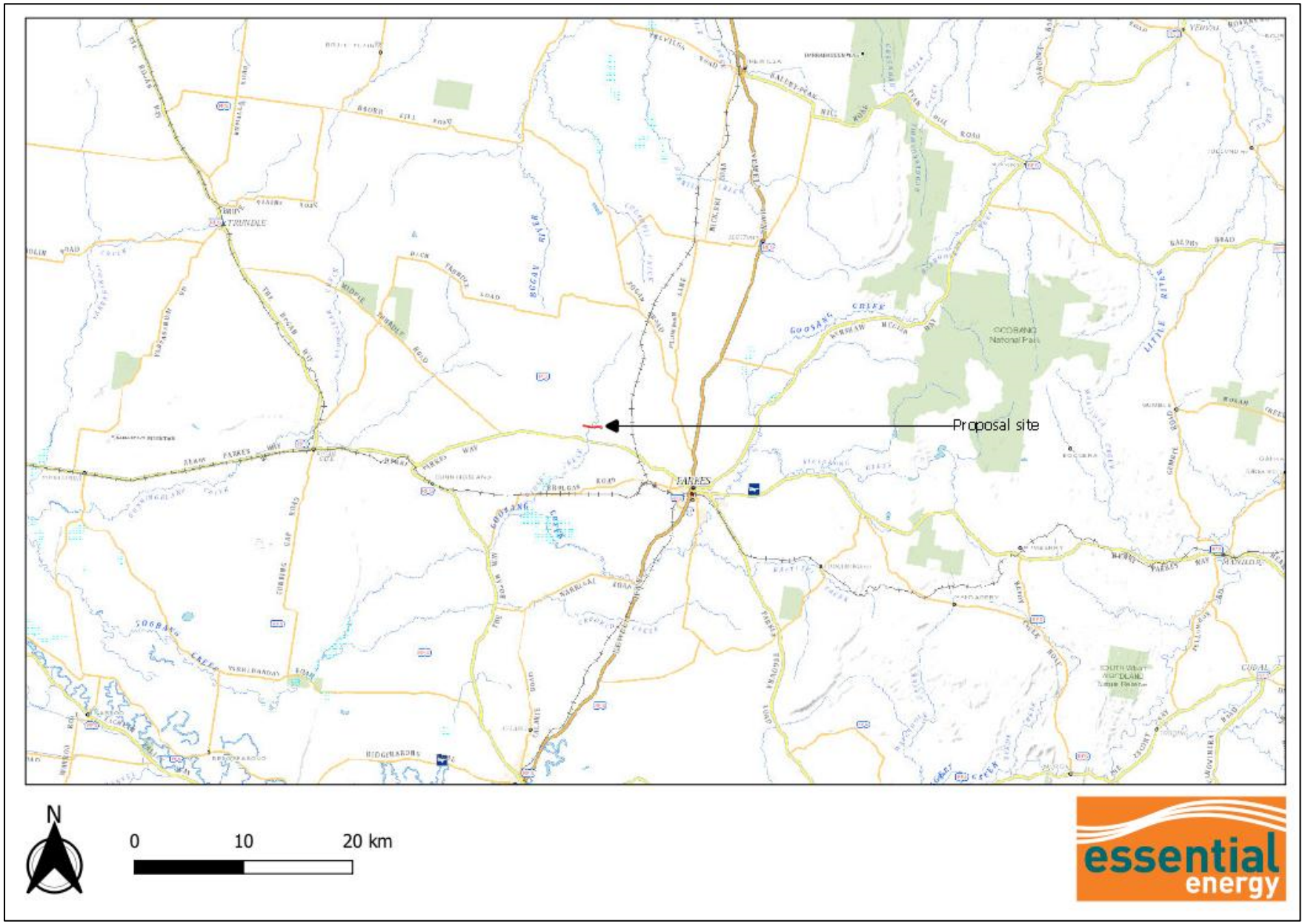

Figure 1-1: Proposal location in regional context

1.5 Proposal Site

The proposed new 132kV SS will be located on cleared farmland currently used for cropping and grazing, within its own newly created land parcel, which will be owned by Essential Energy. The SS land parcel will be located north of an unsealed portion of Back Trundle Road (refer **Plate 1-1**), and within the footprint of the Quorn Park Solar Farm (QPSF), which is subject to a separate State Significant Development (SSD) application, approved under Part 4 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act). The SS access road is proposed to be constructed to connect the SS with Back Trundle Road to the south, and will traverse a strip of planted wind break vegetation (refer **Plate 1-2**), as well as remnant roadside vegetation, within the road reserve of Back Trundle Road (refer **Plate 1-3**).

Augmentation of the existing 132kV network will involve constructing two new, three wire powerlines that will extend from the western boundary of the SS land parcel, and connect to Essential Energy's existing 132kV powerline, located approximately 1.4 kilometres (km) west of the SS. Each new section of 132kV powerline will comprise an overhead and underground component. An approximately 1.16km section of existing 66kV overhead powerline will also be realigned, with 750m being co-located with the southern arm of the overhead 132kV component of the project. The proposed routes of the 132kV powerlines and realigned 66kV powerline intersect with the western margin of the planted wind break, and remnant roadside vegetation in the vicinity of a private residence access road near the intersection of Back Trundle Road and McGarth Lane, both of which are unsealed. At this same intersection, the southern arm of the 132kV powerline and realigned 66kV powerline will impact on a small patch of remnant roadside vegetation within the Currajong Travelling Stock Reserve (TSR) (Crown Land) (refer **Plate 1-4**). The remaining overhead components of the 132kV and co-located 66kV powerlines traverse cleared and recently ploughed farmland, south of Back Trundle Road (refer **Plate 1-5**). Further assessment and confirmation of vegetation types and potential impacts to biodiversity is presented in **Chapter 6** and **Appendix A**.

The new 132kV SS, new sections of 132kV powerlines, and realigned 66kV powerline collectively form the "proposal site". **Figure 1-2** shows the location of the proposal site in its local context.

The proposal site is located within the Parkes Shire Council (PSC) Local Government Area (LGA) and is currently zoned RU1 Primary Production according to the *Parkes Local Environmental Plan 2012* (Parkes LEP). The immediate surrounding landscape consists predominately of cleared land used for cropping and grazing, intersected by roads and existing powerlines, with low density rural residences located throughout the landscape. Small patches of remnant vegetation are scattered within the predominately cleared landscape that surrounds the proposal site, including within the Currajong TSR (Crown Land), located either side of McGrath Lane. An example of the vegetation within the Currajong TSR, at the intersection of McGrath Lane and Back Trundle Road, is shown in **Plate 1-4**.

The closest waterway is an unnamed Strahler fourth order ephemeral drainage line that runs along the northern side of Back Trundle Road, approximately 70 metres (m) south of the proposed new SS. The SS access road will be constructed over this drainage line before it connects with Back Trundle Road. The ephemeral drainage line flows into Ridgey Creek (refer **Plate 1-6**), also a Strahler fourth order ephemeral waterway, which the proposed overhead components of the powerlines will span, on the southern side of Back Trundle Road approximately 880m west of the proposed new SS (refer **Figure 1-2**). Current site drainage along the proposed powerline routes would be expected to follow overland flow, towards the aforementioned ephemeral drainage line and Ridgey Creek. Once constructed the SS site would have its own internal drainage. Further assessment of waterways is provided in **Chapter 6**.

The closest sensitive receiver is a rural residence (R1) located approximately 550m southwest of the western extent of the proposal site. The next closest sensitive receiver is a rural residence (R2) located approximately 1km northwest of the proposal site, while a third rural residence (R3) is located approximately 1.5km north of proposed site (refer **Figure 6-1**). R2 will cease to be a sensitive receiver once construction of the QPSF project commences, as it is located within the development footprint of this project, and will no longer function as a residence.

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Figure 1-2: Proposal site in local context

Plate 1-1: Cropping land, north of Back Trundle Road on which the proposed new SS will be located.

Plate 1-2 – Planted wind break vegetation along the southern boundary of the proposed new SS lot boundary in the vicinity of the proposed access road.

Plate 1-3: Remnant roadside vegetation in the road reserve of Back Trundle Road in the vicinity of the proposed access road.

Plate 1-4: Patch of remnant roadside vegetation within the Currajong TSR, at the intersection of Back Trundle Road and McGrath Lane

Plate 1-5: Looking west along the proposed overhead section of 132kV and realigned 66kV powerline routes.

Plate 1-6: Unformed, degraded ephemeral channel of Ridgey Creek, which the new sections of 132kV and realigned 66kV overhead powerlines will span.

1.6 Study Area

The broader study area includes the surrounding predominately cleared rural areas, used for cropping and other agricultural pursuits. Sensitive environmental areas within the broader region include waterways, wetlands, biodiversity, Aboriginal and non-Aboriginal heritage, and other environmental values, that form part of the immediate surrounding landscape.

1.7 Purpose of REF

The purpose of this REF is to document the assessment of potential environmental impacts of the proposal, and identify if there are likely to be any significant environmental impacts. It informs Essential Energy's determination of the proposal under Part 5 (Division 5.1) of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

2. Description of the Proposal

2.1 Scope of Works

Essential Energy is proposing to design, construct, operate and maintain a new 132kV SS, and augment the existing powerline network. The scope for each component is outlined below:

2.1.1 132kV SS

Construction of the SS will include civil works, consisting of:

- Internal and external access roads
- Site bench and drainage system
- Equipment footings for underground pits and conduits
- Earth grid
- Fencing
- On-site wastewater system.

Other construction work will include:

- The erection of tilt panel design control room, including a metering panel, battery room, communication room and a separate building for amenities
- Installation of various pieces of switchgear an electrical equipment, including gas switches, circuit breakers, voltage transformers and power transformers
- Construction of an approximately 80m long by approximately 8m wide all-weather access road to connect Back Trundle Road to the south of the SS. An approximately 50m wide clearing zone through the planted and roadside vegetation adjacent to Back Trundle Road has been allowed for the construction of this road. This clearing zone will also be used to install new sections of low voltage cable and optical fibre required as part of this project (refer **Section 2.1.2**), and a future 132kV overhead powerline that will be required to connect the new SS to the Parkes SAP, further to the south.

Refer **Figure 2-1** for the proposed layout of the Switching Station.

2.1.2 Augmentation of Existing Powerline Network

In order to connect the proposed new 132kV SS to Essential Energy's existing 132kV network, the following scope of works is proposed:

- Construction of two new sections of 132kV powerline between the proposed new 132kV SS and an existing 132kV powerline (feeder 300) approximately 1.2km west, to create a loop in and out of the proposed new SS. Each new section of powerline will comprise an overhead and underground component, as follows:

  Underground:

  - From the proposed new SS site to the new proposed underground-overhead (UGOH) poles (Pegs 9/10 and 11/12) (approximately 300m), the powerline will be installed as underground cables, to avoid conflict with an existing section of overhead 132kV powerline.
  - The underground components will include:
    - Installation of four alignments of six 200 millimetre (mm) conduits and two 63mm (one comms, one earth) conduits
    - Installation of two new circuits of three 132kV underground cables
    - Installation of two new earth wires.

  Conduits and cables will be laid in two separate trenches approximately 1.0m wide by 1.2m deep by 300m long.

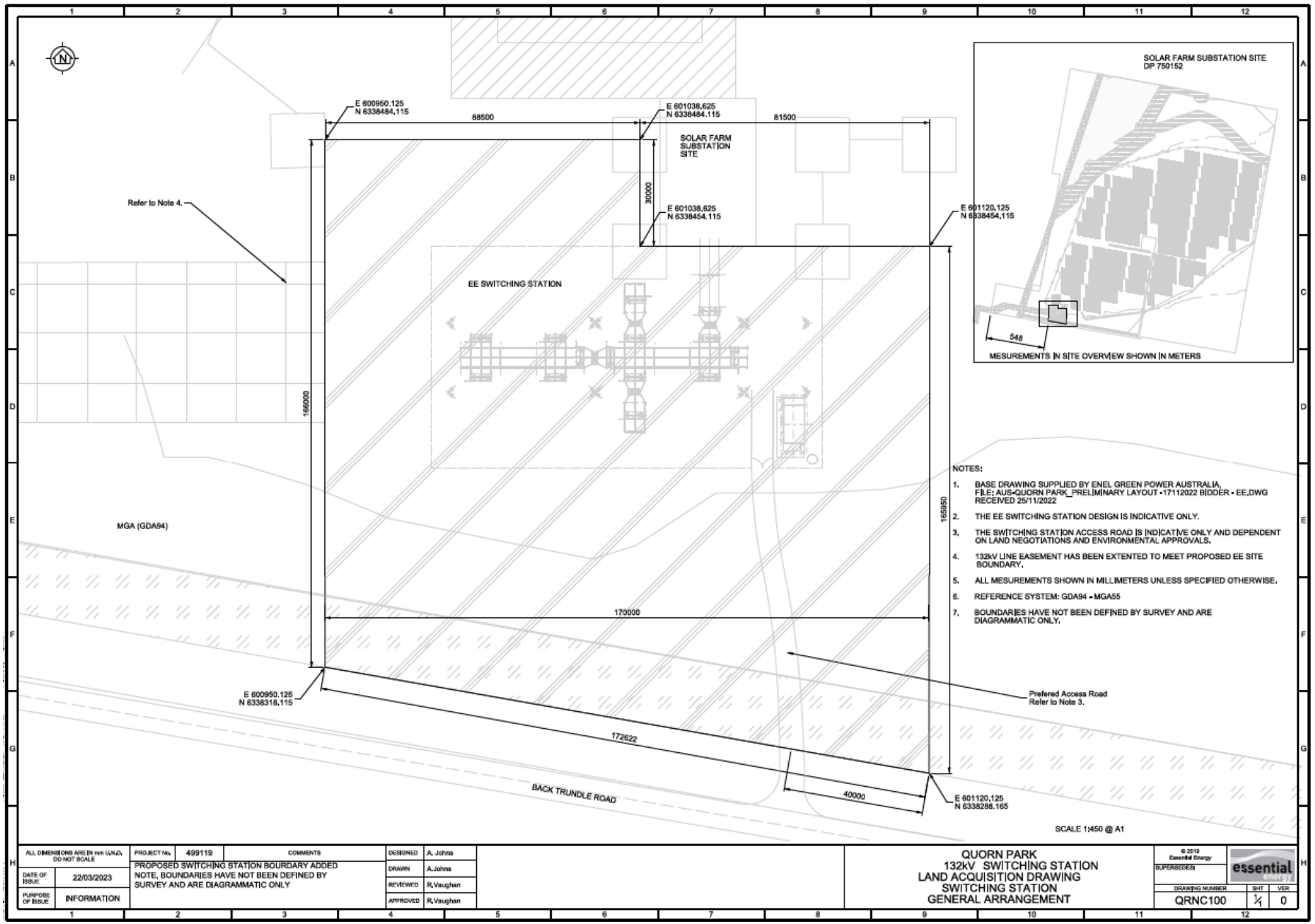


Figure 2-1: Layout of proposed new 132kV SS

- In addition it is proposed to:
  - Install a new approximately 150m section of underground optic fibre cable between the existing 66kV network, on the southern side of Back Trundle Road, and the new proposed SS
  - Install new low voltage service cable between the existing 11kV powerline that runs parallel to Back Trundle Road, between the planted and roadside vegetation, to the auxiliary supply connection of the proposed new SS.

  It is proposed to install the new optical fibre and low voltage cable referred to above within a 50m wide clearing zone allowed for as part of the SS access road construction.

Overhead

- From the proposed new UGOH poles (Pegs 9/10 and 11/12) the remainder of each of the new sections of 132kV powerline will be constructed as overhead and continue in a westerly direction for approximately 130m before turning southwest for approximately 280m, as they cross Back Trundle Road
- The proposed overhead route then heads in a westerly direction again on the southern side of Back Trundle Road for approximately a further 570m until reaching the connection point with the existing 132kV powerline
- The overhead components of the new sections of 132kV powerlines will include the installation of 22 new poles
- In addition it is proposed to:
  - Erect a new 11kV substation pole on the existing 11kV powerline that runs parallel to Back Trundle Road, between the planted and roadside vegetation, and install suitable substation earthing
  - Realign approximately 1.16 kilometres of existing 66kV powerline (750m of which will be co-located with one of the 132kV powerlines) and install one new pole.

  Pole holes will be augured using a truck-mounted borer (approximate diameter of 1.2m) to an approximate depth of 3.0m.

Figure 2-2 provides an overview of the powerline augmentation works relative to the proposed new switching station site.

The project also includes the replacement of existing overhead earth wire (OHEW) with optical ground wire (OPGW) along an existing 66kV powerline (feeder 89L), from Back Trundle Road to TransGrid's 132kV Substation, 1500m south of the proposal site. This work will all be contained within the existing 66kV powerline corridor.

2.1.3 Staging areas

The designated lot for the SS will house all the construction equipment required for that component of the activity. Construction equipment and machinery for the powerline component of the activity will move as work progresses along the proposed route. All civil work will be completed by a suitably qualified contractor.

2.2 Design Criteria

The proposed new 132kV SS will primarily be constructed to enable the connection of several new major customers, and increase electricity reliability in the broader region. The design has been developed to meet the following criteria:

- Meet the design life requirements
- Be cost-effective when assessed on a life-cycle cost basis
- Be capable of being constructed cost-efficiently and within time constraints
- Provide durability and reliability of the intended function
- Minimise potential environmental impacts.

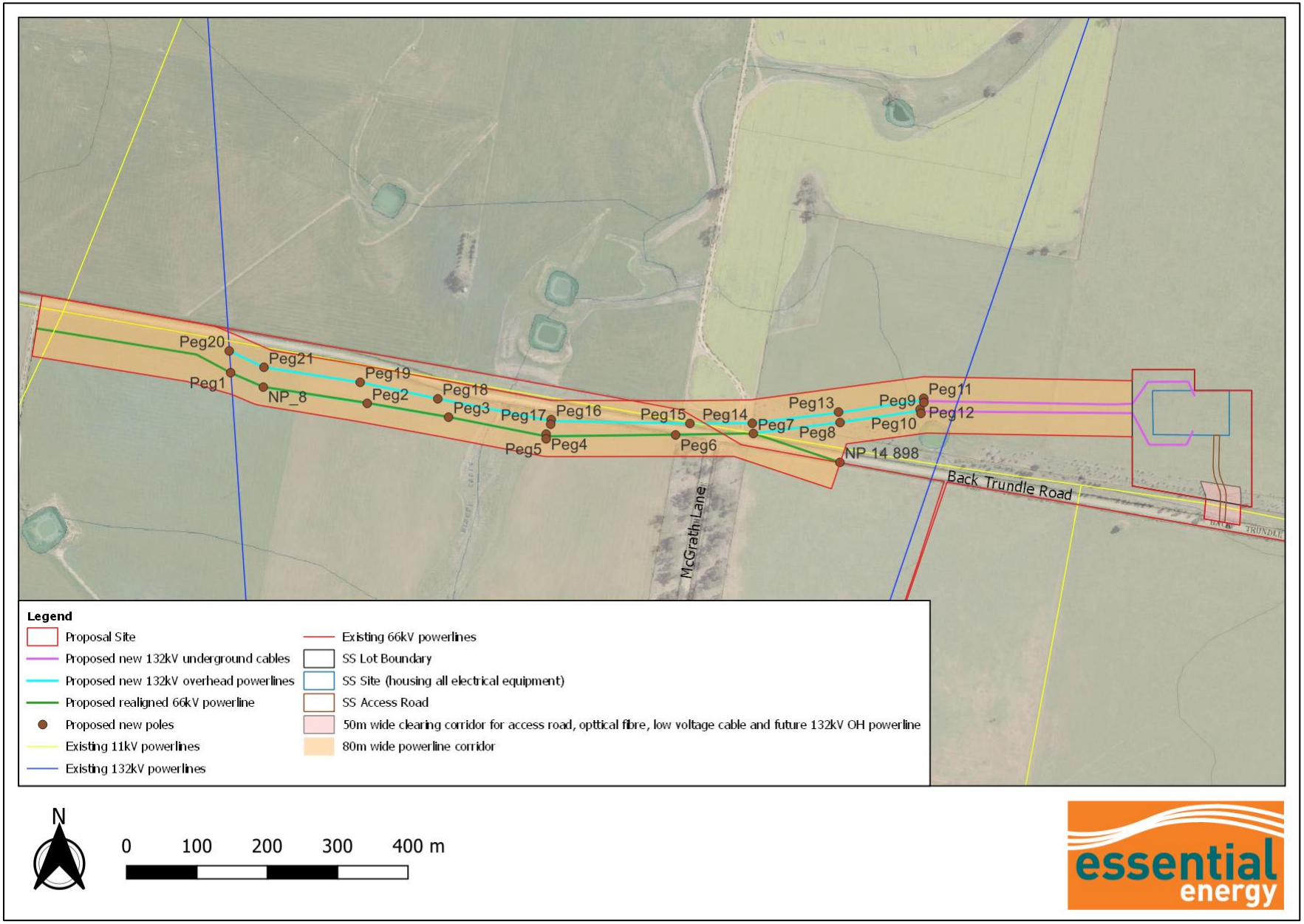


Figure 2-2: Proposed powerline augmentation works relative to SS site

2.3 Building Code of Australia

Development by the Crown under section 6.28 of the EP&A Act is required to comply with the technical provisions of the State's building laws and in particular, the BCA.

Essential Energy's design standards for buildings and switching stations meet the requirements of the BCA where appropriate; and the relevant Australian standards (such as AS2067 2008 Substations and high voltage installations exceeding 1kV a.c.).

2.3.1 Utilities

Water supply for the SS site will be supplied via rainwater tanks, while a septic system will be installed for wastewater treatment and application to land.

2.3.2 Fencing and signage

Security of a SS is of paramount importance due to the extreme dangers which energised electrical equipment can pose to untrained individuals. Adequate security fencing will be provided. The fence will be designed in accordance with Essential Energy's SS security fencing requirements.

2.3.3 Access and parking

Car parking will be provided within the SS yard. Given that the SS will be an unmanned facility, this will provide for more than adequate off-street parking.

2.4 Construction Activities

2.4.1 Timing and work hours

Construction work is expected to commence in 2023, and take approximately 12 months to complete, weather dependant.

In considering the remote nature of the proposed SS site, being at least 550m away from the nearest sensitive residential receiver, work hours will be between 7am and 6pm Monday to Saturday. On occasions, works outside these hours that are audible at the nearest sensitive receiver may be undertaken where the following requirements are met:

- Neighbours (and other sensitive receivers) adjacent to the works or the local council or the Environment Protection Authority (EPA) have been notified, and
- The works are justified on the basis that they are emergency works, or, because of supply security network outages or construction limitations, it is deemed that the works can only be achieved outside these hours.

2.4.2 Resources and equipment

The following equipment is likely to be used on site to complete the work:

- Excavator
- Backhoe
- Elevated work platforms (EWP)
- Trucks
- Concrete trucks
- Cranes
- Grader
- Roller
- Bulldozer
- Concrete pump truck
- Forklift
- Under borers
- Bobcat
- Water truck
- Trencher
- Cable trucks
- Light vehicles.

2.4.3 Impact mitigation

The mitigation measures as detailed in **Section 6** form part of the proposed activity and will be implemented, as required, as part of the construction and operational phases.

2.5 Operation and Maintenance Requirements

Once the project is constructed, periodic maintenance will be required. Regular inspections of the infrastructure will be undertaken to help identify defects and hazards such as damaged components and vandalism. The proposal site will not accommodate staff or contractors on a permanent basis. Periodic collection of waste may be required.

Likely maintenance activities include:

- Vegetation maintenance around perimeter of new SS and to maintain legislative clearances around the augmented sections of powerlines
- General landscape maintenance within the new SS site
- Regular inspection and maintenance of SS equipment and powerlines.

3. Consultation

3.1 Overview

Community consultation defines the processes we use to seek views or provide information about projects. The term consultation can describe processes ranging from simply delivering information to residents, community information displays, or holding meetings with community representatives designed to actively seek feedback from local communities into a particular project.

The population as a whole is more aware than ever of their social, environmental and economic needs. They want to know about what is planned for their area and how it would impact on them.

Incorporating community consultation as a key business practice is both a necessary and a desirable path for Essential Energy to take. It must be undertaken in good faith and be transparent in all activities.

Essential Energy has in place a policy for community consultation on all major projects. The policy ensures that the community is informed about proposed development, and that concerns and issues are taken into consideration.

3.2 Engaging the Community

Consultation has been ongoing with QPSF regarding the location of the SS site and powerline augmentation works. Landholder consultation regarding the proposed routes of the augmented powerlines has also occurred. Impacted sensitive receivers along the proposal route would also be advised of the works schedule and provided with details of a site contact.

3.3 Consultation and its Requirements under the T&I SEPP 2021

Under the EP&A Act, Essential Energy is the determining authority for certain developments defined under the T&I SEPP as being permissible without consent. While the nature of work being undertaken does not require council consent, Division 1 of the T&I SEPP does provide consultation requirements with the local council where works are anticipated to impact upon council infrastructure, local heritage items, flood liable land and certain land within the coastal zone. In addition, consultation may be required with the State Emergency Service (flood liable land) and other specified public authorities in certain circumstances.

The proposed new SS site will include its own site drainage, and stormwater flow within the powerline corridors will likely be overland towards the nearby ephemeral drainage line and Ridgey Creek. As such, the proposal is unlikely to have a substantial impact on the local council's stormwater system. Water supply for the SS site will be supplied via rainwater tanks, and a septic system will be installed for wastewater, which will require approval under the *Local Government Act 1993* (refer **Section 5.3.6**), but not a connection to any part of the sewerage system. While some disruption to local roads may occur during the delivery of large plant and equipment, the works, including pole hole auguring in the road reserve of Back Trundle Road and McGrath's Lane, are considered to be minor and inconsequential, and will not involve significant disruption of pedestrian or vehicle traffic, or strain the capacity of the local road system. Consultation with the local council is therefore not triggered under clause 2.10 of the T&I SEPP.

The proposal site is not located within a mapped area of local heritage, according to the Parkes LEP. Consultation with the local council is therefore not triggered under clause 2.11 of the T&I SEPP.

The proposed SS site is located above the one in 100 year flood level, however the powerline augmentation work is partially located on flood liable land, predominately where it spans Ridgey Creek. However, given the small scale and intermittent nature of structures (i.e., power poles), the proposed activity is not expected to change flood patterns more than a minor extent. Therefore consultation with the local council under clause 2.12 of the T&I SEPP is not required.

The proposal is not a relevant provision in accordance with clause 2.13(2), and therefore consultation with the State Emergency Service is not required under clause 2.13 of the T&I SEPP.

The proposal is not located within the coastal zone, therefore consultation with the local council is not triggered under clause 2.14 of the T&I SEPP.

The proposal is not located on land, or adjacent to land, that would trigger consultation with other specified public authorities under clause 2.15 of the T&I SEPP.

The proposal is not a development type listed in clause 2.16(1) of the T&I SEPP, and therefore there is no requirement to consider *Planning for Bushfire Protection* guide.

In addition to consultation requirements, additional notification and approval requirements are outlined in **Table 5-2**.

4. Project Alternatives

4.1 Do Nothing (Maintain Current Supply Infrastructure)

One option would be to refrain from undertaking any further development of the network in the area. The consequences of Essential Energy doing nothing would be that, as years passed, supply interruptions would occur more frequently and affect more people, and there would be insufficient capacity within the existing electricity supply network to enable the connection of new major customers.

Due to Essential Energy's network licence obligations, the 'do nothing' option is not a viable alternative to the proposed activity.

4.2 Project Planning Options

In response to several new major customer connection requests, Essential Energy has been considering and investigating several 132kV network augmentation options for the Parkes region. The preferred option, subject to assessment in this REF, was chosen as it met the needs of the major customers, strengthens Essential Energy's existing electricity network in the broader area, and increases its capacity, which will help support future electricity connections, while having the least societal and environmental impacts.

5. Environmental Legislation

The following section addresses the regulatory and statutory context of the proposed activity including its definition, land use permissibility, and compliance with the relevant environmental planning instruments (EPIs).

5.1 Environmental Planning and Assessment Act, 1979 (EP&A Act)

The EP&A Act is the primary piece of legislation regulating land use planning in NSW. It provides the framework for the development of state and local planning instruments which, through their hierarchy, determine the statutory process for environmental impact assessment. Under the EP&A Act there are two distinct processes, which are:

- Part 4 - 'development' proposals which require consent, including state significant development
- Part 5, which regulates 'activities' and requires an approval by a determining authority (e.g. Essential Energy). Part 5 also includes an assessment pathway for state significant infrastructure.

The proposal satisfies the definition of an activity under Part 5 of the EP&A Act given the proposal:

- May be carried out without development consent
- Is not exempt development, and
- Would be carried out by a determining authority or requires the approval of a determining authority.

A determining authority, for the purposes of this activity, is defined in Part 5 of the EP&A Act to include, but not be limited to, a state-owned corporation within the meaning of the *State Owned Corporations Act 1989*. Essential Energy is listed as a state-owned corporation, and would therefore be the determining authority for the activity covered by this REF.

In accordance with state and local EPIs (described below), this REF has been prepared under Part 5, Division 5.1 of the EP&A Act to assess the possible environmental outcomes of the proposed activity. In determining the proposal and degree of impact, Essential Energy is required to consider section 5.5 of the EP&A Act and clause 171 of the EP&A Reg which are summarised in **Section 9**.

In accordance with clause 171(4) of the EP&A Reg, Essential Energy is required to publish this REF on the NSW planning portal, as the capital value of the proposal will exceed $5 million, prior to the activity commencing.

5.2 Environmental Planning Instruments

EPIs regulate the permissibility to undertake an activity and the type of assessment process that is required. EPI is the generic term used to describe state environmental planning policies, regional environmental plans[1] and local environmental plans (LEPs). EPIs that apply to this development are outlined below.

5.2.1 State Environmental Planning Policies

5.2.1.1 State Environmental Planning Policy (Transport and Infrastructure) 2021

State Environmental Planning Policy (Transport and Infrastructure) 2021 (T&I SEPP) consolidates and updates the planning process for new infrastructure. Subject to certain exemptions the T&I SEPP allows development for the purpose of an electricity transmission or distribution network to be carried out by or on behalf of an electricity supply authority or public authority without consent on any land.

Exemptions to this broad (on any land) application include developments which require Part 4 approval under *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP) or activities triggering designated development under *State Environmental Planning Policy (Resilience and Hazards) 2021.*

[1] The *Environmental Planning and Assessment Amendment Act 2008 No 36* repealed the power to make regional environmental plans. Regional environmental plans still in force are now considered to be state environmental planning policies.

The proposed activity falls within the scope of the T&I SEPP as being permissible without development consent.

Consultation requirements under the Infrastructure SEPP are addressed in **Section 3.3**, whilst notification provisions are detailed in **Table 5-2**.

5.2.2 Local Environmental Plans (LEP)

LEPs are developed by councils (they become law only after Ministerial approval) and guide planning decisions for local government areas. According to the Department of Planning and Environment (DPE), LEPs, through zoning and development controls, allow councils to regulate the ways in which land is used. Council LEPs also list heritage items that are of local heritage significance.

The application of the T&I SEPP overrides the need to consider zoning controls, as developments covered by the T&I SEPP are permissible on *any land* without consent. However, the T&I SEPP provides consultation and notification provisions where activities are likely to substantially impact upon council-related infrastructure, or items of local heritage significance.

5.3 Key Legislation

5.3.1 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth) (EPBC Act)

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) requires the approval of the Commonwealth Minister for the Environment for actions that may have a significant impact on matters of national environmental significance (MNES). Approval from the Commonwealth is in addition to any approvals under NSW legislation.

The EPBC Act lists nine MNES which must be addressed when assessing the impacts of a project. An assessment of how the project may impact on MNES is provided in **Table** *5-1*.

Table 5-1: Matters of national environmental significance

Matter of national environmental significance	Impact
World heritage properties	There are no world heritage properties proximate to the proposed development, or that would potentially be affected by the proposal.
National heritage places	There are no national heritage places proximate to the proposed development, or that would potentially be affected by the proposal.
Wetlands of international importance	There are no Ramsar wetlands proximate to the proposed development, and the proposal is not likely to have a significant impact on the ecological character of a Ramsar wetland.
Commonwealth listed threatened species and ecological communities	The proposal is not expected to have any significant impact on threatened species, populations or ecological communities listed within Commonwealth (or State) legislation (refer **Section 6.5**).
Great Barrier Reef Marine Park	The proposal would not result in any impacts to the Great Barrier Reef Marine Park.
Commonwealth listed migratory species	The proposal is not expected to have an impact on listed migratory species (refer **Section 6.5**).
Nuclear action	The proposal would not result in any nuclear action, nor would the activity require any nuclear action to be undertaken.
Commonwealth marine areas	There are no Commonwealth marine areas proximate to the proposed development, or that would potentially be affected by the proposal.
Impacts on water resources resulting from large coal mining and coal seam gas developments	The proposal is not related to any large coal mining or coal seam gas developments. The project would not impact on water resources.

Given that the project would not significantly impact on matters of NES (refer to **Section 6.5** and **Appendix A**) and would not be carried out on Commonwealth land, the EPBC Act is not triggered and approval from the Commonwealth Minister for the Environment is not required.

5.3.2 Native Title Act 1993 (Commonwealth) (NT Act)

The *Native Title Act 1993* (Cth) (NT Act) as validated by the *Native Title (New South Wales) Act 1994* was part of the Commonwealth Government's response to the High Court's decision in *Mabo v Queensland*, which found that Australian common law can recognise the rights and interests over land and water possessed by Indigenous people in Australia under traditional laws and customs – 'native title'. The High Court rejected the doctrine that Australia was terra nullius (land belonging to no-one) at the time of European settlement and said that native title can continue to exist:

- Where Aboriginal and Torres Strait Islander people have maintained their connection with the land through the years of European settlement; and
- Where their title has not been extinguished by valid acts of Imperial, Colonial, State, Territory or Commonwealth Governments.

The decision does not give native title primacy over valid interests in land granted by governments. A validly granted freehold title would extinguish native title.

In relation to development on land subject to a successful native title claim or Indigenous Land Use Agreement, certain future acts are valid to the extent that they are "…….acts involving facilities for services to the public (section 24KA)……"

The native title holders and any registered native title claimants or parties to an Indigenous Land Use Agreement (ILUA), in relation to land concerned, have a procedural right for their interests to be considered. Therefore, where land is subject to native title or an Indigenous Land Use Agreement, they are required to be notified of the proposed "future act" and are entitled to have matters considered including their native title rights and interests in the land.

The proposal is not located on land subject to an application for, or determination of, native title or an Indigenous Land Use Agreement, and therefore notification to native title holders and any registered native title claimants is not required under the NT Act.

5.3.3 Biodiversity Conservation Act 2016

The *Biodiversity Conservation Act 2016* (BC Act) provides the process for listing threatened species, threatened ecological communities, and areas of outstanding biodiversity value, and details the process for assessing impacts on those matters.

Section 1.7 of the EP&A Act requires that assessment of an activity must consider its impact on threatened species, threatened populations, and threatened ecological communities or their habitats in accordance with Part 7 of the BC Act. The assessment for determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats, referred to in section 7.3 of the BC Act, determines whether the proposed works are likely to have a significant impact. If a significant impact is determined, a species impact statement (SIS) is required, or if the proponent so elects, a Biodiversity Development Assessment Report (BDAR) can be prepared.

The proposal site is not located within a declared area of outstanding biodiversity value. The proposed activity will be carried out on predominately and highly disturbed land associated with previous farming practices. A significant impact on threatened species, populations, ecological communities, or their habitats as a result of the proposal is considered unlikely (refer to **Section 6.5** and **Appendix A**).

5.3.4 Biosecurity Act 2015

The *Biosecurity Act 2015* (Biosecurity Act) provides for the prevention, elimination, minimisation and management of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers. Section 22 of the Biosecurity Act requires that any person who deals with biosecurity matter, or a carrier, and who knows, or ought reasonably to know, the biosecurity risk posed or likely to be posed by the biosecurity matter, carrier or dealing, has a biosecurity duty to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised. This obligation is referred to elsewhere within the Biosecurity Act as the "general biosecurity duty".

Given the excavation and disturbance of surface soils associated with the proposed activity, Essential Energy has a general biosecurity duty to ensure the biosecurity risks posed by the potential for the introduction of weed species are prevented, eliminated or minimised.

5.3.5 Crown Land Management Act 2016

The *Crown Land Management Act 2016*, (Crown Land Management Act) consolidates several pieces of legislation, including the repeal of the *Crown Lands Act 1989*, the *Crown Lands (Continued Tenures) Act 1989*, the *Western Lands Act 1901* and certain other legislation. Existing leases, licences or permits issued under previous legislation will continue for its agreed term. From 1 July 2018, all new leases, licences and permits will be issued under the new legislation.

The vast majority of the work areas are located either on private property or within the existing road reserve of Back Trundle Road. The southern arm of the two 132kV powerlines and co-located section of the realigned 66kV powerline have been designed to avoid being placed within the Crown Land associated with the Currajong TSR, and therefore no easement across Crown Land is required. Up to four mature Grey box (*Eucalyptus macrocarpa*) located on the corner of McGrath Lane and Back Trundle Road will require trimming or removal to accommodate the construction and safe operation of the powerline. While these trees are located within the TSR (Crown Land), the proposed works are to be lawfully carried out under Part 5 of the EP&A Act and therefore are a lawful use on Crown Land. An assessment of the proposal's compliance with the six 'principles of Crown land management', as set out in section 1.4 of the Crown Land Management Act, is provided in **Appendix C**.

5.3.6 Electricity Supply Act, 1995 (ES Act)

The *Electricity Supply Act 1995* (ES Act) establishes a comprehensive wholesale and retail market in electricity and regulates the network operations, wholesale trading, and electricity supply in the retail market. The ES Act confers special powers on Essential Energy in respect of development and maintenance of electricity infrastructure and sets out the licencing regime. In particular, it allows Essential Energy to trim and remove trees, carry out works on public roads, and acquire land.

The ES Act also requires that no works (other than routine repairs or maintenance works) may be carried out unless 40 days' notice has been given to the local council to make a submission in relation to the proposal. Any submission received within 40 days must be considered by Essential Energy.

5.3.7 Heritage Act, 1977 (Heritage Act)

The *Heritage Act 1977* (Heritage Act) provides for the protection of heritage items of local and state significance. Such items may include places, buildings, works, relics, moveable objects, or precincts with historical, scientific, cultural or aesthetic value to the state. Where works are likely to impact upon an item listed on the State Heritage Inventory (SHI), approval may be required under two sections of the Heritage Act:

- Section 60 approval relating to impacts on items listed on the SHI; and
- Section 140 approval requiring an excavation permit for activities with potential to excavate or disturb a relic.

As described in **Section 6.7.2** there is no foreseeable likelihood that an item listed on the SHI would be impacted by the proposal, therefore further assessment and a permit from the Department is not required. Further discussion of potential impacts and measures to minimise impacts to items of local heritage significance is provided in **Section 6.7**.

5.3.8 Local Government Act 1993 (LG Act)

The Local Government Act 1993 (LG Act) implements a commitment made under section 51 of the NSW Constitution Act 1902 that requires the continuance of local government. The LG Act provides the legislative framework in which local councils operate, and encourages local participation in the affairs of local government.

Whilst the central focus of the LG Act is about the governance of local councils and the participation of the local community in its affairs, the LG Act also includes provisions for approval of certain works. In areas outside of the operation of the Sydney and Hunter Water Boards, local councils have the responsibility for the regulation of water supply, sewerage and stormwater drainage work.

According to section 68 of the LG Act, approval from local council is required for water supply work, sewerage work, and stormwater drainage work. Water supply work includes the extension of any pipes or fittings of any water services communicating or intended to communicate, directly or indirectly, with any water main of a council. Sewerage work includes not only works related to the sewer system, but also septic tank disposal systems.

As the proposal will require installation of an on-site wastewater system (i.e., a septic system) a section 68 approval will be required from the local council.

5.3.9 Local Land Services Act, 2013 (LLS Act)

The *Local Land Services Act 2013* (LLS Act), established Local Land Services, a government agency with the responsibility for providing advice on biosecurity, natural resources and agricultural advisory services in NSW. The LLS Act includes provisions for the regulation of native vegetation including the approval of certain activities.

Under the LLS Act, approval is required from the Minister for the Environment or delegate to clear native vegetation (exemptions apply). Exemptions include, but are not limited to, urban areas, electricity line maintenance and Part 5 activities under the EP&A Act.

The LLS Act is administered by the various local land services under delegated authority by the Minister for the Environment.

Given that the proposal will be assessed under Part 5 of the EP&A Act, the provisions relating to the LLS Act are not applicable.

5.3.10 National Parks and Wildlife Act, 1974 (NPW Act)

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the management of all national parks, historic sites, nature reserves, reserves, Aboriginal areas and state game reserves. It also provides for the protection and care of native flora and fauna, and Aboriginal places and objects throughout NSW. Under the NPW Act it is an offence, without authorisation, to:

- Harm an Aboriginal object or place without consent;
- Pick or harm any plant or animal that is protected or is a threatened species, population or ecological community; or
- Damage any critical habitat, or habitat of a threatened species, an endangered population or an endangered ecological community or reserved land.

When an activity is likely to harm an Aboriginal object or place, approval under section 90 is required.

The NPW Act also serves to direct the management and protection of reserved land[2]. In relation to utility installations, the Minister for the Environment may grant easements or rights of way through reserved land for the conveyance or transmission of electricity.

The proposal site is not located on reserved land. Approval under the NPW Act is not required in respect of the proposed activity.

As described in **Section 6.6,** based on the design and mitigation measures, the proposal is not likely to impact upon known Aboriginal objects.

5.3.11 Protection of the Environment Operations Act, 1997 (POEO Act)

The *Protection of the Environment Operations Act 1997* (POEO Act) provides a framework for the licencing of activities that have potential to result in pollution of the environment. The POEO Act is administered by OEH. An environment protection licence is not required for the proposed activities as they do not fall within Schedule 1 of the POEO Act; however, the following restrictions apply:

- The proposal must not pollute waters
- Waste from the works must not be wilfully or negligently disposed of in a manner that harms or is likely to harm the environment
- Waste must not be transported to a place that cannot lawfully be used as a waste facility for that waste
- There must be no litter in or on a public place or an open private place caused by workers
- Any environmental incident that involves actual or potential harm to the health or safety of human beings or to ecosystems must be reported to the Environment Protection Authority (EPA).

[2] Land being a national park, historic site, state conservation area, regional park, karst conservation reserve, nature reserve or an Aboriginal area.

During construction, there is the potential for discharge to surface waters from excavation and trenching activities. A number of management strategies are available to Essential Energy for the discharge to surface waters, including discharging water over grassed or well vegetated areas away from waterways, or the use of filter bags in urban environments.

5.3.12 Roads Act 1993 (Roads Act)

The *Roads Act 1993* (Roads Act) provides for the ownership and management of public roads, and also requires the consent of the appropriate roads authority for various works in respect of certain public roads.

Section 138 of the Roads Act requires the consent of the appropriate roads authority for various works in respect of public roads and classified roads. Under Schedule 2 (5) (1) of the Roads Act Essential Energy is exempt from obtaining approval for works on or over an unclassified road other than a Crown road. However, works that require a connection to or crossing of a classified[3] road must be approved by Transport for NSW (TfNSW).

The proposed activity will be limited to private property and the road reserve of Back Trundle Road, a local council road. No work within, on, or over a classified road is required, therefore there is no requirement for a Section 138 approval from TfNSW.

5.3.13 Water Act, 1912 (Water Act)

Under the *Water Act 1912*, for any temporary or permanent works not defined in a gazetted water sharing plan under the *Water Management Act 2000* (WM Act), a licence or permit is required to:

- Extract water from a stream, river or water course via a pump or other work; or
- Extract groundwater via any type of bore, well, spear point or groundwater interception scheme (including dewatering).

It is unlikely that the shallow trenching works (to a maximum depth of approximately 1.2m) and isolated pole hole auguring (approximately 1.2m in diameter, to approximately 3.0m deep) will require dewatering during construction of the proposal.

5.3.14 Water Management Act, 2000 (WM Act)

The *Water Management Act 2000* (WM Act) governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced. Under the WM Act, should water need to be extracted from a surface water source, defined in gazetted water sharing plan, then three licence/approvals must be obtained including:

- An Access Licence to obtain access to a share of the water source;
- A Works Approval to obtain permission to install and use the works for water supply, drainage or flood mitigation work. For groundwater extraction or dewatering, an Aquifer Interference Approval may be required. A Controlled Activity Approval may be required for a works location in, on, or under waterfront land; and
- A Water Use Approval to obtain permission for how the water would be used.

Under the WM Act, a controlled activity means:

a) the erection of a building or the carrying out of a work (within the meaning of the *Environmental Planning and Assessment Act 1979),* or

b) the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise, or

c) the deposition of material (whether or not extractive material) on land, whether by way of landfill operations or otherwise, or

d) the carrying out of any other activity that affects the quantity or flow of water in a water source.

The WM Act defines an aquifer interference activity as involving any of the following:

a) the penetration of an aquifer,

[3] Classified Roads include main roads, highways, freeways, a controlled access road, a secondary road, a tourist road, a tollway, a transitway and State work.

b) the interference with water in an aquifer,

c) the obstruction of the flow of water in an aquifer,

d) the taking of water from an aquifer in the course of carrying out mining, or any other activity prescribed by the regulations,

e) the disposal of water taken from an aquifer as referred to in paragraph.

The proposal would not include works in locations that would trigger the above licences/approvals (including wetlands). In addition, Essential Energy, a public authority, is exempt from section 91E (1) of the WM Act in relation to all controlled activities that it carries out in, on, or under waterfront land.

5.4 Summary of Licences, Permits, Approvals and Notifications

Specific approvals required for the construction, maintenance and operation of the proposal are outlined in **Table 5-2**.

Table 5-2: Summary of licences, permits, approvals and notifications

Legislation	Authority	Requirement
State Environmental Planning Policy (Transport and Infrastructure) 2021	Local Council and occupiers adjoining land	21 days notification required for works involving new or existing substations. Essential Energy's Design Services will be responsible for this notification. These notifications have been sent.
Electricity Supply Act 1995	Local Council	40 days notice of the proposed works must be given. Essential Energy's Design Services will be responsible for this notification. This notification has been sent.
Local Government Act 1993		Section 68 approval will be required for the installation of an on-site septic disposal system.

6. Environmental Assessment

6.1 Air Quality and Greenhouse Gases

6.1.1 Existing environment

The proposal site is situated on predominately cleared land, historically used for cropping and grazing, as well as for the construction and operation of the local road and electricity distribution and sub-transmission networks. The main air quality influences on the existing environment would therefore be agricultural and transport exhaust emissions, and dust from vehicles utilising Back Trundle Road and McGrath Lane, both of which are unsealed.

The closest sensitive receiver is a rural residence (R1) located approximately 550m southwest of the western extent of the proposal site. The next closest sensitive receiver is a rural residence (R2) located approximately 1km northwest of the proposal site, while a third rural residence (R3) is located approximately 1.5km north of proposed site (refer **Figure 6-1**). R2 will cease to be a sensitive receiver once construction of the QPSF project commences, as it is located within the development footprint of this project, and will no longer function as a residence.

6.1.2 Assessment of impact

6.1.2.1 Air quality during construction

It is expected that during civil excavation works required for construction of the SS site and the underground component of the new 132kV powerlines, there would be minor amounts of dust generated from the disturbance of soil, and wind erosion of any exposed stockpiles.

There will be minimal exhaust emissions from vehicles. Exhaust emissions from construction equipment are likely to include nitrogen oxides (NOx), carbon monoxide (CO), sulphur oxides (SO2), hydrocarbons, and total suspended particulates. All vehicles will be fitted with approved exhaust systems to maintain vehicle exhaust emissions within accepted standards.

Works will be limited to the proposal site itself. Impacts to air quality will be small in intensity, over twelve months, and will be small in scope. It is unlikely that there will be an odour impact. Any impacts on air quality will be short-term and localised.

6.1.2.2 Air quality during operation

Once operational, the SS will have negligible impacts on air quality. All Essential Energy's assets are subject to regular maintenance and monitoring to ensure all equipment is operating effectively. Capped surfaces, gardening and landscaping will ensure no dust is generated during the lifetime of the SS.

The new SS will initially include four, with a future capacity of up to eight, enclosed gas switches containing Sulfur hexafluoride (SF6, known to be a potent greenhouse gas). Essential Energy's Principal Engineer Overhead Construction Standards confirms that the quantity of gas is small, and that the unit is sealed for life. Therefore, the potential risk from gas being expelled to the atmosphere is low.

6.1.3 Environmental mitigation measures

Appropriate dust minimisation measures will be implemented as required, including:

- Any potential dust-borne materials transported to and from the activity site will be covered at all times during transportation
- Any temporary stockpiles of surplus excavated material will be covered or wet down during dry and windy conditions
- All vehicles and machinery will be well maintained according to manufacturer requirements to ensure emissions are kept within acceptable limits.

6.1.4 Conclusion

The proposal is not anticipated to result in substantial or uncontrollable dust or exhaust emissions in the area during construction or operation. Any air quality impacts would be short-term and minor during construction or future maintenance. Given the mitigation measures outlined in this assessment the overall environmental risk is considered to be low.

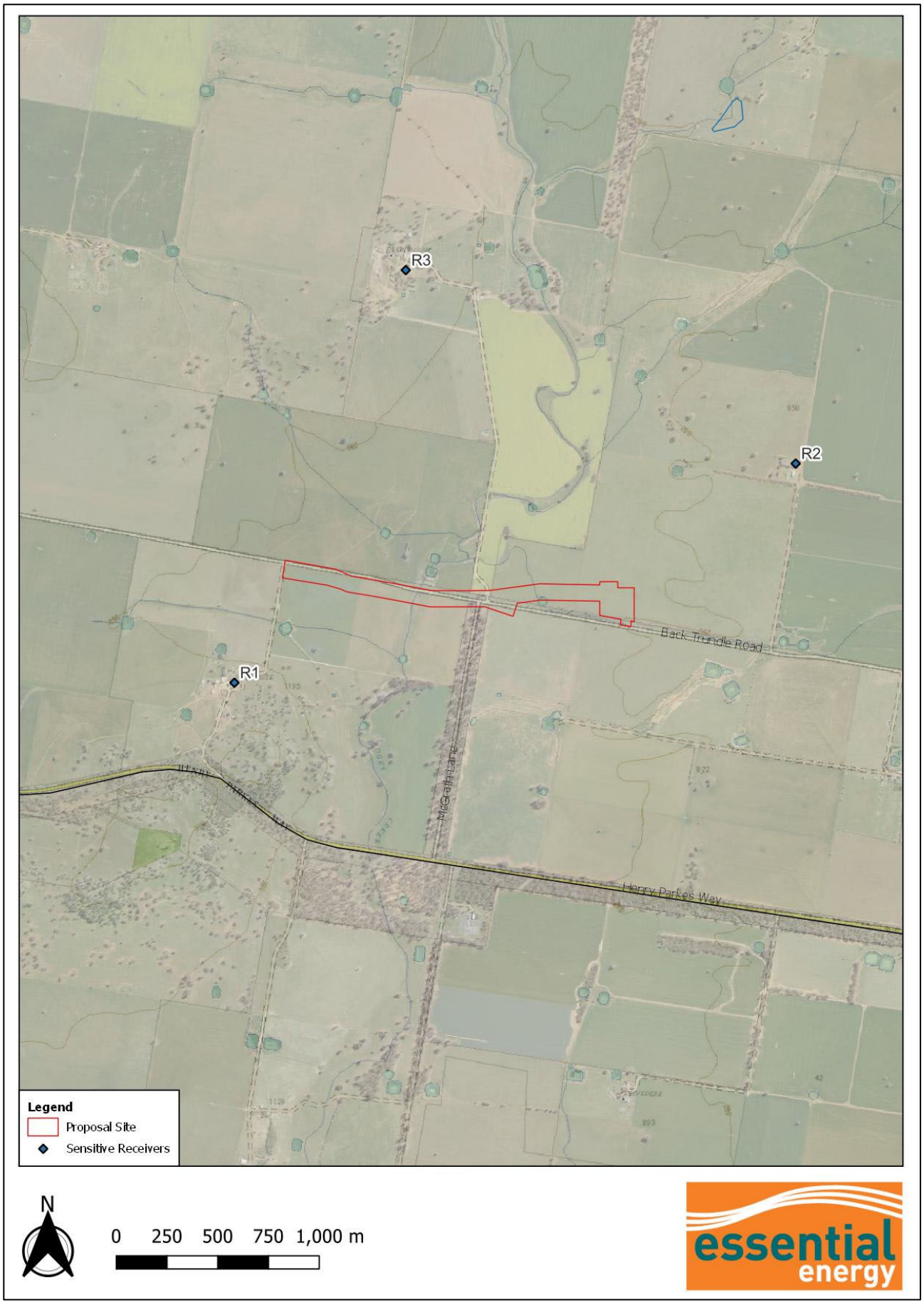


Figure 6-1: Nearby sensitive receivers

6.2 Geology and Soil

6.2.1 Existing environment

Reference to the NSW Geology Simplified layer, which can be viewed on the NSW Government's Central Resource for Sharing and Enabling Environment Data in NSW (SEED) website, indicates the proposal site is underlain by Cenozoic undifferentiated sediments/sedimentary rocks, consisting of unconsolidated mud, silt, sand and gravel of an uncertain age and origin (State Government of NSW and Department of Regional New South Wales 2023).

Review of the Mitchell Landscapes Mapping V3.1, which can be viewed on the NSW Government's SEED website, indicates that the majority of the proposal site is located on the Bimbi Plains soil landscape, comprising quaternary alluvial plains from bedrock hills and ridges of the Gobondery/Gillenbine and the Belmont/Brooklyn land systems. General elevation is between 200 and 250m, with local relief 30m. Soils of this landscape typically comprise gravelly clay loams and red brown clays, and red-brown texture-contrast soils on higher slopes grading to red-brown gradational and uniform profiles of clay loams and clays along creeks. Approximately 300m of the most western extent of the proposal is located on Goonumbla Hills soil landscape comprising rounded low hills on Ordovician and Silurian sandstone, andesite, siltstone and phyllite with a partial blanket of Tertiary quartz gravels and sands. General elevation is between 290 and 390m, with local relief 70m. Soils of this landscape typically comprise stony yellow earths on the sands, and thin brown structured loams on the hills merging with red-brown and red texture-contrast soils on the flats (NSW DECC, 2002).

Figure 6-2 shows mapped Mitchell Landscapes relative to the proposal site.

Given the distance from the coast, the proposal site is not likely to contain actual or potential acid sulfate soils.

6.2.2 Assessment of impact

The proposed works will involve site disturbance through vegetation removal (consisting predominately of groundcover, but also some shrubs and mature trees), trenching and pole hole auguring works required for the underground and overhead section of the 132kV powerlines, respectively, and excavations required for the construction of the SS and access road. These activities have the potential to impact on soil stability and erosion potential within the proposal site. However, the extent of these impacts is likely to be minimal as works will be restricted to active work areas only, which particularly along the proposed overhead powerline and underground cable routes, will be stabilised as soon as practicable as work progresses along the routes. The proposed activity is expected to have a low impact on soils and geology in the area.

Mitigation measures proposed to manage erosion and sedimentation are outlined in **Section 6.2.3**. Water quality impacts are discussed in **Section 6.3.2**, air quality impacts are discussed in **Section 6.1.2**, and contamination impacts are discussed in **Section 6.8.2**.

6.2.3 Environmental mitigation measures

The following mitigation measures will be employed to manage erosion and sedimentation:

- Risks associated with sediment and erosion will be managed in accordance with The Blue Book – Managing Urban Stormwater: Soils and Construction (Landcom 2004)
- Disturbed areas will be stabilised as soon as practicable following construction activities
- Essential Energy's CEOP8064 Management of Excavated Material; Guideline for Construction Sites will be consulted to determine the most appropriate beneficial reuse or disposal method for any surplus excavated materials.

6.2.4 Conclusion

The proposal is not anticipated to have any adverse impacts on the soils and geology of the environment. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low. Further potential impacts to water quality are discussed in the following section.

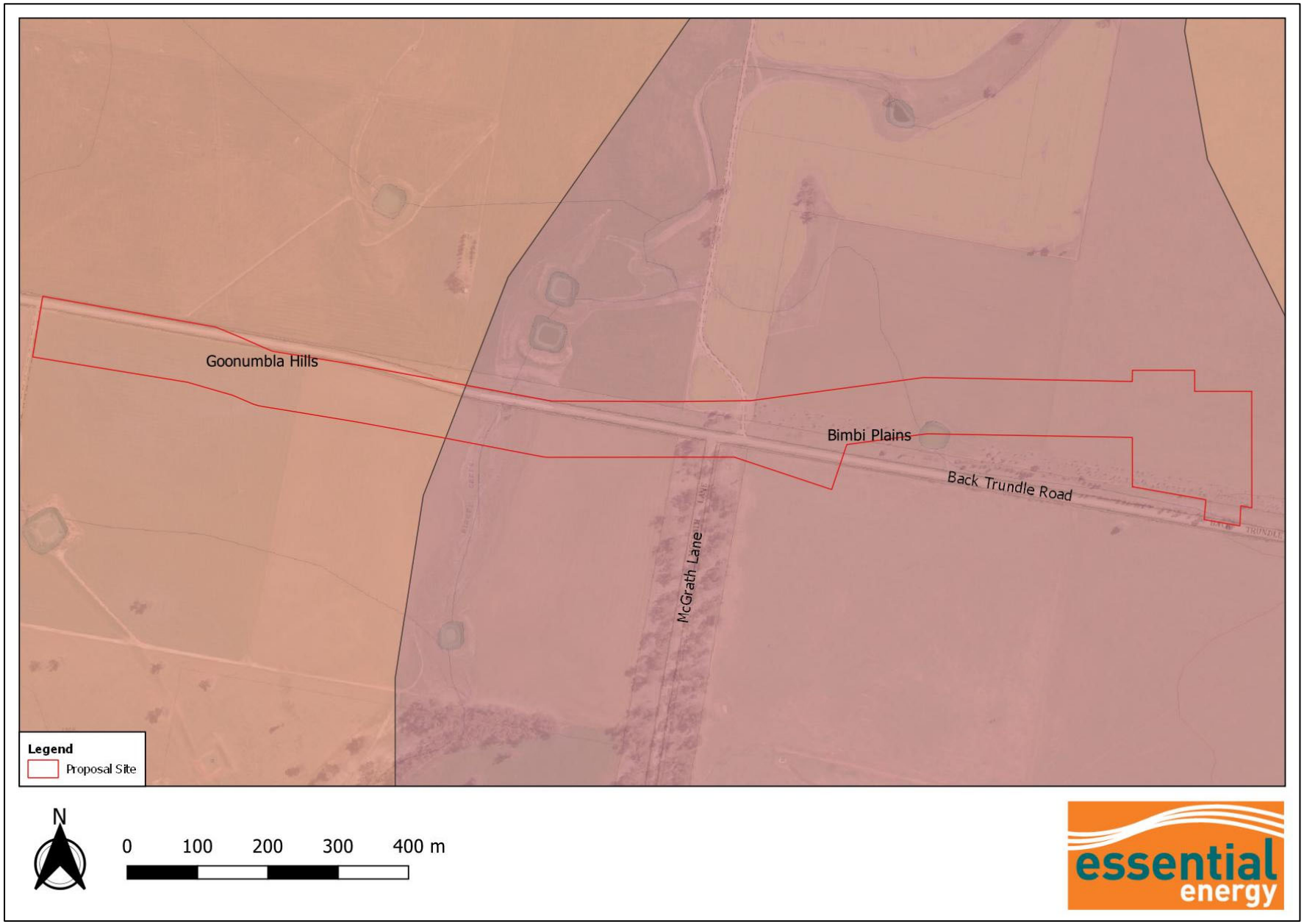


Figure 6-2: Soil landscapes relative to the proposal site

6.3 Water Quality and Hydrology

6.3.1 Existing environment

The proposal site falls within the Lachlan catchment. The Lachlan catchment covers an area of approximately 84,700 square kilometres (km^2). The Lachlan River rises near Gunning and terminates in the great Cumbung Swamp near Oxley, 1,450 river kilometres to the west (NSW DPI, 2018).

The closest waterways include two Strahler fourth order ephemeral streams. The first is an ephemeral drainage line, which runs along the northern side of Back Trundle Road, approximately 70m south of the proposed new SS. The SS access road will intersect with this drainage line, before it connects with Back Trundle Road. The drainage line flows into, the second of the two fourth order waterways, Ridgey Creek, which the proposed new sections of overhead powerlines will span, on the southern side of Back Trundle Road, approximately 880m west of the proposed new SS (refer **Figure 6-3**). Current site drainage would be expected to follow overland flow, towards the aforementioned ephemeral drainage line and Ridgey Creek. Once constructed the SS site would have its own internal drainage.

Much of the landscape in which the proposal site is located in subject to periodic flooding This is most pronounced along the ephemeral drainage lines, and Ridgey Creek.

Figure 6-3 provides an illustration of waterways in the vicinity of the proposal site.

6.3.2 Assessment of impact

The following activities have the potential to impact on water quality during the construction and operation of the project:

- Earthworks, including trenching, excavations and benching
- Concreting works
- Fuel or oil leaks from construction and maintenance equipment.

These activities have the potential to affect the water quality in the area. In consideration of the small, isolated area of disturbance and location away from the receiving waterways, any potential impacts to surface water flows are likely be negligible. Similarly, the proposal is not expected to have an impact on the Ridgey Creek system.

The proposed SS site is located above the one in 100 year flood level, although the access road in the vicinity of where it crosses the ephemeral drainage line will be located on flood liable land. The powerline augmentation work is also partially located on flood liable land, predominately where it spans Ridgey Creek. However, as the proposal presents minimal impediments to surface water flows (i.e., power poles of approximately 1m diameter, intermittently spaced throughout the landscape) it is expected that there would be no impact on local hydrological conditions.

Regarding groundwater, it is unlikely that the relatively shallow excavation and trenching works will result in interaction with any aquifer.

6.3.3 Environmental mitigation measures

The following mitigation measures will be applied:

- Control measures will be implemented to manage risks associated with the handling of fuel through using spill trays when undertaking in field re-fuelling
- Disturbed areas will be managed in accordance with the requirements of the Blue Book to minimise potential impacts to waterways. Sediment fencing will be erected, where required, downslope of disturbed areas, and impacts would be minimised where practicable. The use of filter bags may be required to discharge collected sediment-laden water where there are insufficient grassed areas available
- Any water collected in excavations and trenches during rainfall and surface water ingress should be pumped to a grassed area on-site (where a suitable area is available) to allow for infiltration, reused for dust suppression, or pumped to stormwater using a sediment sock. All options should be conducted in a manner that does not result in turbid water entering the stormwater system or nearby waterway.

Figure 6-3: Waterways in the vicinity of the proposal site

- Weather conditions and forecasts will be monitored to minimise work undertaken during heavy rainfall and to allow demobilisation of plant and equipment from flood prone areas in which overland flooding is forecast.

6.3.4 Conclusion

The proposal is not anticipated to have any impact upon the water quality or hydrological conditions in the area. Any impacts that might occur would be short-term and minor, and would occur during construction and maintenance. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.4 Noise and Vibration

6.4.1 Existing environment

The proposal site is located in a predominately rural environment. The main noise influences on the existing environment would be from agricultural activities and road traffic noise emanating from Back Trundle Road and McGrath Lane. The closest sensitive receiver is a rural residence (R1) located approximately 550m southwest of the western extent of the proposal site. The next closest sensitive receiver is a rural residence (R2) located approximately 1km northwest of the proposal site, while a third rural residence (R3) is located approximately 1.5km north of proposed site (refer **Figure 6-1**). R2 will cease to be a sensitive receiver once construction of the QPSF project commences, as it is located within the development footprint of this project, and will no longer function as a residence.

With the exception of intermittent noise from agricultural machinery and vehicles passing on nearby Back Trundle Road and McGrath Lane, the immediate surrounding landscape would be characterised as a low noise environment.

6.4.2 Assessment of impact

Construction noise

Noise impacts during construction may potentially disturb sensitive receivers in close proximity to the SS. The main sources of noise during the construction phase will be equipment needed for site works and the transportation and installation of electrical equipment. The following activities are likely to be the main sources of construction noise impacts:

- Site preparation and benching
- Vehicles and trucks transporting construction materials to and from the site
- Set up and movement of construction vehicles and equipment
- Alteration of traffic movements on surrounding roads.

Construction vehicles will use the local road network to access the proposal site. Given the duration of the works, surrounding land use, the open landscape, the nature of existing traffic movements and relatively low intensity construction methods, it is anticipated that construction activities will not substantially affect the ambient noise in the area.

Operational noise

Apart form the infrequent, intermittent noise from switch gear, which is only required when load switching, there is not expected to be any significant operational nose from the proposal.

6.4.3 Environmental mitigation measures

In considering the remote nature of the proposed substation site location, being at least 550m away from the nearest sensitive residential receiver, work hours will be between 7am and 6pm Monday to Saturday. On occasions works outside these hours that create an audible noise at the nearest sensitive receiver may be undertaken where the following requirements are met:

- Neighbours (and other sensitive receivers) adjacent to the works or the local council or the NSW Environment Protection Authority (EPA) have been notified, and
- Where the works are required to take place in the vicinity of private access ways or driveways ,consultation with individual residents would be undertaken to advise residents of the planned timing of the works.

All plant and equipment will be operated and maintained in accordance with the manufacturer’s

specifications. Any noise complaint will be investigated with additional control measures put in place if required.

6.4.4 Conclusion

The proposal will have acoustic and vibration impacts during construction and operation. The acoustic and vibration impacts during the construction phase will be medium term and moderate, whilst operational noise generated by the proposal will be negligible and unlikely to impact on the closest sensitive receivers.

Given the mitigation measures outlined in this assessment, the impacts can be effectively managed, and the overall environmental risk is considered to be low to moderate.

6.5 Flora and Fauna

AREA Environmental and Heritage Consultants (AREA) (2023) were engaged to undertake an ecological impact assessment for the proposal. The key findings of this assessment are presented below, with the full assessment report attached to this REF as **Appendix A**.

6.5.1 Methodology

The following methods were used for this assessment:

- Desktop review of ecological databases and literature
- Field survey of the study area using transect method by foot and vehicle.

The assessment rationale was to evaluate the type and quality of habitat to be impacted by the proposal, apply professional judgement, and then complete targeted assessment of potential habitat to detect the region's listed species, populations, or communities.

Desktop / Database Searches

Information Sources

AREA (2023) initially undertook a preliminary assessment, drawing on local experience, previous reporting, and information held on government databases and archives, including, but not limited to:

- DPE State Vegetation Type Mapping
- DPE Threatened Species website
- EPBC Protected Matters Search for MNES
- Guide to Surveying Threatened Plants
- NSW Biodiversity Values Map and Threshold Tool
- NSW Native Vegetation Regulatory Map
- NSW Planning Portal
- PlantNET
- Significant Impact Guidelines 1.1 - Matters of National Environmental Significance
- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft
- Threatened Species Assessment Guideline - The Assessment of Significance.

The desktop review was used to inform field surveys and assessment of potential impact to threatened flora and fauna.

Field Survey

The field survey was undertaken on 27 April 2023 by an AREA ecologist.

The objectives of the field assessment were to:

- Describe the nature and extent of vegetation removal
- Determine if species, populations or communities listed in the EPBC, BC or FM Acts would be,

or have potential to be, affected by the proposal

- Determine if groundwater dependent communities would be, or have potential to be, affected by the proposal
- Describe the quality and value of the habitat affected by the proposal.

Database searches were used to inform the field assessment, and applied to determine the likelihood for a protected matter and Plant Community Type (PCT) to be recorded within the proposal site and what targeted searches would be needed for detection.

Results of the field assessment are summarised in **Section 6.5.2** and presented in detail in **Appendix A**.

PCTs

PCTs were identified in the field using State Vegetation Map: Central West / Lachlan Region Version 1.4 VIS_ID4468 (SVM4468) PCT map sourced from the NSW SEED website, as a baseline for the study area and region. The field assessment aimed to confirm PCTs and update those incorrectly mapped to the correct vegetation class, PCT and / or Threatened Ecological Communities (TECs). PCT IDs and boundaries between mapped PCTs were adjusted after ground-truthing. Areas of not native vegetation were also identified, and included areas where the vegetation consisted of exotic species or where there was no vegetation such as along tracks and roads.

Threatened Ecological Communities

TECs were predicted using database searches, and the PCTs associated with a TEC. Data collected during the field assessment and the NSW and Commonwealth descriptions of TECs were used to confirm presence or absence of TECs in the proposal site.

Habitat assessment

Habitat was assessed for its potential to provide resources for listed species predicted or known to occur. Database searches were used to inform the field assessment. Professional judgement was applied on site to determine a likelihood for a protected matter to be recorded and what targeted searches would be needed to detect and consider the magnitude of the potential impact.

In the field, any indirect evidence of fauna (i.e., scats, tracks, calls, fur, feathers, sloughed skins etc.) was investigated. Mature trees, where present, were inspected for hollows and signs of use from listed fauna species and to determine if they were used as fauna breeding sites. Ground features such as rocks and logs which may be potential habitat for listed reptiles were inspected to determine if they were significant habitat.

Threatened fauna

Opportunistic sightings of mammals, birds, reptiles, and frogs were recorded during assessment of the study area. Attention was given to identifying the presence of suitable habitat (e.g. tree hollows, nests, logs, waterways) and signs of activity (e.g. feeding scars, scats).

6.5.2 Existing Environment

Desktop analysis

The proposal overlaps the NSW South Western Slopes Interim Biogeographic Regionalisation of Australia (IBRA) Region and Lower Slopes subregion. IBRA and IBRA subregion inform the identification of PCTs and habitat suitability for threatened species.

An EPBC Protected Matters Report generated for this proposal considered MNES within a 1500m buffer of the proposal. This report is provided in **Appendix A** and summarised in **Table 6-1**.

Potential impacts to species and communities highlighted are considered in the following sections of this report.

Table 6-1: EPBC Protected Matters Report summary

MNES	Result	Relevance to this assessment
World Heritage Properties	None	-
National Heritage Places	None	-
Wetlands of International Importance	4	N/A – All are more than 500km downstream of the proposal with indirect impacts being

MNES	Result	Relevance to this assessment
		negligible in considering the minor extent of works.
Great Barrier Reef Marine Park	None	-
Commonwealth Marine Area	None	-
Listed Threatened Ecological Communities	4	Section 4.2.2 and Section 5.1.3
Listed Threatened Species	31	Section 4.4 and Section 5.1.4
Listed Migratory Species	10	Section 5.1.5
Commonwealth Land	None	-
Commonwealth Heritage Places	None	-
Listed Marine Species	17	All birds, considered as Migratory Species, Section 5.1.5
Whales and Other Cetaceans	None	-
Critical Habitats	None	-
Commonwealth Reserves Terrestrial	None	-
Australian Marine Parks	None	-
Habitat Critical to the survival of Marine Turtles	None	-
State and Territory Reserves	None	-
Regional Forest Agreements	None	-
Nationally Important Wetlands	None	-
EPBC Act Referrals	1	Unrelated referral
Key Ecological Features (Marine)	None	-
Biologically Important Areas	None	-
Bioregional Assessments	None	-
Geological and Bioregional Assessments	None	-

Predicted species

Desktop results using the IBRA Lower Slopes subregion threatened species search, identified a total of 105 EPBC and or BC listed species predicted to occur in the subregion overlapping the proposal (**Appendix A**).

Of these, three species have previously been recorded within 1500m of the proposal (refer **Table 3-2** and **Figure 6-4**).

Table 6-2: BioNet results within 1500 meter buffer

Scientific name	Common name	NSW status	Commonwealth status
Aves			
Polytelis swainsonii	Superb Parrot	V	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-
Flora			
Austrostipa wakoolica	A spear-grass	E	E
V = Vulnerable E = Endangered CE = Critically Endangered M = Migratory			

A full of list of threatened species with potential to occur in within the proposal site is provided in **Appendix A**.

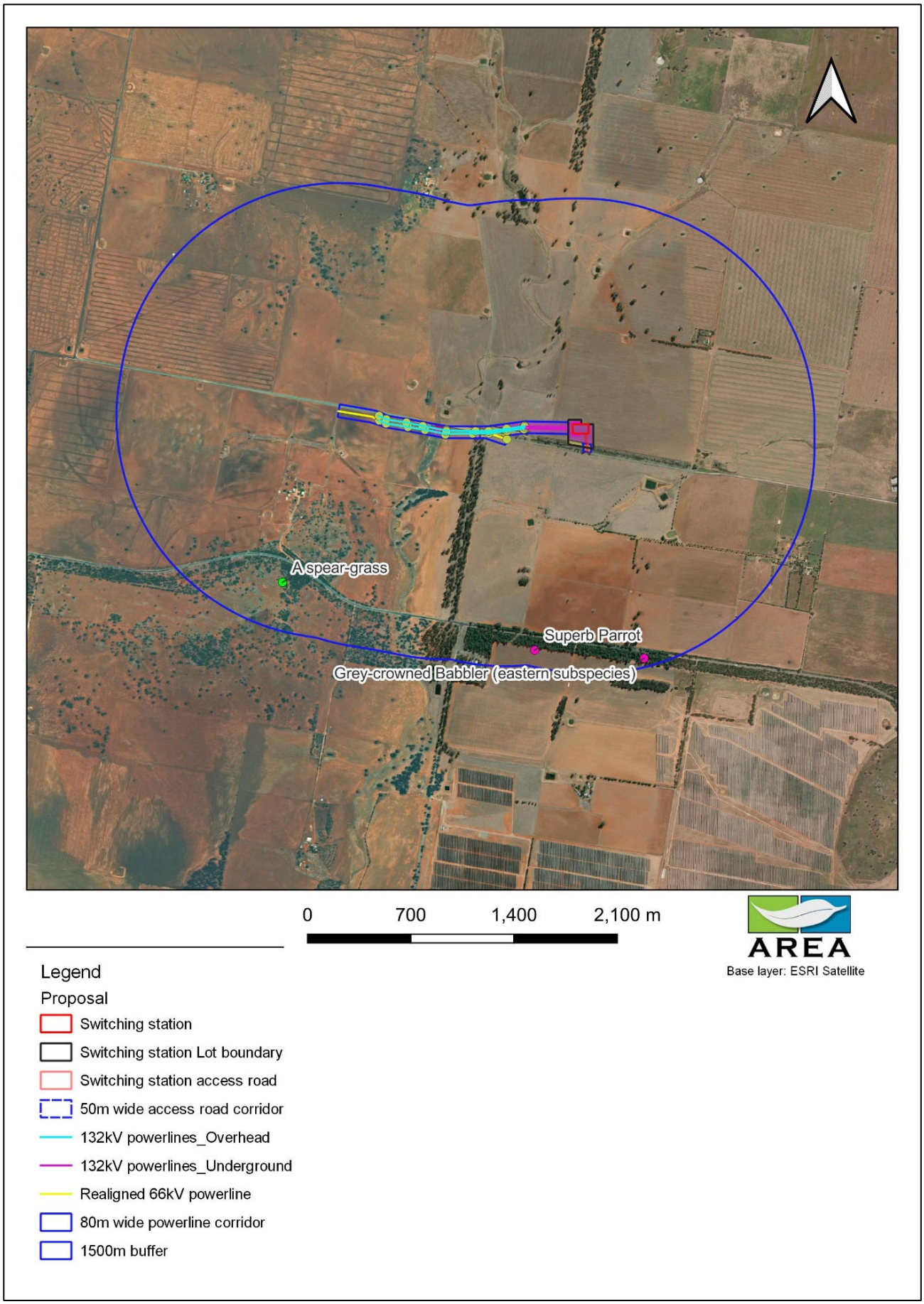


Figure 6-4: BioNet records within 1500m of the proposal site

Plant Community Types

State Vegetation Map (SVM) SVM4468 PCTs with a 500m buffer applied, was used to determine PCTs with potential to occur within the proposal site (refer **Figure 6-5**).

Six PCTs including not native vegetation were mapped as potentially occurring as described in **Table 6-3**.

Table 6-3: Plant Community Types mapped within 500m

PCT ID	PCT Name	Formation	Class
0	Not Native	Not Native	Not Native
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands
201	Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
250	Derived tussock grassland of the central western plains and lower slopes of NSW	Grasslands	Western Slopes Grasslands
267	White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands

Most of the vegetation within the proposal site reflects historic ground surface disturbance and is highly altered from agricultural clearing and cropping. Native and not native vegetation exists throughout the broader landscape.

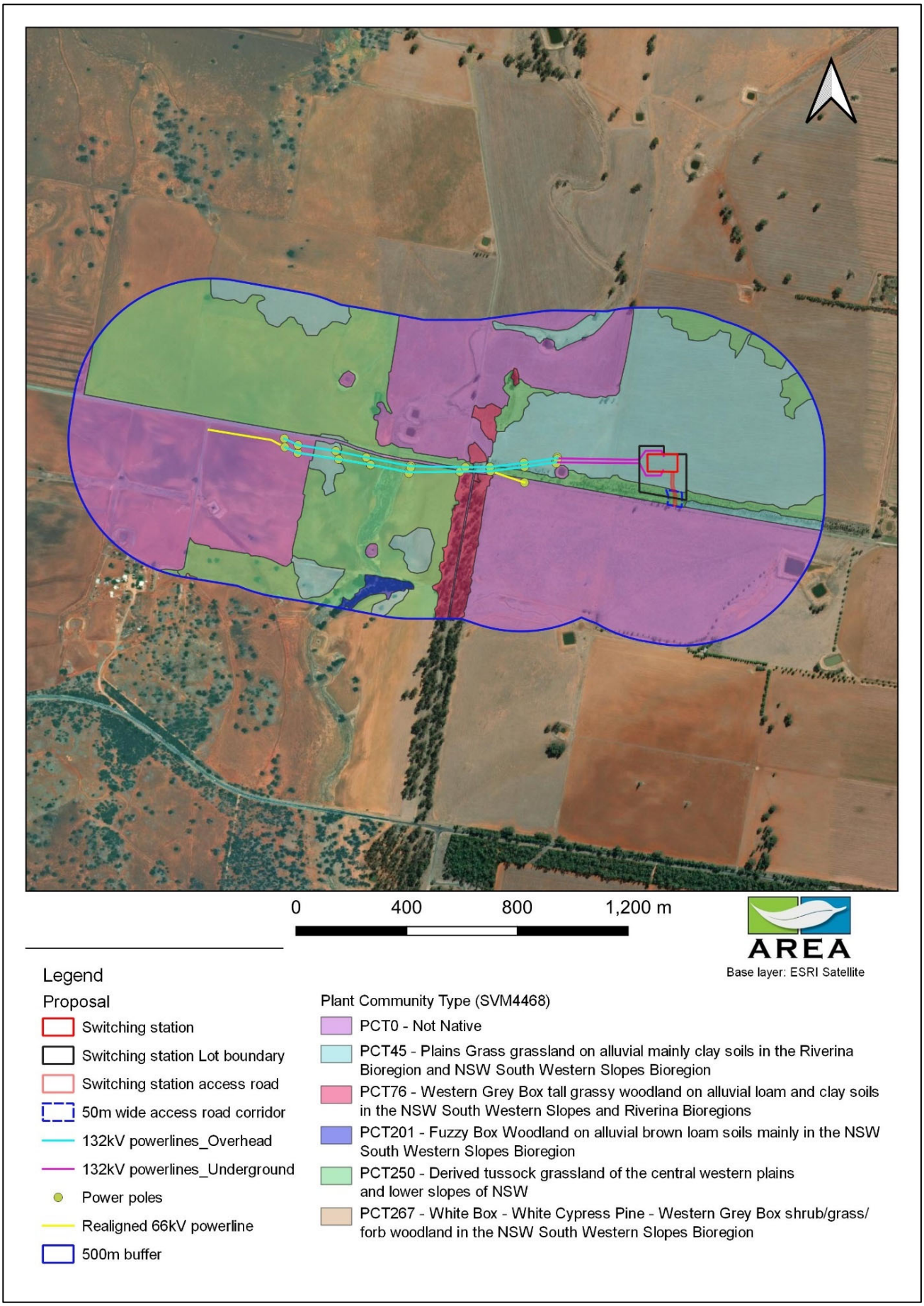


Figure 6-5: PCTs from State Vegetation Mapping 4468

Threatened Ecological Communities

IBRA and MNES database searches identified 10 TECs as potentially occurring in the proposal site (refer **Table 6-4**).

Table 6-4: Predicted Threatened Ecological Communities

Threatened Ecological Community	NSW status	Commonwealth status
Poplar Box Grassy Woodland on Alluvial Plains (CID 141)	-	Endangered Ecological Community
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CID 43)	-	Critically Endangered Ecological Community
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (CID 86)	-	Endangered Ecological Community
Weeping Myall Woodlands (CID 98)	-	Endangered Ecological Community
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Endangered Ecological Community	-
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Endangered Ecological Community	-
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Endangered Ecological Community	-
Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia	Critically Endangered Ecological Community	-
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	Endangered Ecological Community	-
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered Ecological Community	-

Biodiversity Values Map

The proposal intersects biodiverse riparian land mapped on the NSW Biodiversity Values Map in one location beneath the proposed overhead powerlines (refer **Figure 6-6**). Pole placement for the powerlines will occur approximately 30 metres either side of the riparian land minimising impact to the areas mapped.

Under Part 5, Division 5.1 of the EP&A Act, impact to native vegetation in areas mapped on the Biodiversity Values Map does not trigger assessment under the Biodiversity Offset Scheme. However, this mapping can provide information about the vulnerability of the threatened species and communities in the region.

Key Fish Habitat

Key Fish Habitat within Ridgey Creek intersects the proposal in two locations (refer **Figure 6-7)**.

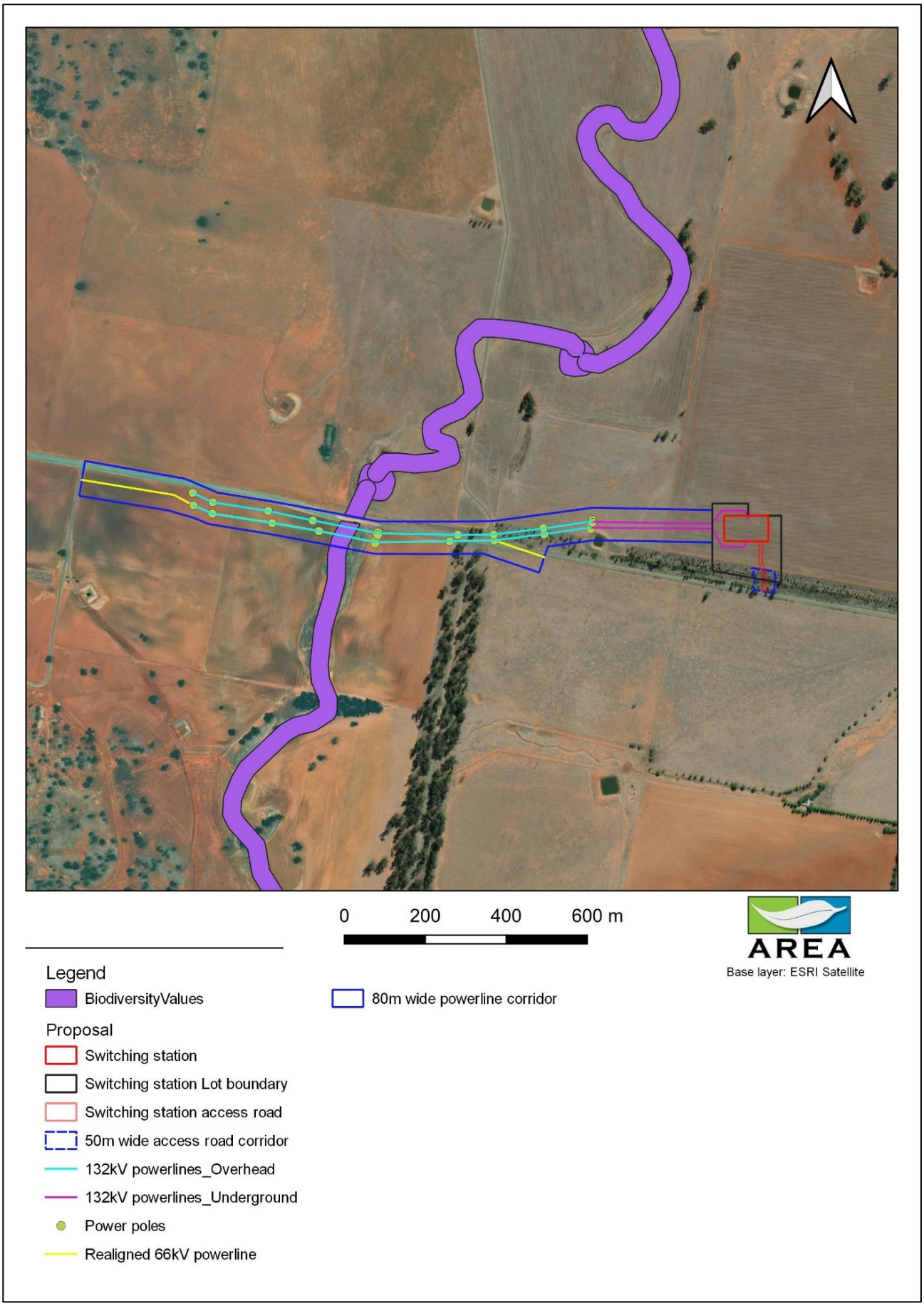


Figure 6-6: NSW biodiversity values map

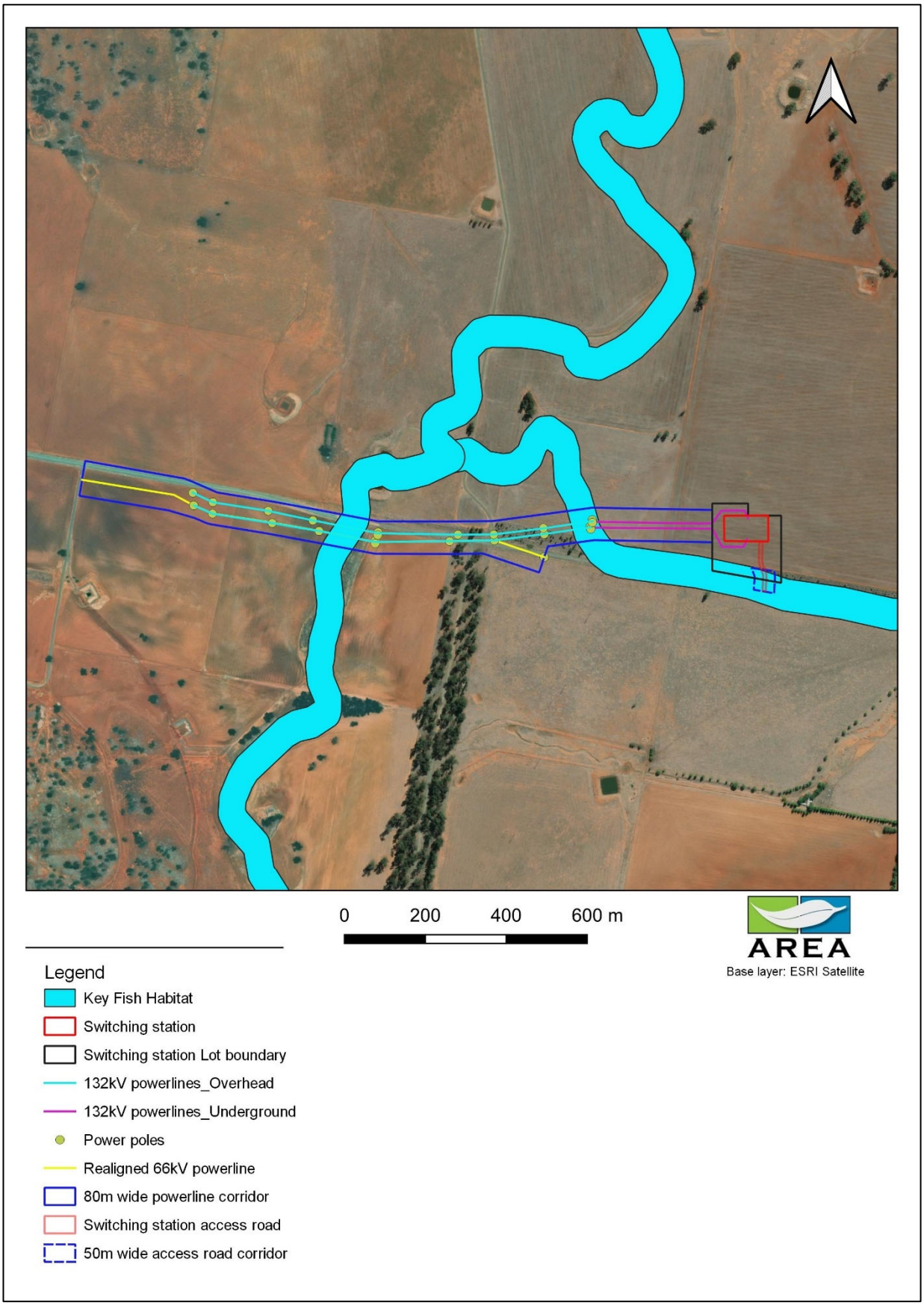


Figure 6-7: Key fish habitat

Groundwater dependant ecosystems

The Bureau of Meteorology (BoM 2019) Atlas of Groundwater Dependant Ecosystems map was checked for Groundwater Dependent Ecosystems (GDEs). Results are provided in **Appendix A**.

The terrestrial groundwater dependence map shows the proposal passes through areas with low potential for groundwater dependent ecosystems. Given the limited scope, and temporary nature of impacts related to the proposal and level of existing ground surface disturbance from agriculture and other infrastructure, impacts to terrestrial groundwater dependent ecosystems are unlikely.

No aquatic groundwater dependent ecosystems are mapped as occurring in the study area.

There are no ecosystems analysed in the study area for subterranean GDE.

Native Vegetation Regulatory (NVR) mapping

One point of the proposal overlaps an area mapped as Category 2 - Vulnerable Regulated Land (refer **Figure 6-8**). No areas of the proposal overlap Land Excluded from the Local Land Services Act 2013.

Areas mapped as Category 2 – Vulnerable Regulated Land indicate areas likely to contain steep or highly erodible land, protected riparian land or special category land. Impact to native vegetation has been assessed as required under EPBC Act and BC Act pathways.

Field Results

PCTs

PCTs mapped as part of the desktop review were refined and corrected based on field observations of mid, upper, and ground stratum species and landform. The vegetation assessment undertaken as part of the overlapping QPSF project (Premise Australia, 2019) was also used in defining PCTs present. PCTs confirmed as occurring within the proposal site are outlined in **Table 6-5** and **Figure 6-9.**

All PCTs are associated with a TEC. Areas of planted native vegetation comprised a mixture of ground, mid and upper stratum species that were not consistent with any of the PCTs identified.

Table 6-5: Plant Community Types recorded within the study area

PCT ID	PCT Name	Class
0	Not-Native – areas comprising largely exotic species/areas used for agriculture or unvegetated areas e.g., existing roads, tracks etc.	Non-Native
81	PCT 81 - Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands	Floodplain Transition Woodlands
82	PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Floodplain Transition Woodlands
278	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Western Slopes Grassy Woodlands

Threatened Ecological Communities

Of the 10 TECs highlighted by database searches (**Table 6-4**), twowere determined to be present, and one potentially present, within the proposal site based on TEC description (including community composition and condition) and presence of associated PCT (**Figure 6-10**). Those determined not present, were inconsistent with the TEC determination. **Table 6-6** provides assessment of the TECs presence in the proposal site.

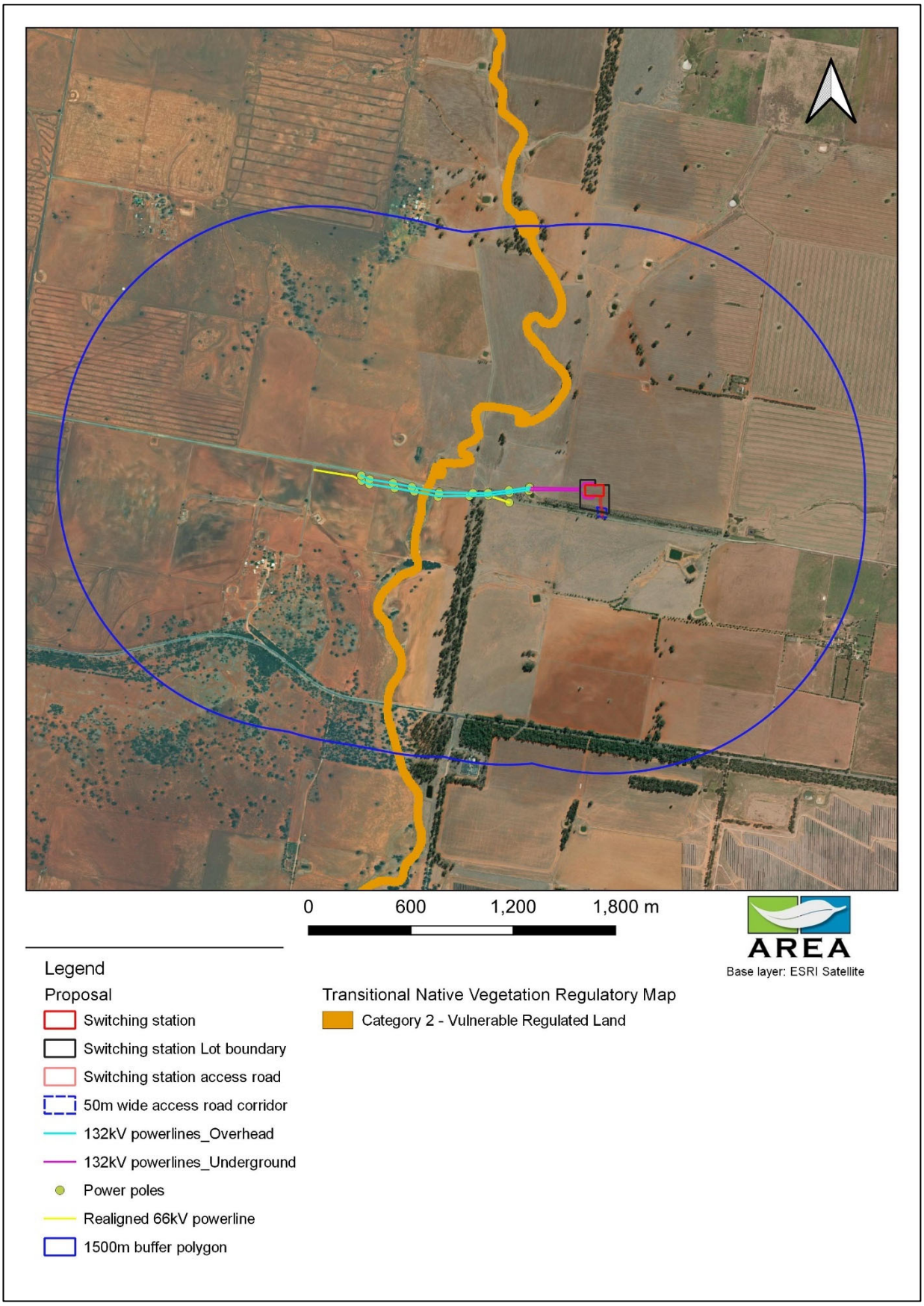


Figure 6-8: Native vegetation regulatory mapping

Table 6-6: Threatened Ecological Community present in the proposal site

Threatened Ecological Community	NSW status	EPBC status	Associated PCT	Presence (Yes/No)
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	-	EEC	81, 82	Yes. Associated PCT present and upper and ground stratum composition consistent with the description for this TEC.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion	EEC	-	81, 82	Yes. Associated PCT present
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	-	CEEC	278	No. Does not meet the condition requirements of the determination where ground layer is dominated by native species containing at least 12 native, non-grass understory species.
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	CEEC	-	278	Potentially.

EEC = Endangered Ecological Community, CE = Critically Endangered Ecological Community

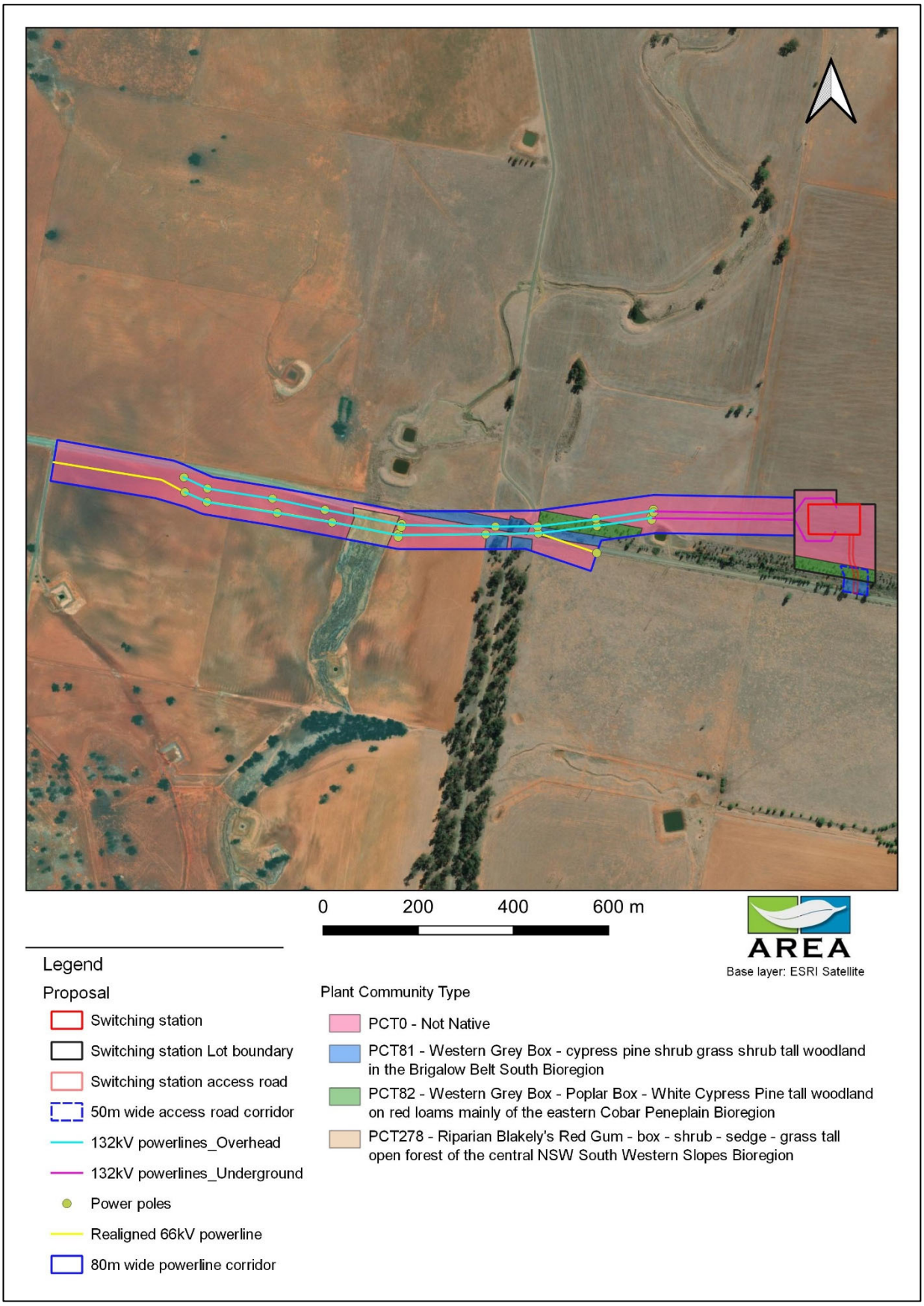


Figure 6-9: PCTs surveyed

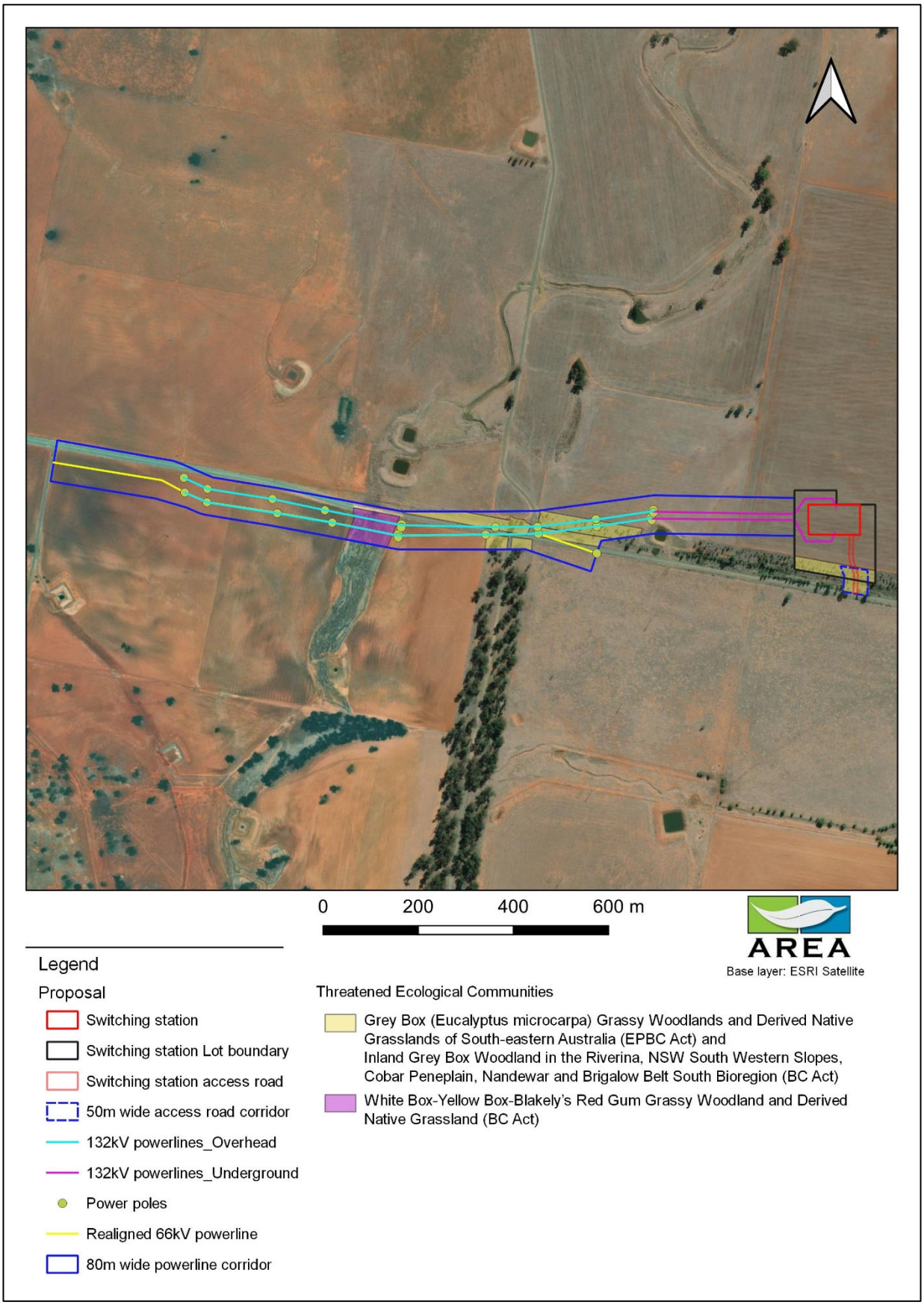


Figure 6-10: TECs identified within the proposal site

Habitat

One waterway (Ridgey Creek) was confirmed as occurring within the proposal site under the proposed overhead powerlines. The creek channel is not well defined and in poor condition surrounded by ploughed agricultural land with no permanent water (**Plate 6-1**).

Five hollow bearing trees, including four mature Grey box (*Eucalyptus macrocarpa*) on the corner of McGrath Lane and Back Trundle Road, and one deceased tree in Ridgey Creek were recorded within the corridor of the proposed overhead powerlines. Habitat forming logs were also recorded in Ridgey Creek.

No hollow bearing trees were recorded in the proposed road access corridor, switching station or underground powerline footprints.

Threatened species

No listed flora species were recorded during the field assessment. Predicted listed fauna species are assumed to occur within the proposal site, where suitable habitat exists and where the survey was not sufficient to confirm the species was not present.

Suitable habitat for listed fauna species (tree hollows, logs, waterways), recorded within the proposal site is shown in **Figure 6-11**.

Plate 6-1: Habitat within Ridgey Creek

Aquatic communities

The overhead powerline component of the proposal crosses Ridgey Creek (**Plate 6-1**) and the proposed access road will intersect an unnamed waterway. Both are ephemeral, Strahler fourth order streams and although highly degraded, most likely form part of the *Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River* (NSW DPI 2006).

Pests, weeds and disease

No high threat exotic species were recorded in the proposal site.

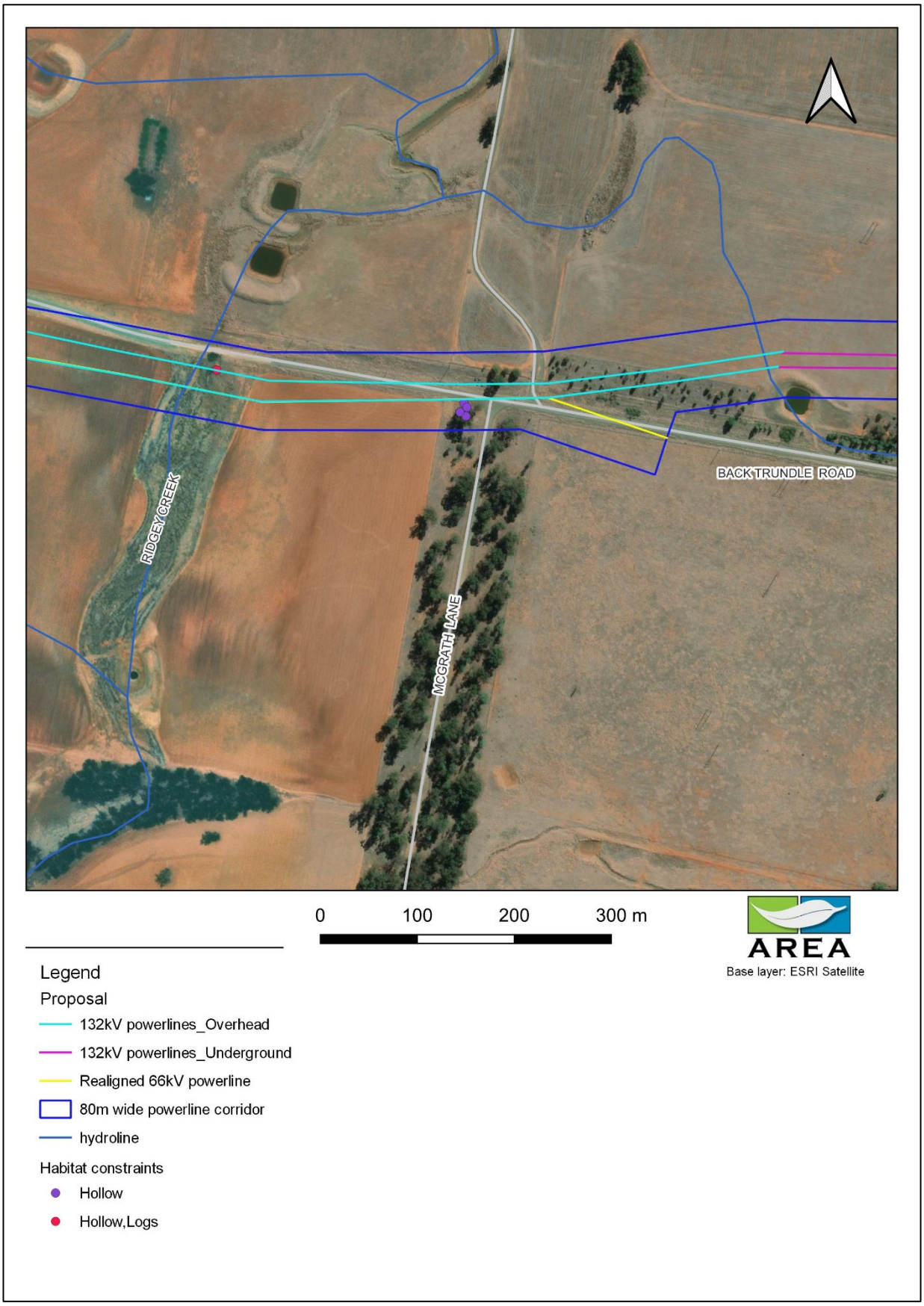


Figure 6-11: Habitat features identified within the proposal site

6.5.3 Assessment of impact

Direct impact

Direct impacts predicted to occur by the proposal are considered in the following sections. Safeguards and mitigation measures to reduce potential impacts are outlined in **Section 6.5.4**.

Habitat, connectivity, and fragmentation

All native vegetation mapped in the study area has some role in habitat connectivity. Some clearing associated with the proposed access road will fragment a strip of planted windbreak and road corridor within a 50 metre clearance corridor. No habitat constraints or evidence of threatened species were recorded during the survey period, and vegetation within this patch has little connectivity to surrounding habitat. The corridor occurs in an already highly disturbed and fragmented agricultural landscape and is therefore unlikely to act as an important corridor for wildlife.

Some obstacles to wildlife movement may exist during the construction phase of the development as created by machinery and construction activities. These will be temporary and where an individual's movement may be disrupted this will not exclude the animal from habitat or its ability to more through the proposal site during or post construction.

Connectivity will not be substantially reduced by the proposal.

Native vegetation

Small areas of native vegetation will be impacted by the construction of the SS, powerlines and the SS access road. Impacts to native vegetation could result in the following outcomes:

- Cause death or harm to fauna present in habitat during clearing
- Remove ground layer foraging, nesting and feeding habitat for native species.

The area in hectares (ha) of impact to PCTs recorded in the proposal site is described in **Table 6-7**.

Table 6-7: Vegetation impacted by the proposal

PCT ID	PCT name	Impact (ha)
0	Not-Native – areas comprising largely exotic species/areas used for agriculture or unvegetated areas e.g., existing roads, tracks etc.	13.2
81	PCT 81 - Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands	1.25
82	PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	1.13
278	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	0.62
	Total	**16.20**
	Total impact to native vegetation	**3.00**

Threatened Ecological Communities

Assessments of significance under the BC Act and EPBC Act, were completed for all TECs found to occur in the proposal site (**Appendix A**). A significant impact to the following TECs was considered unlikely:

- Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC Act)
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion (BC Act)
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney

Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (BC Act)

- Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River (FM Act).

Mitigation measures outlined in **Section 6.5.4** further aim to minimise any impacts to TECs.

Threatened species

No threatened species were identified as being significantly impacted by the proposal.

Tests of significance undertaken as part of the ecological impact assessment (**Appendix A)** show a significant impact to threatened species from the proposal is considered unlikely. Outcomes of this assessment are summarised in **Table 6-8**.

Table 6-8: Test of significance summary for threatened species potentially impacted

Scientific name	Common name	NSW status	EPBC status	Likelihood of occurrence in proposal site	Significant impact under the BC and or EPBC Acts (yes/no)
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential, Species habitat occurs within a small section of the alignment	No - the proposal will not result in a significant impact to these species. Although some habitat trees (<5) will be removed, better quality habitat is available outside the proposal site.
Vespadelus baverstocki	Inland Forest Bat	V	-	Potential, Known to roost in very small hollows in stunted trees only a few metres high	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Potential, Species roosts in tree hollows and can utilise mammal burrows in treeless areas. Species also forages for insects above the tree canopy and lower in open country	
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	Potential, species nesting habitat of small hollow bearing trees occurs within a small section of the proposal site	No - the proposal will not result in a significant impact to these species or an important population. A small number (<5) habitat trees will be cleared with better quality breeding and foraging habitat represented outside the proposal site.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Potential, Species can be found in farmland most often at the edge of a forest or woodland.	
Hieraaetus morphnoides	Little Eagle	V	-	Potential Nests in tall living trees within remnant patch. Recorded within 10km	

Scientific name	Common name	NSW status	EPBC status	Likelihood of occurrence in proposal site	Significant impact under the BC and or EPBC Acts (yes/no)
Circus assimilis	Spotted Harrier	V	-	Potential, Species occurs in grassy open woodland, most commonly in native grassland and can be found in agricultural land	
Polytelis swainsonii	Superb Parrot	V	V	Potential, Species nest in the hollows of large trees 6cm or wider which do occur within the proposal site	
Neophema pulchella	Turquoise Parrot	V	-	Potential, Species Lives on the edges of eucalypt woodland adjoining clearings and nests in tree hollows which do occur within the proposal site.	
Phascolarctos cinereus	Koala	E	E (combined populations of Queensland, New South Wales and the Australian Capital Territory)	Potential. No scats or scratches on trees observed	No - The proposal will not result in a significant impact to this species. No population of this species is known to occur in the study area. Disturbance will be temporary with more favourable habitat available outside the proposal site.

V = Vulnerable, E = Endangered

Migratory species

The ecological impact assessment (**Appendix A**) identified 10 EPBC listed migratory birds' species as potentially occurring at the proposal site. The species have been considered against the significance criteria in **Table 6-9**.

A significant impact to migratory bird species under the EPBC Act is considered unlikely.

Table 6-9: Test of significance summary for migratory species potentially impacted

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
Criteria	**Response**
I. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important	There is little evidence to suggest that the proposal site supports 'important habitat' for migratory species given the absence of permanent water and high disturbance levels within the landscape. The lack of proximity of wetlands of international importance reduces the likelihood that habitat in the proposal site is 'important habitat'. The proposal is therefore unlikely to substantially modify, alter, destroy or isolate important habitat for migratory species.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
Criteria	**Response**
habitat for a migratory species	
II. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	The local area has a history of habitat modification for agriculture. The proposal is unlikely to further contribute to establishment of invasive species beyond that which may already exist.
III. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The proposal site is not an area of 'important habitat' for migratory birds, whether they are wetland or terrestrial species. It is unlikely that an ecologically significant proportion of migratory birds would rely on habitat in the proposal site.

Impact to groundwater dependent communities

The study area contains small areas of native vegetation with low potential for groundwater interaction. The proposal is not expected to place any component of groundwater-dependent communities at risk of local extinction given the small scale of the development, which will predominately occur in cleared agricultural land.

Impact to hollow bearing trees

Five hollow bearing trees are likely be impacted by construction of the overhead powerlines.

Fragmentation of habitat

Vegetation in the surrounding landscape is already highly fragmented from previous disturbances. The proposal will further contribute to fragmentation by impacting small patches of native vegetation within the road reserves of Back Trundle Road and McGrath Lane, as well as planted wind break vegetation along the southern SS lot boundary.

Given the location of the patches within the broader landscape, they are unlikely to act as an important corridor for the movement of fauna.

Soils and drainage

Soils will be disturbed during construction and maintenance. Disturbed soils have the potential to move off the proposal site and impact waterways if not appropriately managed. Ridgey Creek, beneath the proposed overhead powerlines, and an unnamed waterway in the road access corridor, have potential to be impacted by soil disturbance and runoff. Soil disturbance will be managed using standard processes to avoid long term impacts.

Standard remediation processes applied to the area after construction will ensure no long-term impact to the biodiversity values. The proposal will not have long term or lasting impact on the hydrology at any scale.

Indirect impact

Indirect impacts are those which are not a direct result of the proposal, often produced away from, or as a result of, a complex impact pathway. They can be hard to predict and difficult to manage. Indirect impacts are considered in the following sections and mitigation measures outlined in **Section 6.5.4**.

Injury to wildlife

Injury to wildlife is unlikely, but possible, during the construction phase of this proposal. Contact

with wildlife and suitable habitat will be avoided wherever possible. A local wildlife rescue organisation should be contacted in the event wildlife requires rescue or removal.

Spread of pests, weeds and disease

No high threat exotic species were recorded in the proposal site. As such the risk of spreading pests and disease is considered unlikely. Standard safeguard measures should be applied as provided in **Section 6.5.4**.

Changes to hydrology and groundwater dependent ecosystems

Construction of the proposed overhead powerlines and access road has the potential to marginally influence waterflow within the ephemeral waterway on the northern side of Back Trundle Road, via the construction of the SS access road. Impact will be minimised by the inclusion of culverts, which will allow waterflow beneath the access road. Ridgey Creek will be spanned by the overhead component of the powerline and therefore no impacts are anticipated to this waterway.

Noise, light and vibration

Construction noise, light and vibration during construction may disturb fauna or prevent them using habitat in the study area. This impact would be short-term. Safeguards and mitigation measures have been provided in **Section 6.5.4**.

Weeds

Soil disturbance may result in new weed populations. Introduction or spread of weeds through the proposal site may be associated with these actions:

- Removing native vegetation
- Excavation, soil stripping and construction or demolition.

The safeguards in **Section 6.5.4** will minimise the risk of weed spread in the proposal site.

Impact on Key Threatening Processes

Key Threatening Processes (KTPs) listed under the BC Act, EPBC Act and FM Act were reviewed in as part of the ecological impact assessment (**Appendix A**). Four will be negligibly exacerbated by the proposal:

- Clearing of native vegetation
- Invasion of native plant communities by exotic perennial grasses
- Loss of hollow-bearing trees
- Anthropogenic climate change.

Cumulative impact

Impacts from the proposal are considered unlikely to result in a permanent cumulative impact to native species, populations and communities given the activity will largely occur in an historically cleared and degraded landscape and a range of measures will be taken to avoid, minimise and mitigate potential impacts as set out in Section **6.5.4**.

6.5.4 Environmental mitigation measures

The proposal has followed the principles of ‘avoid, minimise, mitigate’ to reduce the impact on local biodiversity values. Impacts to native vegetation have been largely avoided through site and route selection, being largely located within land previously cleared for agricultural grazing or cropping and road corridors. Where impact was unavoidable, it has also been minimised through site and route selection which will largely impact on vegetation with lower habitat value and plant density. Notwithstanding, the following mitigation measures are recommended for minimising the residual impact of the proposal:

- Any change in design affecting land outside the proposal site assessed in this report will require further ecological survey - notwithstanding minor changes where the ecological values have been assessed for this proposal
- All personnel will be inducted to be aware any stand of native vegetation outside the proposal site has legislative consequences if deliberately or accidentally impacted without approval. The extent of the clearing footprint is to be confined to the assessed areas. No clearing is permitted

outside these areas without further assessment

- Groundcover disturbance will be kept to a minimum and within the assessed areas
- Where possible, vegetation to be removed will be mulched on-site and re-used to stabilise disturbed areas
- Erosion and Sediment Control measures will be established in accordance with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004) and documented in a Construction Environmental Management Plan (CEMP) to be prepared for the work.
- Stockpile and compound sites will be located using the following criteria:
  - At least 40 m away from the nearest waterway
  - In areas of low ecological conservation significance (i.e., previously disturbed land)
  - On relatively level ground
  - Outside the one in 10-year Average Recurrence Interval (ARI) floodplain.
  - Stockpiling materials and equipment and parking vehicles would be avoided within the dripline (extent of foliage cover) of any tree.
- Essential Energy has a general biosecurity duty under the Biosecurity Act 2015 to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable. Field crews shall follow procedures as outlined in Essential Energy's Operational Guideline: Biosecurity Risk Management (CERM1000.96) to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable, with particular reference to vehicle and equipment hygiene practises
- Any fallen timber, dead wood and bush rock (if present) encountered on site will be left in situ or relocated to a suitable place nearby
- Prior to clearing, inspect trees with bird nests or hollows before pushing or felling to ensure the nests are vacant. Inspection would occur immediately before pushing or felling. If a bird is in the nest, clear the trees around it first to see if the animal will disperse. If the bird is a nestling (baby bird confined to the nest) all measures would be taken to collect the bird and remove to a safe location
- Immediately prior to commencement of any vegetation removal involving machinery and/or tree-felling the area of clearing work is to be inspected for fauna
- If fauna is detected, the animal is to be allowed to leave the site without any coercion or a local wildlife rescue service is to be contacted to facilitate the safe removal of the animal from the worksite
- Revegetation of any bare soil or cleared areas with locally occurring native flora species typical of the original habitat types is usually recommended
- Segments of trees removed from tree lopping are to be placed in adjoining habitat without damaging it
- Waterways will be accessed in a way that minimises harm to banks or native vegetation
- Machinery will be kept away from banks of the waterway (where possible)
- Do not refuel, store or decant chemicals within 50m of a waterway
- All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent providing forage habitats for foxes, rats, dogs and cats.

6.5.5 Conclusion

The proposal will not result in a significant impact to the ecological values present in the proposal site. The impact to listed threatened species, populations or communities recorded or presumed to occur in the proposal site was assessed as not significant. Safeguards and mitigation measures have been provided to minimise harm to the environment. The proposal is unlikely to have a significant impact to species, populations or communities listed under the EPBC Act, BC Act, or FM Act. As such the environmental risk is considered to be low.

6.6 Aboriginal Heritage

6.6.1 Existing environment

Desktop Assessment

A desktop assessment of Aboriginal heritage was undertaken in the general vicinity of the proposal site. A review of registered sites from Heritage NSW's Aboriginal Heritage Information Management System (AHIMS) (NSW Heritage 2023) was undertaken (refer **Appendix B**). The search revealed no Aboriginal sites or objects located within the footprint of the proposed SS site. Two registered sites (Site ID's 43-3-0144, and 43-3-0153), which are located in the vicinity of Ridgey Creek, south of Back Trundle Road, are within, or in close proximity to, the routes of the overhead powerline component of the proposal. The search revealed a third registered site (ID 43-3-015) is located approximately 230m south of the proposed dual circuit 132kV powerline route, and will not be impacted by the proposal.

The results of an extensive AHIMS search, review of site cards (**Appendix B**), and information garnered from the Aboriginal Cultural Heritage Assessment Report and Historic Heritage Assessment Report (OzArk Environment & Heritage Management, 2018), prepared to support the EIS for the QPSF (Premise, 2019) provided the following information on the two registered sites within, or in close proximity to, the routes of the proposed overhead powerlines.

Site ID: 43-3-0144 (Site Name: Ridgey Creek-IF1)

Ridgey Creek-IF1 is a single basalt flake located within a gently undulating plain landform, in a heavily ploughed field (refer **Figures 6-12 and 6-13**). At the time of the OzArk (2018) survey the surrounding vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. The ground surface exposure (GSE) at the time of recording was high (70%) with a ground surface visibility (GSV) of 80%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Ridgey Creek-IF1 was assessed as negligible (OzArk, 2018).

Site ID: 43-3-0153 (Site Name: Ridgey Creek-OS1)

Ridgey Creek-OS1 is a low-density artefact scatter comprising four flakes and a core with raw materials including basalt, silcrete and quartzite. These artefacts are located within a gently undulating plain landform to the west of Ridgey Creek within the ploughed field. The 51 x 16m extent of the site was defined by the area of recognisable artefacts (refer **Figures 6-14 and 6-15**). The GSE at the time of recording was extremely high (100%) with a GSV of 95%. Identified disturbances include continued ploughing and cultivation. Potential for the presence of further subsurface archaeological deposits at Ridgey Creek-OS1 was assessed as negligible as the artefacts have been displaced by ploughing (OzArk, 2018).

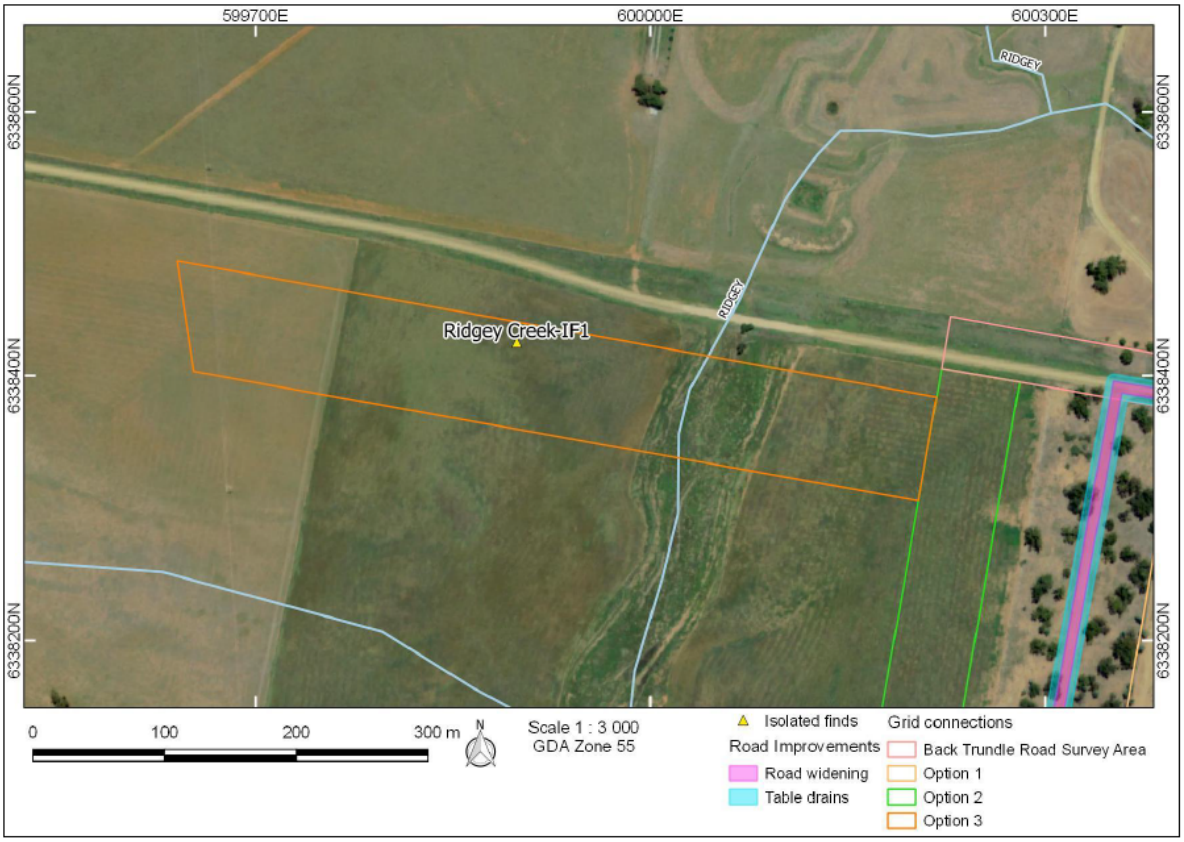
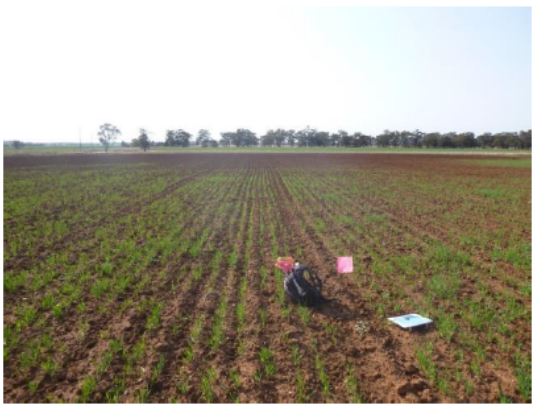


Figure 6-12: Location of Ridgey Creek-IF1. (OzArk, 2018)



1. Overview of Ridgey Creek-IF1 facing west towards Ridgey Creek.

2. View of Ridgey Creek-IF1: a basalt flake.

Figure 6-13: Photographs showing an overview and details of Ridgey Creek-IF1 (OzArk, 2018)

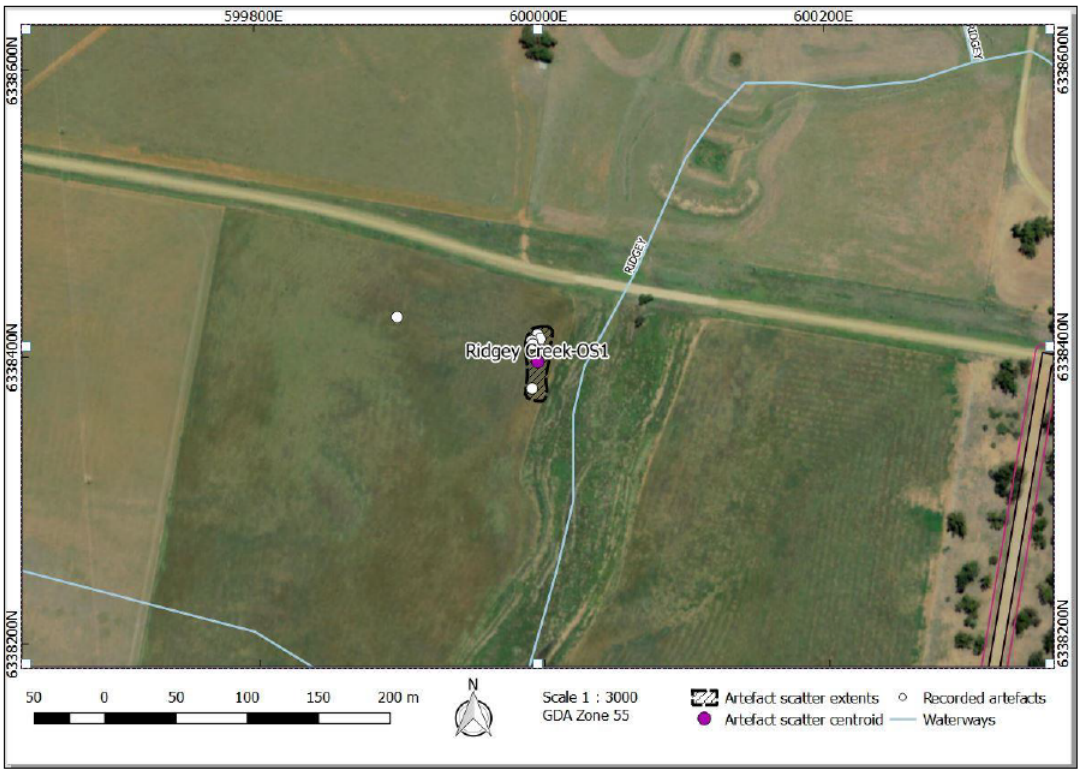
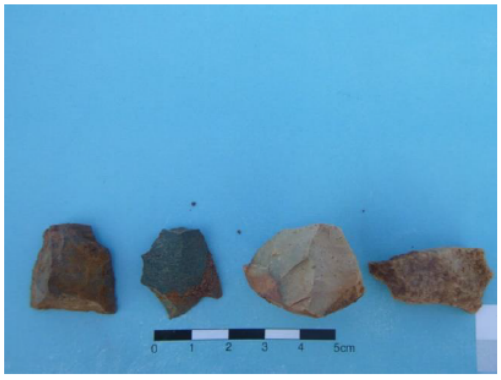


Figure 6-14: Location and extent of Ridgey Creek-OS1 (OzArk, 2018)

1. Overview of Ridgey Creek-OS1 facing east towards Ridgey Creek.

2. Overview of Ridgey Creek-OS1 facing south.



3. View of Ridgey Creek-OS1 artefacts: basalt flakes (left and second from left); silcrete core (second from right); and quartzite flake (right).

4. View of Ridgey Creek-OS1 basalt flake.

Figure 6-15: Photographs showing an overview and details of Ridgey Creek-OS1 (OzArk, 2018)

Site Inspection

Essential Energy's Senior Environmental Engineer undertook an inspection of the proposal site on 27 April 2023. The site inspection included a thorough walkover of the proposed route of the new sections of overhead powerlines, including visual inspection of each of the registered AHIMS sites. GPS coordinates of the registered sites and information provided on the site cards were used to as accurately as possible identify the location of the registered sites on ground. Despite this effort, artefacts relating to each of the registered AHIMS sites could not be relocated on ground. It was noted during the site inspection that the ground surface had been heavily disturbed by recent ploughing activity, as shown in **Plates 6-2** and **6-3**.

Plate 6-2: Looking west along proposed overhead powerline route, on southern side of Back Trundle Road, showing recently ploughed paddock. Location of AHIMS site 43-3-0144 (Ridgey Creek-IF1) marked by placement of backpack.

Plate 6-3: Looking west along proposed overhead powerline route, on southern side of Back Trundle Road, showing recently ploughed paddock. Centroid of AHIMS site 43-3-0153 (Ridgey Creek-OS1) marked by placement of backpack.

6.6.2 Assessment of impact

The NPW Act requires that proponents follow a due diligence approach in regard to the protection of Aboriginal objects. There are three essential issues to consider when undertaking a due diligence assessment:

- The nature of the proposed activity (e.g. the extent of development impacts)
- Land condition and prior land uses (e.g. impacts to bushland or undisturbed ground, areas containing sandstone outcrops, rock shelters and overhangs, old growth trees, sand bodies, ground adjacent to creeks, rivers, lakes and swamps)
- Knowledge and available information (e.g. AHIMS database search, previous reports or studies relating to the site or in the area, and local knowledge, such as councils or Local Aboriginal Land Councils (LALC)).

An assessment against the due diligence requirements is provided in **Table 6-10**.

Table 6-10: Assessment against due diligence requirements

Aboriginal heritage due diligence process			
Step	Question	Answer	
1.	Are you disturbing the ground surface or culturally modified tree? *If yes proceed to step 2, if no, Aboriginal heritage considerations not required proceed with caution*	☒ Yes	☐ No
2.	Are you working near known Aboriginal sites – check the Aboriginal heritage information management system (AHIMS)? (http://www.environment.nsw.gov.au/awssapp/Login.aspx?ReturnUrl=%2fa wssapp). Attach results from search. *If no, proceed to step 3. If yes, must obtain site cards/information and proceed to step 4*.	☒ Yes	☐ No
3.	Are you carrying out development on disturbed land? Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable. Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.)? *If yes, Aboriginal heritage considerations not required proceed with caution and no further consideration required. If no proceed to step 4.*	☒ Yes	☐ No
4.	Is there any other information which suggests an Aboriginal object or place at or near where the works will be carried out?	☒ Yes	☐ No
5.	Are there any landscape features which may indicate the presence of Aboriginal objects? This includes proposed activities: a. Within 200m of waters, b. Below within 200m below or above a cliff face, c. located within a sand dune system, d. within 20m of, or in, a cave, rock shelter or a cave mouth; e. land not disturbed *Note:* "waters" and "sand dune system" are defined in the due diligence code of practice) and/or	☒ Yes	☐ No

6.	Are you unable to avoid harm to any known object or disturbance of the landscape feature with potential for an Aboriginal heritage find?	☐ Yes	☒ No
7.	Has there been a visual inspection by a person with expertise in locating and identifying Aboriginal objects?	☒ Yes	☐ No
If yes to 4, 5, or 6 above, then further Aboriginal archaeological investigations, for example, a field survey by an Environmental Services team member or engagement of an archaeologist are required prior to works. If no, describe why harm to Aboriginal objects is not likely (refer below)..			

The proposal site has been subjected to varying degrees of land disturbance associated with clearing for current and previous agricultural use of the site, and including evidence of recent and historic ploughing along the proposed new sections of overhead powerlines. As such, the land on which the proposal site will be located can be considered disturbed land in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (NSW DECCW, 2010), due to past impacts of clearing, agricultural activities, including ploughing.

The AHIMS search indicated no sites or places of Aboriginal heritage identified within the footprint of the proposed new SS site. Two registered sites, 43-3-0144 (Ridgey Creek-IF1) and 43-3-0153 (Ridgey Creek-OS1) are located within, or in close proximity to the proposed route of the new sections of 132kV powerlines. Artefacts relating to the two registered sites could not be relocated during the site inspection undertaken on 27 April 2023, where it was noted that recent ploughing of the paddock had occurred. Notwithstanding, to avoid potential future impact, the sections of overhead powerline have been designed to span each of these registered sites. That is, the poles have been located well outside of the artefact locations (noting they could not be re-located) with just the aerial conductors spanning across the sites.

The proposed pole locations were closely inspected during the survey conducted on the 27 April 2023. No artefacts or other material evidence of Aboriginal occupation was identified at or within the broader vicinity of proposed pole locations.

No trees exhibiting signs of cultural modification (scarring) have been identified within the proposal site.

Considering the highly disturbed nature of the proposal site, the design of the powerline to avoid impacts to registered AHIMS site, the limited diameter of the pole hole auger (approximately 1.2m), the location of the activities away from other known Aboriginal sites, and the mitigation measures proposed in **Section 6.6.3**, the proposal is not likely to impact Aboriginal heritage.

6.6.3 Environmental mitigation measures

In order to mitigate any potential impacts on Aboriginal heritage, the following mitigation measures will be employed:

- The location and extent of the two registered AHIMS sites, 43-3-0144 (Ridgey Creek-IF1) and 43-3-0153 (Ridgey Creek-OS1), will be clearly marked on construction plans
- Essential Energy staff and contractors working on this project will be inducted, and made aware of the locations of the two registered sites and their legislative responsibilities in relation to Aboriginal heritage
- In the unlikely event that an Aboriginal heritage site or object is located during the construction phase of the project, works will cease in that area and a representative from Essential Energy's Environmental Services will be notified. Works with the potential to disturb the object would not resume until the object had been properly identified, and appropriate action taken
- If human remains are uncovered, works must immediately cease and the NSW Police department and Essential Energy's Environmental Services team will be notified.

6.6.4 Conclusion

The proposal is not anticipated to have any impact upon Aboriginal heritage in the area. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be

low.

6.7 Non-Aboriginal Heritage

6.7.1 Existing environment

Non-Aboriginal heritage refers to any deposit, object or material evidence which relates to the settlement of New South Wales, not being Aboriginal settlement, and is of state or local heritage significance (Section 4 of the Heritage Act).

A desktop search of Australia's World Heritage Sites (Commonwealth DCCEEW, 2022b), National Heritage List (Commonwealth DCCEEW, 2022c), NSW State Heritage Inventory (Heritage NSW, 2023b), and the Parkes LEP was conducted to determine the extent of non-Aboriginal heritage in the vicinity of the proposal.

6.7.2 Assessment of impact

A review of the above-mentioned heritage registers indicated no sites of world, national, state or local heritage significance are located within, or intersected by, the boundary of the proposal site.

6.7.3 Environmental mitigation measures

The following mitigation measures would be applied:

- All construction work would be undertaken within the assessed areas of the proposal site only
- In the unlikely event that a previously unknown heritage site or object is located during construction of the proposal, works would cease immediately in that area and a representative from Essential Energy's Environmental Services would be notified. Works with the potential to disturb the object would not resume until the object had been properly identified, and appropriate action taken.

6.7.4 Conclusion

The proposal is unlikely to have a significant impact upon non-Aboriginal heritage in the area. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.8 Contamination

6.8.1 Existing environment

Current and historical land uses within the proposal site may have resulted in the contamination of soils. The contaminants that may be encountered within the project site include insecticides, fungicides and herbicides from agricultural activities, as well as potentially hydrocarbons and heavy metals in road reserves and chemicals associated with wood preservation in the immediate vicinity of existing power poles.

A search of the NSW EPA 'Contaminated Land – Record of Notices' (EPA, 2023a) and 'List of NSW Contaminated Sites Notified to EPA' (EPA, 2023b) did not identify any contaminated sites within, or in the near vicinity of, the proposal site.

A search of NSW Department of Primary Industries (DPI) Cattle Tick Dip Site Locator did not indicate any tick dip sites within or in the near vicinity of the proposal site.

6.8.2 Assessment of impact

There are no known records of contamination at, or within the near vicinity of, the proposal site. Although no known contamination is present at the project site, given the historic use of the site for agricultural use, potential contaminates may include insecticides, fungicides and herbicides, hydrocarbons, heavy metals and chemicals associated with wood preservation. However, given the considerable ground disturbance that has taken place through use of the project site as farmland and road reserve, with no known areas of contamination, the risk of encountering significant areas of contamination is considered low, and could be managed on-site during construction.

Spillage of diesel, lubricating oils or other chemicals could occur during refuelling and/or maintenance of construction plant/equipment and vehicles, whilst leakage of fuels or oils could occur from poorly maintained construction plant/equipment and vehicles. Any on-site chemical spill or leak could adversely affect the water quality of surrounding waterways. The risk of chemical spills and leaks is expected to be minor, provided that adequate mitigation measures are implemented (see **Section 6.8.3**).

6.8.3 Environmental mitigation measures

The following mitigation measures will be adopted if and where required:

- It is intended to reuse surplus spoil beneficially on site
- Essential Energy's CEOP8064 Management of Excavated Material; Guideline for Construction Sites will be consulted to determine the most appropriate beneficial reuse or disposal method for excavated materials
- In the event of encountering any suspected contamination in the work area, it will be separated and contained on site until it can be classified in accordance with the EPA (2014) Waste Classification Guidelines, and then disposed of at a facility that is lawfully able to accept the waste
- Control measures will be implemented to manage risks associated with the handling of fuel through using spill trays when undertaking in field re-fuelling
- Sediment and erosion control structures will be established and maintained in accordance with The Blue Book to minimise potential impacts on receiving watercourses.

6.8.4 Conclusion

The proposal is not anticipated to have any impact upon contamination in the area. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.9 Electric and Magnetic Fields

6.9.1 Existing environment

Electric and magnetic fields (EMF) are part of the natural environment and are present in the Earth's core and the atmosphere. EMF is also produced wherever electricity or electrical equipment are in use. Powerlines, electrical wiring, household appliances and electrical equipment all produce EMF.

The electric field is proportional to the voltage (which can be considered as the pressure with which electricity is pushed through the wires). The magnetic field is proportional to the current, that is, to the amount of electricity flowing through the wires. Both electric and magnetic fields are also dependent on the source geometry (i.e., conductor heights, cable depths, phase separations and so on). All fields decrease rapidly with distance from the source. Generally, the smaller the object or closer the conductors producing the field, the more rapidly the field would decrease with distance from the source. Essential Energy is aware of concerns in the community and some scientists regarding the possibility of adverse health effects from exposure to EMF.

All of the research has been extensively reviewed over the last 30 years by Australian and international inquiries and expert panels established for the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects.

There is scientific consensus that health effects have not been established, but that the possibility cannot be ruled out. Some scientists argue that there is a need for ongoing high quality scientific research in order to give better answers to the questions which have been raised. Others hold the view that no further research is required and that EMF should not be regarded as a risk to health.

It is well accepted by scientists that no study considered in isolation would provide a meaningful answer to the question of whether or not EMF can contribute to adverse health effects. In order to make an informed conclusion from all of the research, it is necessary to consider the science in its totality. Over many years, governments and regulatory agencies around the world have commissioned independent scientific review panels to provide such an overall assessment. The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), as part of the Health and Ageing Portfolio, is a Federal Government agency charged with responsibility for protecting the health and safety of people, and the environment, from EMF.

ARPANSA advises that:

> "On balance, the scientific evidence does not indicate that exposure to 50 Hz EMFs found around the home, the office or near power lines is a hazard to human health."
>
> "… the majority of scientists and Australian radiation health authorities in particular, do not regard chronic exposure to 50 Hz electric and magnetic fields at the levels commonly found in the environment as a proven health risk. Moreover, the evidence we have is inconclusive

and does not allow health authorities to decide whether there is a specific magnetic field level above which chronic exposure is dangerous or compromises human health."

"At the present time there is no evidence that exposure to electric fields is a health hazard (excluding of course electric shock)."

There are currently no Australian standards regulating exposure to these fields. The National Health and Medical Research Council has issued interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields. The recommended magnetic field exposure limit for members of the public (24 hour exposure) is 0.1 millitesla (1,000 mG - milligauss) and for occupational exposure (whole working day) is 0.5 millitesla (5,000 mG).

Essential Energy operates its powerlines, substations, switching stations and other electrical infrastructure well within these interim guideline limits.

Essential Energy's policy involves providing balanced and accurate information, operating our electrical power system prudently within Australian health guidelines, and closely monitoring scientific research on the EMF health issue.

6.9.2 Assessment of impact

The proposed new 132kV SS and new sections of 132kV and 66kV powerlines incorporate prudent EMF avoidance measures into the design of the alignment with the routes selected on the basis of avoiding areas of proximity to sensitive receivers. The design of the proposal has minimised the magnetic field as far as technically reasonable and within the context of "…[doing] whatever can be done without undue inconvenience and at modest expense to avert the possible risk [to health]", consistent with Gibbs Inquiry (1991).

Essential Energy completed EMF modelling for the proposed powerline. EMF levels associated with a particular powerline vary from time to time and from place to place depending upon a variety of factors, principally the load in the powerline and ground clearance. Accordingly, when undertaking calculations in the context of EMF assessments it is necessary to make conservative assumptions about these variables to provide a conservative indication of the long-term average fields which might be associated with a section of the line.

Typically when performing magnetic field calculations, a relatively high loading condition (85th percentile) is used in conjunction with a ground clearance which corresponds to the low point in a low span. As such the resulting field estimates can often appear high when compared to actual measurements taken along the powerline.

In undertaking the EMF modelling a number of conservative and worst-case scenario inputs were factored into the model. The model assumed the highest proposed feeder current rating (winter night) for all conductors, including the realigned 66kV powerline, which is co-located on the same structure as a section of the southern arm of the 132kV powerline. Under these conditions the highest possible magnetic and electric fields recorded in the model were 11.5μT (115mG) and 1.4kV/m, respectively, approximately mid span between poles 4/5 and pole 6. Refer to **Appendix D** for EMF model results.

The figures above related specifically to levels directly under the powerline, approximately one metre from the ground surface. EMF levels drop relative to the distance from the electrical circuit creating the field (the conductors). Under the worst-case scenario conditions, EMF levels at 20m from the centreline are similar to the ranges expected from typical household electrical appliances. Refer to the ENA Guideline included as **Appendix E.**

The powerlines are a minimum 550m from the nearest sensitive receiver (R1). At a distance of 550m from the powerline, EMF contributions at this receiver would be negligible to nil.

Given the above, it is expected that any EMF generated by the proposed powerline will fall well below the interim guidelines for continuous public exposure (24 hours per day) of 1,000mG.

Given the distance to sensitive residential receivers, it is unlikely the new powerline will expose sensitive receivers to EMF.

6.9.3 Conclusion

The proposal will comply with all relevant national and international guidelines. The resulting magnetic fields from the substation are within the range of fields expected from electricity infrastructure in the area. The overall environmental risk is considered to be low.

6.10 Visual and Aesthetics

6.10.1 Approach

The following visual amenity assessment approach was applied to evaluate the potential visual impacts associated with the project. It is based on a professionally recognised system developed by the United States Forest Service (1974), and similar methods adopted by the Forestry Commission of Tasmania (1983) and the NSW Department of Planning (1980).

The approach used in this assessment is as follows:

- The existing visual environment of the site is described (in terms of landscape character, scenic quality, visual and landscape sensitivity and major view points);
- A brief description is made of the proposed visual changes; and
- An impact assessment is then undertaken, assessing both the changes to the site itself, and any impacts to views from surrounding areas.

The visual impact of the proposed activity has been determined though the interaction of visual modification and visual sensitivity. These are discussed in more detail in the following sections. The 'visual impact matrix', illustrated in **Table 6-11**, is used to determine the potential visual impact of the proposed activity by combining a ranking of high, medium and low for both visual modification and visual sensitivity.

Table 6-11: Visual impact matrix

		Visual Sensitivity		
		High	**Medium**	**Low**
Visual Modification	**High**	**High Impact**	**High Impact**	**Moderate Impact**
	Medium	**High Impact**	**Moderate Impact**	**Minor Impact**
	Low	**Moderate Impact**	**Minor Impact**	**Minor Impact**

6.10.2 Visual modification

Visual modification expresses the visual interaction between the proposal and the existing visual environment. It is the visual contrast between pre and post-development, and is a combination of the appearance of the development (size, form, colour, texture), absorptive capacity of the landscape setting, and the distance from which the development is viewed. Visual modification is expressed here as high, medium or low.

High modification

A high degree of visual modification would result if the proposed developments are a major element and contrast strongly with the existing landscape. The contrast is likely to occur if there is little or no natural screening or integration created by vegetation, or if there is an open plain. For example, powerlines passing over vegetated ridge tops also usually represent a high visual modification, particularly if it is a new powerline passing through otherwise undisturbed vegetated terrain and the viewer is parallel to the line.

Medium visual modification

A medium degree of visual modification would result if the proposed developments are visible and contrast with the landscape but are integrated to some degree. This would happen if the surrounding vegetation and/or topography provide some measure of visual screening, backgrounding or other form of visual integration of the development with its setting. An example of a medium visual modification is an urbanised streetscape with existing powerlines and/or established trees on the roadside.

Low visual modification

A low degree of visual modification occurs if there is minimal visual contrast and a high level of integration of size, form, colour or texture between the development and the environment. This would

occur if there is a high degree of visual integration of the development into the existing landscape or a low level of visual modification of the existing visual setting is achieved. A low visual modification may reflect a situation where the development may be noticeable, but it does not markedly contrast with the existing landscape, as is the case with upgrading existing powerlines.

Throughout the study area, the degree of visual modification is highly dependent on the distance the viewer is from a new development. As the distance from the new development to the viewing location increases, the development becomes less prominent, and therefore its visual modification is less.

Visual modification is also affected by the angle at which a new development is viewed. In general, the visual modification when viewing the new development at right angles is less than when viewing in parallel, depending on the distance from the new development.

6.10.3 Visual sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from various viewpoints. This is dependent on a number of viewer characteristics, such as the number of viewers affected, land use, existing vegetation patterns, distance of the development from viewers, and the visibility of the development from critical viewing locations.

High visual sensitivity

Occupiers of residential properties with long viewing periods adjacent or within close proximity to the proposal. High sensitive areas can also apply to users of outdoor recreational areas, including reserved land or nature recreation such as walking, swimming, fishing or trail riding. This is particularly the case where their attention is focussed, in part, on the landscape and amenity that is being affected by the proposed development.

Medium sensitivity

Medium sensitivity would apply to circumstances in which viewers have intermittent exposure, such as outdoor workers and outdoor recreation users, however, for the recreational user, attention is focussed predominately on the activity they are viewing, such as a sporting event, rather than the proposed development. In addition, medium sensitivity would also apply to occupiers of residential properties with long viewing periods at a distance from or partially screened from the proposed development or project area.

Low sensitivity

Low sensitive viewers include predominately those groups that have a short term view of the proposed development. This would be limited to mainly road users, trains or transport routes that are passing through or adjacent to the study area. Low sensitivity would also apply where viewers are adequately screened from the proposed development so that their viewing periods are limited to short periods.

6.10.4 Existing visual environment (landscape description)

The proposal site is situated in a predominately flat, cleared rural landscape, which currently and historically, has been used for cropping and grazing. The landscape is dominated by agricultural uses, with farm dams constructed throughout to capture overland flow. Several unnamed Strahler first, second and third order ephemeral draining lines are located in the near vicinity of the proposal site. A Strahler fourth order ephemeral drainage line running on the northern side of Back Trundle Road, and Ridgey Creek, also Strahler fourth order waterway, will be intersected by the proposal. Scattered remnant vegetation exists in the road reserve of Back Trundle Road, located to the South of the proposed new SS. More significant remnant vegetation is present within the road reserve of McGrath Lane and the Currajong TSR.

The closest sensitive receiver is a rural residence (R1) located approximately 550m southwest of the western extent of the proposal site. The next closest sensitive receiver is a rural residence (R2) located approximately 1km northwest of the proposal site, while a third rural residence (R3) is located approximately 1.5km north of proposed site (refer **Figure 6-1**). R2 will cease to be a sensitive receptor once construction of the QPSF project commences, as it is located within the project boundary of this development. While located in the road reserve of Back Trundle Road, the entrance to an access road servicing private property (R3) is spanned by a new section of overhead powerlines between Pegs 7/14 and Pegs 6/15. Two new approximately 20m tall poles (Peg 7 and 14) will be located in the near vicinity (within approximately 10m) of this private residence’s access road.

6.10.5 Visual changes.

Construction of the new 132kV SS will take place on what is currently farmland, predominately used for cropping and grazing, and will ultimately back on to a new substation that will be constructed as part of the QPSF development. The new sections of both overhead and underground 132kV powerlines will also be predominately located on what is currently cleared farmland, with one span located within the road reserve and crossing Back Trundle Road. In the short-term there will be a high degree of visual change associated with site preparatory works, civil works, and construction of the SS and new sections of overhead powerlines. Over the longer term there will also be a permanent change in the visual landscape, with the operation of both the new SS and powerlines, however, the new SS will have a considerable degree of integration with the electrical infrastructure (i.e., substation and solar farm) to be built as part of the QPSF development, and the new sections of overhead powerlines will have a high degree of integration with existing powerlines in the near vicinity. As such, visual modification is expected to be high over the short term, and low to medium over the longer term.

6.10.6 Visual sensitivity

Being located in what is currently a primarily rural setting, and part of what will become a new 80 megawatt (MW) solar farm, there are few nearby sensitive receivers. The closest sensitive receiver is a rural residence (R1) located approximately 550m southwest of the western extent of the proposal site. The next closest sensitive receiver is a rural residence (R2) located approximately 1km northwest of the proposal site, while a third rural residence (R3) is located approximately 1.5km north of proposed site. Views to the proposal site from all sensitive receivers are somewhat limited due to the distance of the proposal from each receiver and certain landscape features, including scattered vegetation. Sensitive receivers R1, and R3, however, will have direct views to the proposed new sections of overhead powerlines when entering their respective properties.

In the short term (i.e., during construction) visual sensitivity of the proposal from the perspective of sensitive receivers R1 and R3, particularly in relation to their access roads, is considered medium. Visual sensitivity of the other sensitive receiver (R2) and local road users in the short term is considered to be low to medium. Over the longer term (i.e., after construction work has been completed, and the new SS and new sections of overhead powerlines are in operation), visual sensitivity is expected to be low for local road users as there will be short intermittent viewing times of the infrastructure as people pass through the area. It is likely that R2 will cease to be a sensitive receptor once construction of the QPSF project commences, as it is located within the project boundary of this development. Visual sensitivity for R1 and R3 is expected to remain at medium, as the access roads for sensitive receivers R1 and R3 will be in close proximity to the new sections of overhead powerlines. In particular, the R3 access road will be spanned by the overhead components of the new sections of overhead powerlines, with two new poles being located approximately 10m from this access road. Overall, visual sensitivity is assessed as medium.

6.10.7 Summary of potential impacts

Visual modification has been assessed as being high over the short term and low to medium over the longer term, whilst visual sensitivity is considered to be medium. In accordance with the visual impact matrix, the proposed activity is likely to result in a high visual impact over the short term, with a minor to moderate visual impact over the longer term.

Whilst the proposal has been determined to have a high visual impact over the short term and moderate impact over the longer term in accordance with the visual impact matrix, this is not the same as a significant impact. Powerlines by their nature are considered to be low impact due to their size, scope and intensity. This is because power poles, although high in height, are spaced sporadically along an alignment. Powerlines, and in particular, the poles, do not block significant amounts of sunlight, and generally do not significantly impede views, nor do they impact upon privacy.

Furthermore, powerlines are an essential service provision that benefits the broader Australian population and the economy. As such, powerlines, like other utilities, are generally permissible within all planning zones and are a reasonable and necessary development.

6.10.8 Environmental mitigation measures

Siting of the proposed new SS, and route selection of the new sections of overhead powerlines, have minimised potential visual impacts. In addition, sensitive receivers R1 and R3 will be consulted and kept informed of construction schedule.

6.11 Waste

6.11.1 Assessment of impact

Waste material generated from the proposal would generally comprise the following:

- General construction waste including but not limited to cardboard, paper, wood, mesh, steel, concrete, and other damaged or excess construction materials
- General refuse generated by personnel including putrescible wastes, food scraps, packaging and other domestic wastes
- Surplus excavated soil material from excavation and trenching works.

Any surplus soil that cannot be reused on site will be assessed against the virgin excavated natural material (VENM) criteria, or any relevant waste exemption order, or classified and disposed of at a facility lawfully able to accept the waste.

Operation of the proposal is not expected to generate any substantial quantities of waste material.

6.11.2 Environmental mitigation measures

The following mitigation measures will be employed to minimise and manage impacts to waste:

- All surplus waste materials that are generated as a result of the project and cannot be considered as VENM or subject to a waste exemption order, will be classified in accordance with the Waste Classification Guidelines (EPA, 2014)
- All waste material will be reused, recycled, or taken to a facility lawfully capable of receiving the waste.

6.11.3 Conclusion

The proposal is not anticipated to generate a large quantity of waste. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.12 Bushfire

6.12.1 Existing environment

The proposal site is not located on mapped bushfire prone land.

6.12.2 Environmental impact assessment

The proposal comprises the construction of a new SS on what is currently rural land and road reserves, with grass cover as the predominate vegetation type. Activities with the potential to generate a spark will be avoided where possible during times of heightened bushfire risk.

6.12.3 Environmental mitigation measures

Ongoing vegetation maintenance would occur to ensure safe clearance distances are maintained for the new sections of powerline and around the SS perimeter.

6.13 Traffic and Access

6.13.1 Existing environment

The proposal site is located in a rural setting, dominated by cleared paddocks used for cropping and grazing. The local road network intersects this landscape, with the closest roads being Back Trundle Road and McGrath Lane (both local roads). Back Trundle Road is located south of the proposed new SS, and is intersected by, and runs parallel to, the north and south of the proposed new sections of overhead powerlines. McGrath Lane runs in a north-south direction, generally perpendicular to the proposal, and connects Back Trundle Road to Henry Parkes Way to the south.

6.13.2 Environmental impact assessment

The proposal site can be accessed via Back Trundle Road and McGrath Lane, and associated road reserves, as well as existing powerline corridors, and private property. A new approximately 80m long access road for the SS will be constructed from Back Trundle Road to facilitate access to the new SS. This access road will be constructed through a strip of planted windbreak vegetation, and sparse remnant roadside vegetation, located to the south of the proposed new SS site. The all-weather access road will be of hard stand construction, approximately 8m wide. While the path of the access road has been chosen to minimise impacts to the vegetation, some vegetation will be impacted.

An approximate 50m wide clearing zone through the planted and roadside vegetation adjacent to

Back Trundle Road has been allowed for the construction of the access road. This clearing zone will also be used to install new sections of low voltage cable and optical fibre required as part of this project, and a future 132kV overhead powerline that will be required to connect the new SS to the Parkes SAP, further to the south (refer **Sections 2.1.1** and **2.1.2**).

During construction, the work site will receive multiple vehicle movements per day ranging from light utility vehicles through to heavy commercial machinery and trucks. Local road users may be subject to minor delays during the delivery of equipment or materials to the proposal site.

During operation, the proposal would only be accessed irregularly by maintenance personnel. The proposal would not strain the capacity of the road system.

6.13.3 Environmental mitigation measures

The following mitigation measures will be employed:

- A Traffic Management Plan (TMP) for the construction phase would be prepared prior to works commencing. The TMP would outline requirements for the safe and continued use of local transport corridors during construction.

6.13.4 Conclusion

The proposal would have traffic and access impacts during construction and maintenance operations. The impacts would be short-term and minor. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.14 Land Use

6.14.1 Existing environment

The proposal site is located in a rural area, zoned RU1 primary production, according to Parkes LEP 2012.

6.14.2 Assessment of impact

Whilst the construction of the new 132kV SS will change the land use from its current rural use to an industrial use, the new SS will be located within the footprint of the approved QPSF, largely away from sensitive residential receivers, limiting any future potential land use conflict. The vast majority of the work areas are located either on private property, or within the existing road reserve of Back Trundle Road and McGrath Lane. Essential Energy will be seeking an easement for the parts of the powerline located on private property, and will take ownership of the land on which the SS will be located.

The southern arm of the proposed overhead powerlines has been designed to avoid being placed within the Crown Land associated with the Currajong TSR, and therefore no easement across Crown Land is required. While up to four mature Grey box (*Eucalyptus macrocarpa*) located on the corner of McGrath Lane and Back Trundle Road will require trimming or removal to accommodate the powerline, it is not expected that operation of the powerline will impact the ongoing use of the TSR. An assessment of the proposal's compliance with the six 'principles of Crown land management', as set out in section 1.4 of the Crown Land Management Act, is provided in **Appendix C**.

6.14.3 Environmental mitigation measures

The following measures should be adhered to during the construction phase of the proposed activity:

- Consultation about the proposed works and schedule will be undertaken directly with affected landholders
- The site should be left in a tidy condition at the conclusion of construction activities.

6.14.4 Conclusion

Any impacts on land use are likely to be minor and manageable. Given the nature of existing land uses, the overall environmental risk is considered to be low.

6.15 Social and Economic

6.15.1 Existing environment

The proposal site is located in the Parkes Shire LGA. In 2016, Parkes Shire had a population of 14,608 people, with over 9,964 people living in the town of Parkes. Within the Shire are the towns of Alectown, Bogan Gate, Cookamidgera, Parkes, Peak Hill, Trundle and Tullamore. Many people

also live on agricultural properties of varying sizes. The Parkes Shire has a relatively stable population, with growth mainly occurring in the Parkes township. Other towns are experiencing static or declining populations, largely due to younger residents moving to larger centres for education, employment and lifestyle opportunities. An ageing population and external migration of younger people continues to pose challenges for the long-term sustainability of diversity in the Parkes Shire population (PSC, 2020).

Analysis of the five-year age groups of Parkes Shire in 2016 compared to Regional NSW shows that there are a higher proportion of people in the younger age groups (under 15) and a lower proportion of people in the older age groups (65+). The majority of people living in the Parkes Shire indicate that they have Australian or English ancestry, followed closely by Irish, Scottish and German, with 88.5% of people being able to speak English only. When compared to the rest of NSW, the Parkes Shire has a higher percentage of the population with Aboriginal or Torres Strait Islander origins. Almost a quarter of the population aged over 15 years hold a vocational qualification; however, only 9.4% hold a Bachelor or Higher Degree. The unemployment rate in the Parkes Shire is 5.94%, which is also higher than the NSW average. Parkes residents have a lower median weekly household income than the NSW average, and less access to public transport, education and health care services than other areas of the State (PSC, 2020).

Agriculture is an important industry for the Parkes Shire, providing significant value to the economy as well as being a major employer. In 2018 there were 560 total registered businesses in the Parkes Shire, with agriculture making up over 40% of the total businesses. Mining, manufacturing and transport also make strong contributions to the economy. Over 200 sporting and community events and celebrations (Parkes Elvis Festival, ABBA Festival, Astrofest and the Parkes Picnic Races) support a range of local businesses and develop social capital in the shire. All these sectors are supported by a vibrant commercial centre at Parkes and significant public sector presence. The Melbourne to Brisbane Inland Railway project, Parkes Newell Highway Upgrade, expansion of the Parkes Special Activation Precinct (Parkes SAP), and proposed mining developments at Northparkes Mine and the Clean TeQ Sunrise mine are major projects that have potential to generate significant economic growth and employment in the Parkes Shire and surrounding region (PSC, 2020).

6.15.2 Environmental impact assessment

An improvement to the electricity supply network provides many benefits to the broader community through a secure and reliable electricity supply. The construction and operation of the new 132kV SS will be undertaken on Essential Energy property, within the broader footprint of the QPSF, while the proposed route of the new sections of overhead powerlines will also be partly located within the footprint of the solar farms; partly on private property, and partly within the road reserve of Back Trundle Road.

Without upgrading the existing electricity infrastructure in the area there is an increased risk of supply interruptions, and it is unlikely that the new major connection requests could proceed. This would detrimentally impact on economic and social development of the region, reduce the capacity for renewable energy connection to the grid, and potentially prove to be disruptive to existing commercial enterprises and to residences throughout the local area.

The proposal would support the push for renewables, including solar power, and connections into the National Electricity Grid outlined as part of the vision in the *Parkes Shire Local Strategic Planning Statement 2020* (PSC, 2020). The proposal, in part, will also support *Planning Priority 5* of the same document, by providing adequate infrastructure to service the Parkes National Logistics Hub Special Activation Precinct. Furthermore, the proposal, through the connection of a new solar farm, supports Objective 2 of the *Central West and Orana Regional Plan 2041* (DPE, 2022b) by supporting the State's transition to Net Zero by 2050 and deliver the Central–West Orana Renewable Energy Zone.

The proposal is unlikely to affect community resources; this may include the use of community infrastructure roads, water, and waste management services. The proposal is unlikely to cause substantial change or disruption to the community through loss of neighbourhood cohesion, access to facilities, community identity, or cultural character.

Electricity is an essential service in the human environment, by virtue of enhancing productivity, comfort, safety, health and the economy. The benefits of a secure and reliable electricity supply are evident in every aspect of our lives. Construction and operation of the proposed new SS and associated augmentation of the associated powerline network will enable the connection of a number of new major customers, including a renewable energy connection to the grid, whilst

ensuring a safe and reliable electricity supply to the broader Parkes region.

6.15.3 Environmental mitigation measures

The following mitigation measures will be employed to manage and minimise potential negative social and economic impacts:

- Management of construction traffic in the vicinity of construction works, including communication with local residents and road users
- Signs and barriers would be erected around construction work sites, where appropriate, to minimise the possibility of personnel injuries and prevent placing the public at risk.

6.15.4 Conclusion

Construction will be temporary in nature, and apart from some changes to the visual amenity, long-term impacts are not expected. The proposal will have a positive social benefit of enabling renewable energy connection to the grid, and supporting regional economic development in the Parkes region.

Any negative social impacts would be short-term and minor. Given the mitigation measures outlined in this assessment, the overall environmental risk is considered to be low.

6.16 Cumulative Impacts

Cumulative impacts may be experienced due to the interaction of elements within the proposal, or with other existing or proposed developments within the locality.

The proposal will largely be located within the footprint of the QPSF (approximately 470ha), assessed and approved as State Significant Development (SSD) under Part 4 of the EP&A Act, and therefore unlikely to represent any additional impacts above and beyond those already assessed as part of that development. Review of relevant historic and current development proposals on DPE's major projects website also reveals two other recent solar farm developments (now built), being the Parkes Solar Farm (PSF) (approximately 210ha) and the Goonumbla Solar Farm (GSF) (approximately 295ha), both located to the south of the proposal site. Similar environmental impacts were identified within the Environmental Impact Statements (EISs) prepared for each of the solar farm developments, being predominately, changes to visual amenity; dust, noise and water quality impacts during construction; biodiversity; Aboriginal heritage; and loss of agricultural land.

In addition to the proposal being assessed in this REF, Essential Energy is also proposing to construct a new 132kV overhead powerline and new 132/11kV ZS within the Parkes SAP, located to the south of the proposal site (discussed further below). Essential Energy is also currently in the early planning stages and investigating route options for the construction of approximately 75km of a new 132kV overhead powerline between Parkes and the Sunrise Mine development, northwest of Parkes. It is proposed that this new 75km section of 132kV powerline will connect to the proposed new SS, which is subject to assessment in this REF. The main potential environmental impacts from these proposals would be similar to those identified in this REF, being biodiversity; Aboriginal heritage; construction noise; visual amenity; loss of / impact to agricultural land; and traffic during construction.

Other current or recently completed infrastructure projects in the Parkes region, which Essential Energy is currently aware of, include the Parkes Bypass and Inland Rail Project. The Parkes Bypass involves relocating the Newell Highway about two kilometres west of its current alignment, between Maguire Road to the north and Barkers Road to the south – a total length of 10.5km. The main impacts identified in the REF prepared for the Bypass project (RMS, 2019) were traffic and transport; socio-economic; noise and vibration; biodiversity; erosion and sediment discharge; soil quality and contamination impacts; property impacts; and temporary loss of access to a travelling stock route.

The Parkes to Narromine section of the Inland Rail project was commissioned in late September 2020 and is now operational. The project involved the upgrade of 98.4km of existing rail track, including a full rebuild of the rail tracks, rail formation, and supporting structures along the rail corridor. The 5.3km stretch of new rail track near Parkes, known as the North West Connection, is also complete and has been transferred to ARTC Operations with trains now using the line (ARTC, 2023). The EIS prepared in support of the State Significant Infrastructure (SSI) application for the Parkes to Narromine section of the Inland Rail Project (GHD, 2017) identified the main environmental impacts to be traffic, transport and access; biodiversity; noise and vibration; air quality; soils and contamination; hydrology and flooding; water quality; Aboriginal and non-

Aboriginal heritage; visual landscape; land use and property; and socio-economic impacts.

The most significant development proposed in the nearby landscape is the Parkes SAP, located on land to the south of the proposal site. The Parkes SAP covers an area of approximately 4,800ha, located west of the Parkes township, and bordered by Henry Parkes Way in the north and the Newell Highway to the east. The Parkes SAP will build on already-planned private and government investments, creating up to 3,000 jobs across a range of industries. A detailed assessment of the Parkes SAP undertaken in 2019 by technical experts, engineers, stakeholders and urban planners tested and finalised the environmental and planning studies to develop a Structure Plan (Jensen Plus, 2019), that in turn informed a Master Plan (DPIE, 2020). The technical studies that informed the Structure Plan identified a range of environmental impacts associated with the Parkes SAP, being air quality and odour; noise and vibration; groundwater; biodiversity; and Aboriginal heritage (WSP, 2019). The Parkes SAP is now in the delivery phase, led by the Regional Growth NSW Development Corporation (RGDC). To supply electricity to the new SAP, a new 132kV overhead powerline and 132/11kV ZS will need to be constructed. Essential Energy will be responsible for the delivery of this infrastructure and is currently in consultation with RGDC to refine potential routes for the powerline and the location of the ZS.

Based on the range of environmental impacts associated with the proposal subject to assessment in this REF, and the known existing and proposed developments in the locality, the potential for cumulative impacts related to the proposal include biodiversity; construction noise; visual amenity; loss of / impact to agricultural land; and traffic impacts during construction. However, given the relatively small disturbance footprint and the localised extent of potential impacts during construction and operational phases of the proposal, the potential cumulative impact to other environmental factors during construction and operation of the proposal has been minimised to the greatest extent possible, and would not be significant. Any residual, minor impacts identified in this section of the REF can be mitigated and managed through the range of measures outlined in this section and summarised in **Table 6-12**.

6.17 Summary of Environmental Mitigation Measures

The environmental mitigation measures outlined in this document would be incorporated into the Project Construction Environmental Management Plan (CEMP). These safeguards would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The mitigation measures are summarised in **Table 6-12**.

Table 6-12: Summary of Environmental Mitigation Measures

Aspect	Environmental Mitigation Measures	Timing
General	• All environmental mitigation measures must be incorporated within the Construction Environmental Management Plan (CEMP), or relevant works plan as applicable for the proposed works.	Pre-works.
General	• Environmental awareness training must be provided to all field personnel, contractors and subcontractors.	Pre-works and during works as required.
Consultation	• Consultation has been ongoing with the solar farm proponents regarding the location of the SS site and powerline augmentation works. • Landholder consultation regarding the proposed routes of the augmented powerlines has also occurred. • Impacted sensitive receivers along the proposal route would also be advised of the works schedule and provided with details of a site contact.	Project planning and pre-works. Project planning and pre-works. During works.
Licences, Permits, Approvals and Notifications	• Notification to the local council and occupiers of adjoining land in accordance with clause 2.45 of *State Environmental Planning Policy (Transport and Infrastructure) 2021*. • Notification to the local council in accordance with clause section 45 of the *Electricity Supply Act 1995*. • Section 68 approval under the *Local Government Act 1994* required for installation of an on-site septic disposal system.	21 days prior to works commencing. These notifications have been sent. 40 days prior to works commencing. This notification has been sent. Prior to commissioning of SS.
Air Quality	• Any potential dust-borne materials transported to and from the activity site will be covered at all times during transportation • Any temporary stockpiles of surplus excavated material will be covered or wet down during dry and windy conditions • All vehicles and machinery will be well maintained according to manufacturer requirements to ensure emissions are kept within acceptable limits.	During works.
Geology and Soil	• Risks associated with sediment and erosion will be managed in accordance with The Blue Book – Managing Urban Stormwater: Soils and Construction (Landcom 2004) • Disturbed areas will be stabilised as soon as practicable following construction activities • Essential Energy's CEOP8064 Management of Excavated Material; Guideline for Construction Sites will be consulted to determine the most appropriate beneficial reuse or disposal method for any surplus	During works.

Aspect	Environmental Mitigation Measures	Timing
	excavated materials.	
Water Quality and Hydrology	• Control measures will be implemented to manage risks associated with the handling of fuel through using spill trays when undertaking in field re-fuelling • Disturbed areas will be managed in accordance with the requirements of the Blue Book to minimise potential impacts to waterways. Sediment fencing will be erected, where required, downslope of disturbed areas, and impacts would be minimised where practicable. The use of filter bags may be required to discharge collected sediment-laden water where there are insufficient grassed areas available • Any water collected in excavations and trenches during rainfall and surface water ingress should be pumped to a grassed area on-site (where a suitable area is available) to allow for infiltration, reused for dust suppression, or pumped to stormwater using a sediment sock. All options should be conducted in a manner that does not result in turbid water entering the stormwater system or nearby waterway.	During works.

Noise and Vibration	• In considering the remote nature of the proposed substation site location, being at least 650m away from the nearest sensitive residential receiver, work hours will be between 7am and 6pm Monday to Saturday. On occasions works outside these hours that create an audible noise at the nearest sensitive receiver may be undertaken where the following requirements are met:
	  • Neighbours (and other sensitive receivers) adjacent to the works or the local council or the NSW Environment Protection Authority (EPA) have been notified; and
	  • Where the works are required to take place in the vicinity of private access ways or driveways ,consultation with individual residents would be undertaken to advise residents of the planned timing of the works.
	• All plant and equipment will be operated and maintained in accordance with the manufacturer's specifications.
	• Any noise complaint will be investigated with additional control measures put in place if required.
		During works.

Flora and Fauna	• Any change in design affecting land outside the proposal site assessed in this report will require further ecological survey - notwithstanding minor changes where the ecological values have been assessed for this proposal • All personnel will be inducted to be aware any stand of native vegetation outside the proposal site has legislative consequences if deliberately or accidentally impacted without approval. The extent of the clearing footprint is to be confined to the assessed areas. No clearing is permitted outside these areas without further assessment • Groundcover disturbance will be kept to a minimum and within the assessed areas • Where possible, vegetation to be removed will be mulched on-site and re-used to stabilise disturbed areas	Pre-works, during works and post works.

Aspect	Environmental Mitigation Measures	Timing

	• Erosion and Sediment Control measures will be established in accordance with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004) and documented in a Construction Environmental Management Plan (CEMP) to be prepared for the work.
	• Stockpile and compound sites will be located using the following criteria:
	  • At least 40 m away from the nearest waterway
	  • In areas of low ecological conservation significance (i.e., previously disturbed land)
	  • On relatively level ground
	  • Outside the one in 10-year Average Recurrence Interval (ARI) floodplain.
	  • Stockpiling materials and equipment and parking vehicles would be avoided within the dripline (extent of foliage cover) of any tree.
	• Essential Energy has a general biosecurity duty under the Biosecurity Act 2015 to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable. Field crews shall follow procedures as outlined in Essential Energy's Operational Guideline: Biosecurity Risk Management (CERM1000.96) to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable, with particular reference to vehicle and equipment hygiene practises
	• Any fallen timber, dead wood and bush rock (if present) encountered on site will be left in situ or relocated to a suitable place nearby
	• Prior to clearing, inspect trees with bird nests or hollows before pushing or felling to ensure the nests are vacant. Inspection would occur immediately before pushing or felling. If a bird is in the nest, clear the trees around it first to see if the animal will disperse. If the bird is a nestling (baby bird confined to the nest) all measures would be taken to collect the bird and remove to a safe location
	• Immediately prior to commencement of any vegetation removal involving machinery and/or tree-felling the area of clearing work is to be inspected for fauna
	• If fauna is detected, the animal is to be allowed to leave the site without any coercion or a local wildlife rescue service is to be contacted to facilitate the safe removal of the animal from the worksite
	• Revegetation of any bare soil or cleared areas with locally occurring native flora species typical of the original habitat types is usually recommended
	• Segments of trees removed from tree lopping are to be placed in adjoining habitat without damaging it
	• Waterways will be accessed in a way that minimises harm to banks or native vegetation
	• Machinery will be kept away from banks of the waterway (where possible)
	• Do not refuel, store or decant chemicals within 50m of a waterway
	• All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent	

Aspect	Environmental Mitigation Measures	Timing
	providing forage habitats for foxes, rats, dogs and cats.	
Aboriginal Heritage	• The location and extent of the two registered AHIMS sites, 43-3-0144 (Ridgey Creek-IF1) and 43-3-0153 (Ridgey Creek-OS1), will be clearly marked on construction plans • Essential Energy staff and contractors working on this project will be inducted, and made aware of the locations of the two registered sites and their legislative responsibilities in relation to Aboriginal heritage • In the unlikely event that an Aboriginal heritage site or object is located during the construction phase of the project, works will cease in that area and a representative from Essential Energy's Environmental Services will be notified. Works with the potential to disturb the object would not resume until the object had been properly identified, and appropriate action taken • If human remains are uncovered, works must immediately cease and the NSW Police department and Essential Energy's Environmental Services team will be notified.	During works.
Non-Aboriginal Heritage	• All construction work would be undertaken within the assessed areas of the proposal site only • In the unlikely event that a previously unknown heritage site or object is located during construction of the proposal, works would cease immediately in that area and a representative from Essential Energy's Environmental Services would be notified. Works with the potential to disturb the object would not resume until the object had been properly identified, and appropriate action taken.	During works.
Contamination	• It is intended to reuse surplus spoil beneficially on site • Essential Energy's CEOP8064 Management of Excavated Material; Guideline for Construction Sites will be consulted to determine the most appropriate beneficial reuse or disposal method for excavated materials • In the event of encountering any suspected contamination in the work area, it will be separated and contained on site until it can be classified in accordance with the EPA (2014) Waste Classification Guidelines, and then disposed of at a facility that is lawfully able to accept the waste • Control measures will be implemented to manage risks associated with the handling of fuel through using spill trays when undertaking in field re-fuelling • Sediment and erosion control structures will be established and maintained in accordance with The Blue Book to minimise potential impacts on receiving watercourses.	During works.
Electric and Magnetic Fields	• The proposal will comply with all relevant national and international guidelines • Siting the location of the proposed new SS and powerlines away (approximately 550m) from the nearest sensitive residential receivers greatly minimises any potential residual EMF exposure risk	Project planning and design.
Visual	• Siting of the SS and route of new overhead powerlines generally away from sensitive residential	Project planning and

Aspect	Environmental Mitigation Measures	Timing
	receivers minimises potential views of the proposal from these receivers. • The SS will have a high degree if integration with the substation required for the QPSF development, and the augmented powerline network will integrate with existing powerline network in the area	design.
Waste	• All surplus waste materials that are generated as a result of the project and cannot be considered as VENM or subject to a waste exemption order, will be classified in accordance with the Waste Classification Guidelines (EPA, 2014) • All waste material will be reused, recycled, or taken to a facility lawfully capable of receiving the waste.	During works.
Bushfire	• Ongoing vegetation maintenance would occur to ensure safe clearance distances are maintained for the new sections of powerline and around the SS perimeter.	Post construction
Traffic and Access	• A Traffic Management Plan (TMP) for the construction phase would be prepared prior to works commencing. The TMP would outline requirements for the safe and continued use of local transport corridors during construction.	Pre-works and during works.
Land Use	• Consultation about the proposed works and schedule will be undertaken directly with affected landholders • The site should be left in a tidy condition at the conclusion of construction activities.	During works.
Social and Economic	• Management of construction traffic in the vicinity of construction works, including communication with local residents and road users • Signs and barriers would be erected around construction work sites, where appropriate, to minimise the possibility of personnel injuries and prevent placing the public at risk.	Pre-works and during works.

7. Ecologically Sustainable Development

Ecologically sustainable development (ESD) is an attempt to provide the best outcomes for the human and natural environments both now and into the indefinite future. One of the most often cited definitions of sustainability is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". Sustainability relates to the continuity of economic, technical, social, institutional and environmental aspects of human society, as well as the non-human environment.

The existing environment has been described throughout **Section 6** of this REF for the various aspects of the natural environment assessed as part of this proposed activity.

The proposal has been assessed against the following four principles of ESD listed in the *Protection of the Environment Administration Act 1991*.

The four principles of ESD are:

- The precautionary principle: section 6(2)(a)(i)(ii)
- The principle of inter-generational equity: section 6(2)(b)
- The principle of biological diversity and ecological integrity: section 6(2)(c)
- The principle of improved valuation of environmental resources: section 6(2)(d)(i)(ii)(iii).

An assessment of the proposal against the principles is provided below.

7.1 Precautionary Principle

The precautionary principle states that:

'If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

1) *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and*
2) *an assessment of the risk weighted consequence of various options.'*

For the precautionary principle to be applicable, two pre-conditions must be satisfied; "*first it is not necessary that serious or irreversible environmental damage has actually occurred – it is the threat of such damage that is required. Secondly, the environmental damage threatened must attain the threshold of being serious or irreversible*"[4].

If there is no threat of serious or irreversible environmental damage, there is no basis upon which the precautionary principle can apply.

Environmental investigations, including a quantitative ecological impact assessment, and desktop Aboriginal heritage due diligence and visual impact assessments, have been undertaken during the preparation of this REF to ensure that the potential environmental impacts are understood with a high degree of certainty. The spatial scale of impacts would be local and isolated to the immediate construction area. Therefore, it can be concluded that this proposal will not result in a threat of serious or irreversible damage.

Mitigation measures have also been proposed in this REF to minimise the identified potential impacts of the project. A Construction Environmental Management Plan (CEMP) will be developed and implemented as a precautionary measure, and no mitigation measures have been deferred due to a lack of scientific certainty. The proposal is therefore consistent with the precautionary principle.

7.2 Principle of Inter-Generational Equity

The principle of inter-generational equity states that:

'The present generation should ensure that the health, diversity and productivity of the environment

[4] Telstra Corporation Limited v Hornsby Shire Council [2006] NSWLEC 133, Preston CJ at 129

are maintained or enhanced for the benefit of future generations.'

To the extent possible, all environmental impacts and appropriate mitigation measures have been identified. The proposal would not harm the health, diversity and productivity of the environment to such an extent that future generations would not be able to benefit.

The proposal is therefore consistent with the principle of inter-generational equity.

7.3 Principle of Biological Diversity and Ecological Integrity

The principle of biological diversity and ecological integrity states that:

'Conservation of biological diversity and ecological integrity should be a fundamental consideration.'

The proposal comprises the construction of a new 132kV SS and augmentation of the local powerline network, on predominately cleared land historically used for cropping and grazing. A quantitative ecological impact assessment has been prepared which concluded the proposal will not result in a significant impact to the ecological values present in the proposal site. The impact to listed threatened species, populations and communities recorded or presumed to occur in the proposal site was assessed as not significant. Impacts upon ecological integrity would therefore be negligible, as described in **Section 6.5**.

7.4 Improved Valuation of Environmental Resources

The principle of improved valuation of environmental resources states that:

'Environmental factors should be included in the valuation of assets and services such as:

- Polluter pays – that is, those who generate pollution and waste should bear the cost of containment, avoidance and abatement
- The users of goods and services should pay prices based on the full life cycle of costs of providing those goods and services, including the use of natural resources and assets and the ultimate disposal of any waste
- Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise cost to develop their own solutions and responses to environmental problems.'

The proposal has been designed taking into consideration the least possible impact on the environment. All costs associated with the containment, avoidance and abatement of pollution have been factored into the design of this proposal. The proposal will have the positive benefit of supporting the connection of a number of new major customers, including connection of renewable energy to the grid, contributing to regional economic opportunities and job growth in the area.

8. Construction Environmental Management Plan

8.1 Introduction

A Construction Environmental Management Plan (CEMP) outlines the environmental objectives of a project, the environmental mitigation measures to be implemented, the timing of implementation, responsibilities for implementation and management, and a review process to determine the effectiveness of the strategies.

The construction contractor(s) would be required to develop a project-specific CEMP that addresses the scope of works to be undertaken. The CEMP would detail how the works would be undertaken to comply with all environmental laws, Essential Energy's environmental policy, and the environmental mitigation measures described in this REF.

The key objectives of the CEMP would include:

- Ensuring that the works are carried out in accordance with legislative requirements and relevant non-statutory policies
- Ensuring that the works are carried out in accordance with the requirements detailed in this REF, including all requirements outlined in any relevant approvals, permits or licences, and the mitigation measures described in **Section 6**
- Ensuring that employees engaged to undertake the works comply with the conditions detailed in the CEMP
- Identifying management responsibilities and reporting requirements to demonstrate compliance with the CEMP.

It is also noted that the CEMP would be a working document and may be amended over the course of the project.

If a particular activity falls outside the scope of the REF and CEMP, and it would increase the environmental impact, the activity is not permitted to continue without an appropriate environmental assessment under the EP&A Act.

8.2 Implementation of the CEMP

The CEMP would be a working document and would be amended should strategies initially implemented be found to be inadequate to manage environmental impacts. The CEMP would typically:

- Establish environmental goals and objectives
- Detail the conditions of approval
- List actions, timing and responsibilities for implementation that arise from the mitigation measures recommended in this REF
- Detail statutory requirements
- Provide a framework for reporting on relevant matters on an ongoing basis
- Detail training requirements for personnel in environmental awareness and best practice environmental management systems
- Outline emergency procedures, including contact names and corrective actions
- Detail process surveillance and auditing procedures
- List complaint handling procedures
- Detail quality assurance procedures.

8.2.1 Auditing schedule of the CEMP

Auditing of the proposal would be undertaken to establish whether the contractor is conducting activities in accordance with their current environmental management plans and whether the

management plans are providing an effective tool to control adverse environmental impacts.

The following activities are proposed to achieve the audit's purpose:

- Review the on-site implementation of the contractor's CEMP
- Review the documentation process to determine if planned works have received endorsement to proceed
- Monitor the compliance of construction activities with the project determination and environmental legislation
- Review the outcomes of any previous audit(s) and determine if there has been any change in the environmental performance of the construction contractor
- Identify opportunities to improve on-site environmental management practices.

The benefits of conducting the environmental audit are to allow:

- Feedback on the CEMP implementation process to assist both the contractor and project manager to improve the future preparation of site environmental management documentation
- Improve the planning of construction projects through documentation and impact assessment to ensure best environmental management practices are implemented on site
- Improve environmental management processes on site.

9. Environmental Checklist

In accordance with section 5.5 of the EP&A Act and clause 171 of the EP&A Reg, Essential Energy, when assessing the environmental impact of an activity on the environment, must consider the factors identified in **Table 9-1** and **Table 9-2** below.

Table 9-1: Section 5.5 requirements

Requirement	Section Reference
For the purpose of attaining the objects of this Act relating to the protection and enhancement of the environment, a determining authority in its consideration of an activity shall, notwithstanding any other provisions of this Act or the provisions of any other Act or of any instrument made under this or any other Act, examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity.	Section 2, 6, 7 and 8
Without limiting the above, a determining authority shall consider the effect of an activity on any wilderness area (within the meaning of the *Wilderness Act 1987*) in the locality in which the activity is intended to be carried on	N/A – there are no wilderness areas within or close to the activity area

Table 9-2: Clause 171 checklist

171 Factor	Section Reference
The environmental impact on a community *The works are located in a predominately rural landscape, with future rural-industrial development associated with the QPSF located nearby. Impacts on the community have been considered by this REF. These include dust, noise, biodiversity, Aboriginal heritage, social and visual impacts. With the exception of noise and visual, these have been assessed to be low. Noise has been assessed as moderate, while visual impact has been assessed as high in the short term and low to moderate in the longer term.*	Sections 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13 6.14 and 6.15.
The transformation of a locality *In the short term there will be a high degree of visual change associated with site preparatory works, civil works and construction of the SS and new sections of underground and overhead powerlines. Over the longer term the SS and overhead powerlines will also be a permanent change in the visual landscape, however, some degree of integration will occur with existing electricity distribution and sub-transmission lines, and the SS will back on to the development boundary of the QPSF.*	Sections 6.10, 6.14, 6.15 and 6.16.
The environmental impact on the ecosystems of the locality *The proposal will not result in a significant impact to the ecological values present in the proposal site. The impact to listed threatened species, populations and communities recorded or presumed to occur in the proposal site was assessed as not significant. Safeguards and mitigation measures have been provided to minimise harm to the environment. The proposal is unlikely to have a significant impact to species, populations and communities listed under the EPBC Act, FM Act, or BC Act.*	Sections 6.5, 7 and Appendix A.
Reduction of the aesthetic, recreational, scientific, or other environmental quality or value of a locality *An overall reduction in aesthetic and recreational quality of the locality is unlikely to occur during the proposed works. Localised impacts may occur at the construction sites, however these impacts will be temporary and of short duration, and can be managed through implementation of mitigation measures in this REF.*	Sections 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.14, 6.15 and 6.16

171 Factor	Section Reference
The effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations. *No sites or places of Aboriginal heritage identified within the footprint of the proposed new SS site. Two registered sites, 43-3-0144 (Ridgey Creek-IF1) and 43-3-0153 (Ridgey Creek-OS1) are located within, or in close proximity to, the proposed route of the new sections of overhead powerlines. Artefacts relating to the two registered sites could not be relocated during the site inspection undertaken on 27 April 2023, where it was noted that recent ploughing of the paddock had occurred. Considering the highly disturbed nature of the proposal site, the design of the powerline to avoid impacts to registered AHIMS sites, the location of the activities away from other known Aboriginal sites, and the mitigation measures recommended in this REF, the proposal is not likely to impact Aboriginal heritage.* *No sites of world, national, state or local heritage significance are located within, or intersected by, the boundary of the proposal site. The proposal is unlikely to have a significant impact upon non-Aboriginal heritage in the area.*	Sections 6.6, 6.7.
The impact on the habitat of protected fauna (within the meaning of the *Biodiversity Conservation Act, 2016*). *The proposed activity is not likely to significantly impact the habitat of a threatened fauna species.*	Section 6.5, Appendix A.
The endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air. *It is not anticipated that the proposal will endanger any species of animal, plant or other form of life, whether living on land, in water, or in the air.*	Section 6.5, Appendix A.
Long-term effects on the environment. *While localised impacts may occur at the construction sites, these impacts will be temporary and of short duration. Long-term adverse environmental effects are not anticipated.*	Sections 6 and 7.
Degradation of the quality of the environment. *This risk is considered low with the implementation of soil and water management measures included in this REF.*	Sections 6.1, 6.2, 6.3, 6.5, 6.8 and 6.11.
Risk to the safety of the environment. *There is the potential risk to the environment from spillage of materials during construction of the proposal. Implementation of the mitigation measures contained in Section 6 of this REF will ensure that potential environmental risks are minimised.*	Sections 6.1, 6.2, 6.3, 6.4, 6.8, 6.11, 6.12, 6.13, 6.14 and 7.
Reduction in the range of beneficial uses of the environment. *No long-term reduction in the range of beneficial uses of the environment is anticipated as a result of the proposal.*	Section 6 and 7
Pollution of the environment. *Risk of pollution to the environment is considered low and can be managed with implementation of mitigation measures provided in this REF.*	Section 6
Environmental problems associated with the disposal of waste *Waste generated as a result of the proposed works will be minor. All wastes that are generated as a result of the project will be appropriately disposed of in accordance with the Waste Classification Guidelines (EPA, 2014).*	Section 6.11
Increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply. *The proposal is unlikely to increase demands upon rare natural resources.*	Section 6

171 Factor	Section Reference
The cumulative environmental effect with other existing or likely future activities *In addition to the proposal, Essential Energy is also proposing to construct a new 132kV overhead powerline and new 132/11kV Zone Substation (ZS), within the Parkes SAP, located to the south of the proposal site, and are currently in the early planning stages and investigating route options for the construction of approximately 75km of a new 132kV overhead powerline between Parkes and the Sunrise Mine development, northwest of Parkes. Essential Energy has also identified several other projects, including three solar farms, the Parkes Bypass, Inland Rail Project, and Parkes SAP, which have either recently been completed, are currently underway, or proposed to commence soon. The anticipated environmental impacts of each of these projects has been detailed in the respective environmental impact assessment documentation for each project. Potential environmental impacts in common with these developments include, traffic, transport and access; biodiversity; noise and vibration; air quality; soils and contamination; water quality; Aboriginal and non-Aboriginal heritage; visual landscape; land use and property; and socio-economic impacts.* *Based on the range of environmental impacts associated with the proposal subject to assessment in this REF (Chapter 6), and the known existing and proposed developments in the locality, the potential for cumulative impacts related to the proposal include biodiversity; construction noise; visual amenity; loss of / impact to agricultural land; and traffic during construction. However, given the relatively small disturbance footprint and the localised extent of potential impacts during construction and operational phases of the proposal, the potential cumulative impact to other environmental factors during construction and operation of the proposal has been minimised to the greatest extent possible, and would not be significant. Any residual, minor impacts identified in this section of the REF can be mitigated and managed through the range of measures outlined in section 6.16 and summarised in Table 6-12.*	Section 6.16.
The impact on coastal processes and coastal hazards, including those under projected climate change conditions? *The proposal is not located on the coast.*	Section 1 and 6.
Applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1, *The proposal will support the push for renewables, including solar power, and connections into the National Electricity Grid outlined as part of the vision in the Parkes Shire Local Strategic Planning Statement 2020 (PSC, 2020). The proposal, in part, will also support Planning Priority 5 of the same document, by providing adequate infrastructure to service the Parkes National Logistics Hub Special Activation Precinct. Furthermore, the proposal through the connection of a new solar farm, supports Objective 2 of the Central West and Orana Regional Plan 2041 (DPE, 2022) by supporting the State's transition to Net Zero by 2050 and deliver the Central–West Orana Renewable Energy Zone.*	Section 6.15
Other relevant environmental factors. *No other relevant environmental factors have been identified during the preparation of this REF*	N/A

10. Conclusion

This REF has been prepared to assess the environmental impacts associated with the construction, operation and maintenance of the new Quorn Park 132kV SS and associated powerline augmentation work. Essential Energy is a determining authority as defined in the EP&A Act. As such, the activity does not require consent under Part 4 of the EP&A Act. The activity has been assessed under Part 5, Division 5.1 of the EP&A Act.

The proposal would enable the upgrade of the local electricity network to both support the connection of a number of new major customers currently seeking connection, and increase overall network capacity, placing Essential Energy in a better position to meet customers' future electricity needs and support planned development and economic growth in the Parkes region.

The proposal complies with the provisions of section 5.5 of the EP&A Act and clause 171 of the EP&A Reg as shown in **Section 9**.

The proposal and its associated environmental impacts are unlikely to have a significant impact on the environment. The proposal would support the connection of a number of new major customers, including the connection of renewable energy to the grid, and strengthen Essential Energy's electricity network in the broader area, maximising the social and economic benefits, whilst minimising any adverse environmental impacts.

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Appendix A – Ecological Impact Assessment (AREA Environment and Heritage)

Ecological Impact Assessment

Proposed Quorn Park Switching Station and Powerline

Essential Energy

Parkes Local Government Area, NSW

June 2023

AREA

essential energy

AREA Environmental & Heritage Consultants acknowledges

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Document controls

Proponent	Essential Energy
Client	Essential Energy
Quote number	QU# 1058
Project No / Purchase Order No	EE00048593
Document Description	Proposed Quorn Park Switching Station and Powerline – Parkes, NSW Ecological Impact Assessment Report
Clients Representative Managing this Document	Nathan Hegerty
AREA Person(s) Managing this Document	Michelle Glover
Cover image	Area of planted vegetation and farmland impacted by the proposal

DOCUMENT STATUS		
DRAFT: Series V1.X AREA internal edits	**Date**	**Action**
V1.0	26/05/2023	For internal review
V1.1	26/05/2023	Internal edit
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V2.0	26/05/23	AREA to client
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V3.0	30/05/23	Final to client
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Executive summary

Essential Energy (the proponent) proposes to construct a 132kV switching station and associated infrastructure 10 kilometres northwest of Parkes, NSW (the proposal). The proposal will facilitate a number of new major customer connections to Essential Energy's 132 kilovolt (kV) network in the Parkes region.

The proposal will include:

- construction of a 6881 square metre 132 kilovolt (kV) switching station, encompassing a disturbance area of approximately 6880 square metres.
- construction of approximately 1.4 kilometres of double circuit 132kV powerline
- realignment of approximately 1.16 kilometres of existing 66kV powerline (750m of which will be collocated with one line of the double circuit 32kV powerline
- installation of 23 poles, and
- construction of an approximately 8 metre wide switching station access road.

The switching station will be located on cleared farming land within the footprint of the approved Quorn Park Solar Farm development (Premise Australia, 2019). The access road will traverse an area of planted and remnant roadside vegetation within the road reserve of Back Trundle Road. The proposed 132kV powerline will comprise both overhead and underground components with the overhead section intersecting the western margin of the planted vegetation, and roadside vegetation, in the vicinity of a private residence access road, near the intersection of Back Trundle Road and McGrath Lane. The remaining areas of the proposed powerline including the realigned sections of the 66kV powerline will traverse cleared farmland and Back Trundle Road.

Impacts to native vegetation for this project will be limited to that impacted by the construction of the proposed switching station, access road, and the new section of double circuit 132kV powerline.

AREA Environmental & Heritage Consultants (AREA) has been engaged by the proponent to complete an ecological impact assessment for the proposal. The proposal will be assessed under Part 5, Division 5.1 of the *Environmental Planning and Assessment Act 1979*. This report takes into account the relevant requirements under the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and NSW *Fisheries Management Act 1994* (FM Act).

The fieldwork component of this assessment was undertaken on 27 April 2023 by Michelle Glover of AREA. The purpose of the field assessment was to identify the range of ecological values present across the study area, evaluate any residual ecological impacts, and determine if there would be a significant impact to matters of environmental significance.

The assessment determined the proposal will not result in a significant impact to matters protected under the EPBC Act, BC Act or FM Act.

The proposal will have an approximate 16.20 hectare footprint including an 80 metre wide powerline corridor and 50 metre wide access road clearance corridor and switching station boundary. Three hectares of native vegetation, in three Plant Community Types have the potential to be impacted.

PCT ID	PCT name	Disturbance area (ha)
0	Not-Native – areas comprising largely exotic species/areas used for agriculture or unvegetated areas e.g., existing roads, tracks etc.	13.2
81	PCT 81 - Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands	1.25
82	PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	1.13
278	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	0.62
	Total	16.20

Three Threatened Ecological Communities listed under the BC Act or EPBC Act have the potential to be impacted by the proposal.

Threatened Ecological Community	BC Act listing	EPBC Act listing
Grey Box (*Eucalyptus microcarpa)* Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	-	EEC
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion	EEC	-
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	CEEC	-

***V = Vulnerable, E = Endangered, CE = Critically Endangered**

Database searches and habitat assessment identified 105 listed species under the EPBC and or BC Act, as potentially occurring in or adjacent to the development footprint.

The impact of the proposal on listed threatened species and ecological communities was assessed using the appropriate test of significance under the EPBC Act or BC Act, which determined the impact on protected matters associated with this proposal will not be significant.

The proposal intersects one named and one unnamed ephemeral waterway with poorly defined channels and limited native vegetation.

Safeguards and mitigation measures have been provided to minimise harm to the environment. If these are implemented then the proposal is unlikely to have a significant impact to species, populations and communities listed under the EPBC Act, BC Act or FM Act.

No further ecological assessment is required.

Contents

Figures

Tables

1 Introduction

Essential Energy (the proponent) proposes to construct a 132 kilovolt (kV) switching station, and associated powerline augmentation work, approximately 10 kilometres northwest of Parkes, NSW (the proposal). The proposal will facilitate a number of new major customer connections to Essential Energy's 132kV network in the Parkes region (Figure 1-1).

AREA Environmental & Heritage Consultants (AREA) was engaged by Essential Energy to complete an ecological assessment for the proposal.

1.1 Objectives

The objectives of this ecological assessment are to provide:

- accurate predictions and mapping of any vegetation clearing on site,
- detailed assessment of the potential impact to any threatened species, populations, endangered ecological communities or their habitats; groundwater dependent ecosystems predicted to occur; and any potential for offset requirements in accordance with relevant State or Commonwealth guidelines, and;
- detailed descriptions of the measures to avoid, minimise, mitigate and offset impacts to biodiversity.

Essential Energy is the determining authority for this proposal under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This Ecological Impact Assessment addresses requirements under s.7.3 of the *Biodiversity Conservation Act 2016* (BC Act) and considers matters protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and NSW *Fisheries Management Act 1994* (FM Act).

This assessment addresses these primary requirements as well as the requirements of the following assessment frameworks.

International agreements

- Japan-Australia Migratory Bird Agreement (JAMBA)
- China-Australia Migratory Bird Agreement (CAMBA)
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
- Ramsar Convention on Wetlands (Ramsar).

Commonwealth Assessment Guidelines

- Significant Impact Guidelines Version 1.1, 2013.

State Assessment Guidelines

- Threatened Species Test of Significance Guidelines (OEH, 2018),
- Guidelines for Division 5.1 assessments (DPE, 2022).

Figure 1-1: Location of the proposal

1.2 Definitions

Terms used in this report include:

- **Development footprint** – the proposal area including buffers established around proposed infrastructure for the purpose of taking into account all associated environmental impacts including:
    - 80 metre wide powerline corridor
    - 50 metre wide access road corridor
- **Impact footprint** – land directly affected by the proposal resulting from construction of power poles and powerlines, the switching station and access road.
- **study area** – land directly or indirectly affected by the proposal and subject to assessment. For this assessment it includes the IBRA subregion, a 1500m around the development footprint for desktop review, and the development footprint for the field assessment.

Additional terms and abbreviations are provided in Appendix A.

1.3 Project description

The switching station (SS) will be located on cleared farming land within the footprint of the approved Quorn Park Solar Farm (QPSF) development (Premise Australia, 2019).

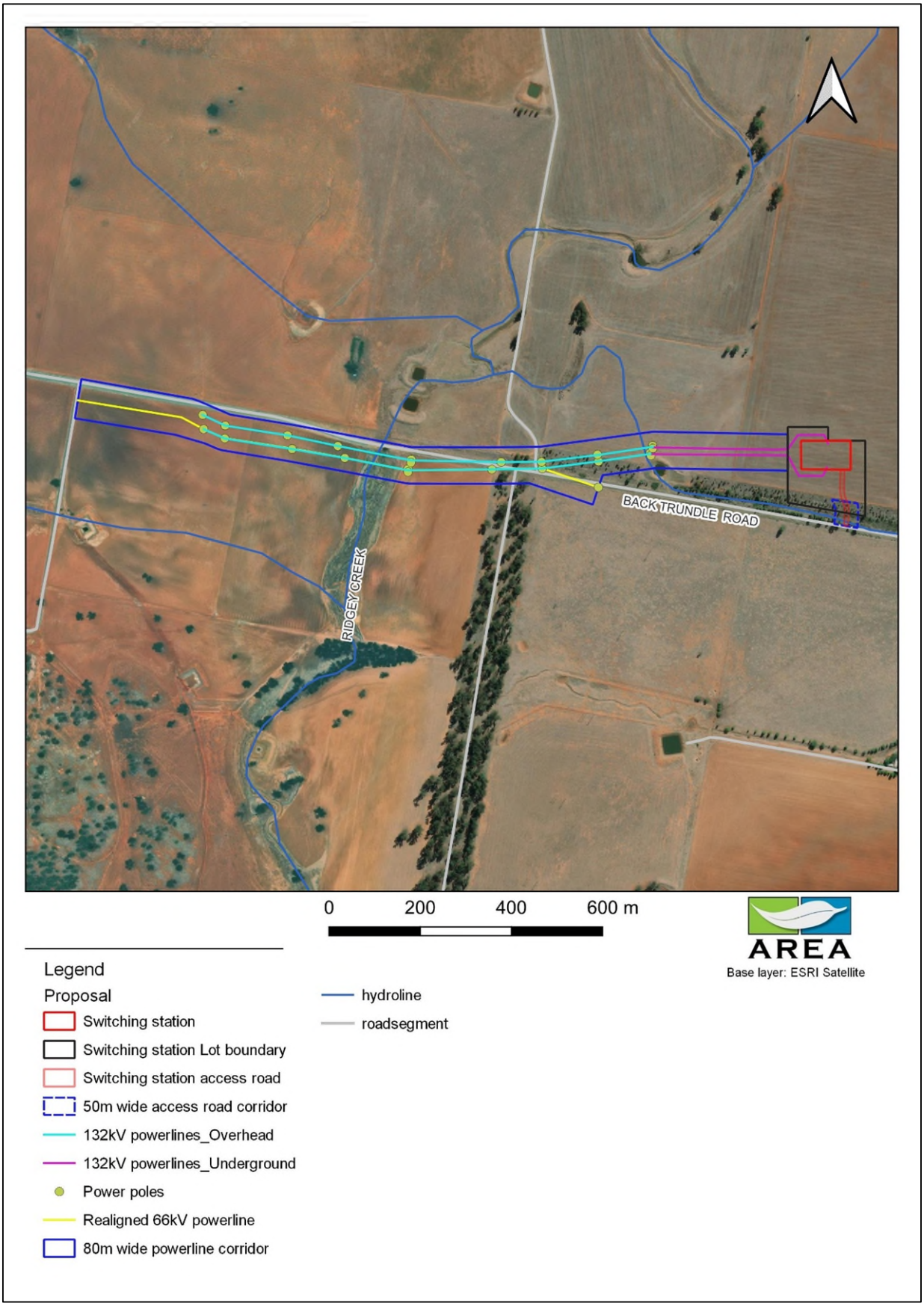
To connect the SS to Essential Energy's existing network, a new double circuit 132kV powerline, comprising both overhead and underground components, will be constructed from the SS to an existing 132kV powerline, approximately 1.4 kilometres west of the proposed SS location (Figure 1-2).

The proposal will include:

- construction of a 132 kilovolt (kV) switching station, encompassing a disturbance area of approximately 6880 square metres,
- construction of approximately 1.4 kilometre of double circuit 132kV powerline,
- realignment of approximately 1.16 kilometres of existing 66kV powerline (750m of which will be collocated with one line of the double circuit 32kV powerline,
- installation of 23 poles, and,
- construction of an approximately 8 metre wide switching station access road.

The current route of the SS access road has been designed to minimise impacts to vegetation, however, some vegetation will require removal and / or trimming along the proposed route. The overhead powerline sections will intersect with the western margin of the planted vegetation, and roadside vegetation, in the vicinity of a private residence access road, near the intersection of Back Trundle Road and McGrath Lane. The remaining areas of the proposed route will traverse cleared farmland but some disturbance to groundcover from pole installation and movement of vehicles and machinery is expected.

Figure 1-2: The proposal



1.4 Study area

The regional and ecological context of the study area is summarised in Table 1-1 and Table 1-2. Figure 1-3 shows the location of the proposal in relation to IBRA regions and sub-regions.

The local area has been historically cleared or disturbed for infrastructure and agricultural.

Table 1-3 provides photos and descriptions of the various points within the development footprint.

Table 1-1: Regional context of the study area

Criteria	Study area
Interim Biogeographic Regionalisation for Australia (IBRA Region)	IBRA Region: • NSW South Western Slopes IBRA Subregion: • Lower Slopes
Local Government Area	Parkes
Land use / disturbance	Road corridor, paddocks, electricity transmission line corridor.
Nearest waterways	Waterways intersected include: • Ridgey Creek (directly beneath proposed overhead powerlines) • Unnamed (directly beneath proposed overhead powerlines and within the southern section of access track) • One farm dam.
Elevation - Australian Height Datum	~280 m

Table 1-2 Proximity of environmentally sensitive areas to the study area

Environmental Considerations	In the study area?
Reserved or a dedicated National Park	No
National Heritage Places	No
World Heritage Area	No
Mapped on Native Vegetation Regulatory (NVR) Map	Yes – section 3.2.9
Mapped on Biodiversity Values (BV) Map	Yes – section 3.2.5
Land identified in an Act as wilderness (Wilderness Act 1987)	No
Dedicated wetlands under the Ramsar Wetlands Convention?	No
State or national critical habitat	No
Key Fish Habitat (KFH)	Yes – section 3.2.6
Regional Forest Agreement	No
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
Critical habitat state or nationally?	No

Figure 1-3:Regional Context

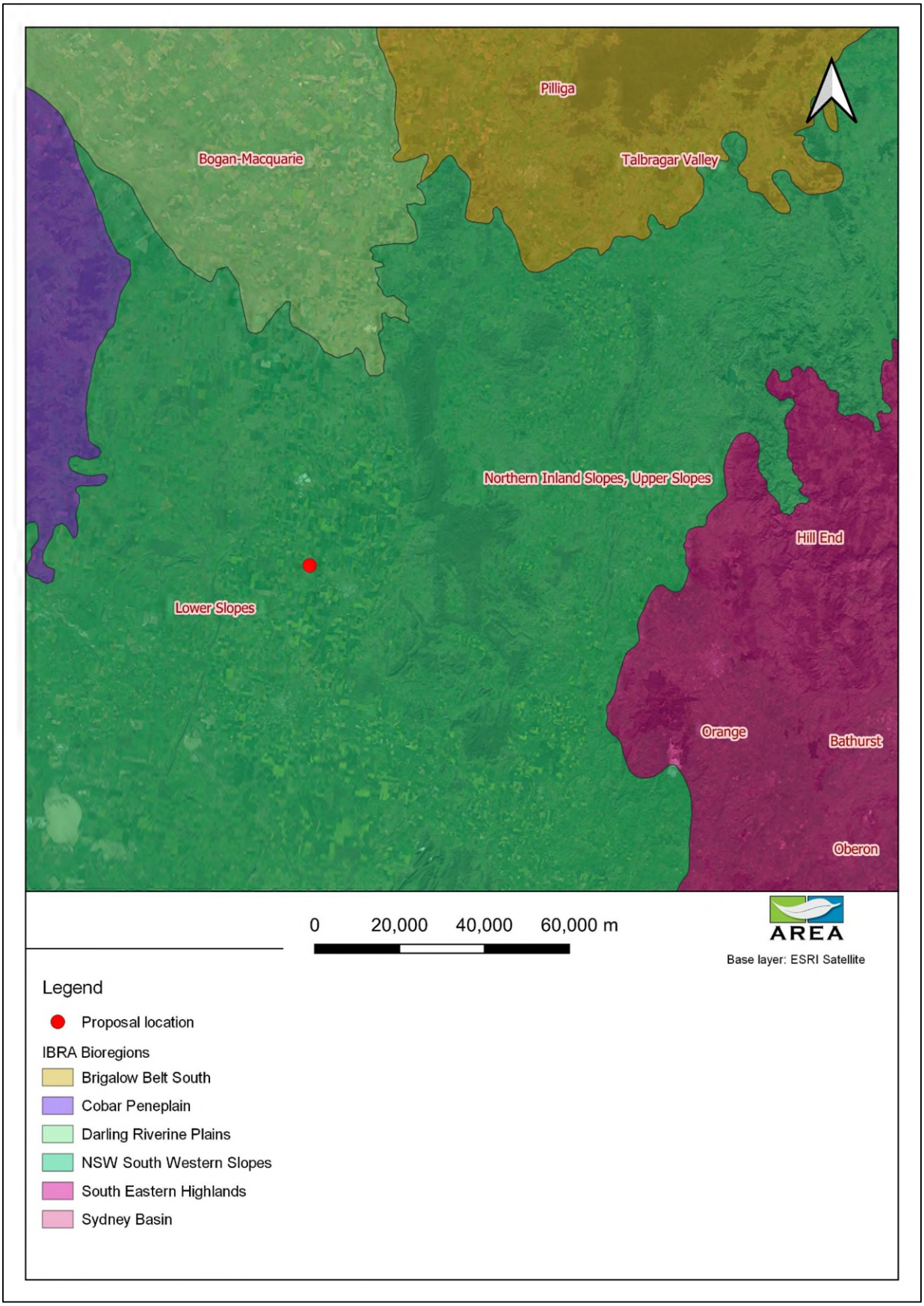


Table 1-3: Pictures of the development footprint

Image	Description
	The proposed switching station and underground powerlines will be constructed on cropped agricultural land.
	The switching station access road will pass through a remnant Yellow Box (*E. melliodora*) community adjacent to Back Trundle Road.
	Transition between native and non-native vegetation through which the access road will pass.

Image	Description
	The 132kV overhead powerlines, realigned 66kV powerlines, and power poles will largely be constructed on cleared/ploughed agricultural land.
 	Overhead powerlines will cross Ridgey Creek with poles positioned approximately 30m either side as indicated by witches hats.

Image	Description
	Grey box (*E.microcarpa*) community that will be impacted by construction of overhead power lines on the corner of McGrath Lane and Back Trundle Road.
	Planted native vegetation and road corridor will be impacted by construction of powerlines and installation of poles.

2 Methods

The following methods were used for this assessment:

- desktop review of ecological databases and literature, and
- a field survey of the study area using transect method by foot and vehicle.

The assessment rationale was to evaluate the type and quality of habitat to be impacted by the proposal, apply professional judgement, and then complete targeted assessment of potential habitat to detect the region's listed species, populations, or communities.

This assessment was completed by suitably qualified AREA staff (Table 2-1).

Table 2-1: AREA staff qualifications

Name	Position	CV Details	Role in this assessment
Michelle Glover	Environmental Consultant	• B. Env. Sc. University of New England • Certificate IV in Project Management • Management planning and environmental assessments under the Environment Protection and Biodiversity Conservation Act 1999 • Indigenous and stakeholder engagement • Provide First Aid. Certificate number: 12249475-7913132	Field assessment Report writing
Gabrielle Green	Environmental Consultant (cadet)	• B. Env. Sc. University of New England (in progress) • AHCPCM201 – Recognising grasses • WHS White Card - general construction induction card (CGI1667253SEQ01) • RMS-worker on foot training • First Aid Certificate (Cert No. 6995717)	Report writing
Rowan Murphy	Senior Environmental Consultant	• B. Env. Sc. University of New England. • LLB. University of New England. • NSW Biodiversity Assessment Method Accredited Assessor: BAAS18152. • CERT IV: Government Investigations (PSP40416). • Auditing Environmental Management Systems. • Aboriginal and Torres Strait Islander Cultural Awareness. • Chainsaw Operation (Level 1 and 2). • Dealing with Threatening and Aggressive Behaviour. • Operate 4WD Vehicles. • Senior First Aid (Remote Situations). • Writing Clear Science. • WHS White Card.	Review

2.1 Desktop review

2.1.1 Information sources

Preliminary assessment drew on local experience, previous reporting and information held on government databases and archives (Table 2-2 and Appendix B). A desktop review was used to inform field surveys and assessment of potential impact to threatened flora and fauna (Section 4).

Table 2-2: Resources used for this assessment

Title	Web address
Legislation	
Biodiversity Conservation Act 2016	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-2016-063
Commonwealth Environment Protection & Biodiversity Conservation Act 1999	http://www.austlii.edu.au/au/legis/cth/consol_act/epabca1999588/
Environmental Planning and Assessment Act 1979	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1979-203
Fisheries Management Act 1994	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1994-038
National Parks and Wildlife Act 1974	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-1974-080
Water Management Act 2000	https://www.legislation.nsw.gov.au/view/html/inforce/current/act-2000-092
Biodiversity	
EPBC Act Protected Matters Search tool	https://www.dcceew.gov.au/environment/epbc/protected-matters-search-tool
DPE Threatened Species website	https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species
Guide to Surveying Threatened Plants (OEH, 2015)	http://www.environment.nsw.gov.au/resources/threatenedspecies /160129-threatened-plants-survey-guide.pdf
NSW Biodiversity Values Map and Threshold Tool	https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap
NSW Native Vegetation Regulatory Map	https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=NVRMap
DPE State Vegetation Type Mapping	Retrieved from: https://datasets.seed.nsw.gov.au/dataset/nsw-state-vegetation-type-map
NSW Planning Portal	https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address
PlantNET	http://plantnet.rbgsyd.nsw.gov.au/
Significant Impact Guidelines 1.1 - Matters of National Environmental Significance	http://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance
Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft (DEC, 2004)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/draft-threatened-biodiversity-survey-guide.pdf
Threatened Species Assessment Guideline - The Assessment of Significance (DECCW, 2007)	https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/assessment-of-significance-guide-070393.pdf

2.2 Field survey

The fieldwork component of this assessment was undertaken from 27 April 2023 by Michelle Glover of AREA.

The objectives of the field assessment were to:

- describe the nature and extent of vegetation removal,
- determine if species, populations or communities listed in the EPBC, BC or FM Acts would be, or have potential to be, affected by the proposal,

- determine if groundwater dependent communities would be, or have potential to be, affected by the proposal; and,
- describe the quality and value of the habitat affected by the proposal.

Database searches were used to inform the field assessment, and applied to determine the likelihood for a protected matter and Plant Community Type (PCT) to be recorded within the development footprint and what targeted searches would be needed for detection.

Published information showing predicted threatened and non-native species were used during the field assessment. Where a potentially threatened flora or fauna or ecological community were identified, such resources were used to confirm occurrence.

The study area was assessed using pedestrian and vehicular survey methods and consisted of sampling areas where impacts to native vegetation may occur, changes in vegetation type were evident and vegetation had a reasonable chance of supporting threatened flora or fauna species or communities.

Results of the field assessment are presented in Section 4.

2.2.1 Plant Community Types

Plant Community Types (PCTs) were identified in the field using State Vegetation Map: Central West / Lachlan Region Version 1.4 VIS_ID4468 (SVM4468) PCT map sourced from the NSW SEED website, as a baseline for the study area and region.

The assessment aimed to confirm PCTs and update those incorrectly mapped to the correct vegetation class, PCT and / or Threatened Ecological Communities (TECs). PCT IDs and boundaries between mapped PCTs were adjusted after ground-truthing.

Areas of not native vegetation were also identified and included areas where the vegetation consisted of exotic species or where there was no vegetation such as along tracks and roads.

Formal vegetation plots were not used for this assessment.

2.2.2 Threatened Ecological Communities

Threatened Ecological Communities were predicted using database searches, and the PCTs associated with a TEC. Data collected during the field assessment and the NSW and Commonwealth descriptions of TECs was used to confirm presence or absence of TECs in the development footprint.

2.2.3 Habitat assessment

Habitat in the development footprint was assessed for its potential to provide resources for listed species predicted or known to occur. Database searches were used to inform the field assessment. Professional judgement was applied on site to determine a likelihood for a protected matter to be recorded and what targeted searches would be needed to detect and consider the magnitude of the potential impact.

In the field, any indirect evidence of fauna (i.e., scats, tracks, calls, fur, feathers, sloughed skins etc.) was investigated. Mature trees in the development footprint, where present, were inspected for hollows and signs of use from listed fauna species and to determine if they were

used as fauna breeding sites. Ground habitat such as rocks and logs which may be potential habitat for listed reptiles were inspected to determine if they were significant habitat.

2.2.4 Threatened fauna

Opportunistic sightings of mammals, birds, reptiles, frogs were recorded during assessment of the study area. Attention was given to identifying the presence of suitable habitat (e.g. tree hollows, nests, logs, waterways) and signs of activity (e.g. feeding scars, scats).

2.2.5 Limitations

Not all animals and plants can be fully accounted for within any given study area. The presence of threatened species is not static, and it changes over time, often in response to longer term natural forces which can at any time be dramatically influenced by man-made disturbance or weather. A 'precautionary approach' for species occurrence has been adopted where required. Database searches were used to identify threatened species known or predicted to occur in study area. All of these are considered for their potential to occur in the development footprint and likelihood of impact, therefore, the use of specific fauna survey methods such as trapping, ultrasonic call capture and nocturnal assessments was not considered necessary.

The assessment was conducted at a time where rare orchids may not be detectable.

Access to private land northwest of McGrath Lane and Ridgey Creek road within the 80 metre powerline corridor was not allowed.

The above-mentioned constraints are not considered to compromise the findings or results of the field assessment.

2.3 Significance of potential impact

EPBC Act, BC Act and FM Act listed species, populations, communities, and migratory species, identified in the desktop review and field survey were assessed for likelihood of occurrence in the development footprint, and likelihood of impact from the development.

The following three terms of likelihood were used in this process:

- **"Unlikely"** = There is a very low to low probability a species uses the development footprint. Species unlikely to occur are also therefore, unlikely to be impacted. A test of significance under the EPBC or BC Act is not required for this species.
- **"Potential"** = There is a medium to high probability a species uses the development footprint. If the development may impact this species a test of significance under the EPBC or BC Act is required for this species. If the development will not impact the species, a test of significance is not required.
- **"Yes"** = The species was or has been observed in or near the development footprint and/or will be impacted by the development. A test of significance under the EPBC and / or BC Act is required for this species. If the development will not impact the species, a test of significance is not required.

Where a species scored 'Potential' or 'Yes' for likelihood of occurrence AND has potential to be impacted by the development, a test of significance has been completed as per the

required BC Act test questions and EPBC Act significant impact criteria, see following sections.

Completed tests of significance required for this proposal, relative to the species conservation listing status and requirements, are included in Appendix D.

2.3.1 NSW legislation – BC Act

To determine whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats, within Section 7.3 of the BC ACT, the following questions are asked in a BC Act Threatened Species Test of Significance:

Adverse effects on the life cycle of a species:

1. in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Adverse effects on ecological communities:

2. in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:
    i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
    ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Adverse effects on habitats:

3. in relation to the habitat of a threatened species or ecological community:
    i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
    ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
    iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality.

Adverse effects on areas of outstanding biodiversity value:

4. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly).

Key threatening processes:

5. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

2.3.2 Commonwealth legislation - EPBC Act

Under the EPBC Act an action will require approval from the Australian Government Environment Minister (the minister) if the action has, or will have, or is likely to have, a

significant impact on a matter of national environmental significance (MNES). The EPBC Act protects nationally and internationally important flora, fauna, ecological communities, and heritage places as defined in the EPBC Act as MNES.

The criteria applied to EPBC listed species, populations or communities when determining if a significant impact on any MNES is likely, are outlined below:

Critically endangered or endangered species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

(i) lead to a long-term decrease in the size of a population
(ii) reduce the area of occupancy of the species
(iii) fragment an existing population into two or more populations
(iv) adversely affect habitat critical to the survival of a species
(v) disrupt the breeding cycle of a population
(vi) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
(vii) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
(viii) introduce disease that may cause the species to decline, or
(ix) interfere with the recovery of the species.

Vulnerable Species

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

(i) lead to a long-term decrease in the size of an important population of a species
(ii) reduce the area of occupancy of an important population
(iii) fragment an existing important population into two or more populations
(iv) adversely affect habitat critical to the survival of a species
(v) disrupt the breeding cycle of an important population
(vi) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
(vii) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat
(viii) introduce disease that may cause the species to decline, or
(ix) interfere substantially with the recovery of the species.

Endangered or Critically Endangered Ecological Community

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

(i) reduce the extent of an ecological community
(ii) fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
(iii) adversely affect habitat critical to the survival of an ecological community

(iv) modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

(v) cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

(vi) cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to assisting invasive species, that are harmful to the listed ecological community, to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological or

(vii) interfere with the recovery of an ecological community.

Definitions: A 'population of a species' as determined by the *Environment Protection and Biodiversity Conservation Act 1999* is an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations, or
- a population, or collection of local populations, that occurs within a particular bioregion.

Important Population as determined by the *Environment Protection and Biodiversity Conservation Act 1999*, is one that for a vulnerable species:

- is likely to be key source populations either for breeding or dispersal
- is likely to be necessary for maintaining genetic diversity
- is at or near the limit of the species range.

3 Desktop review results

3.1 Landscape context

The landscape context of the study area was considered when assessing potential impact of the proposal. The study area is in the NSW South Western Slopes IBRA bioregion at approximately 280 metres AHD.

The landscape in which the proposal occurs primarily contains woodlands and land cleared for agriculture. The study area supports Grey Box and Yellow Box communities. Where vegetation exists, the groundcover comprises both native and non-native grasses and forbs with few shrubs and varying densities of weeds. The sections cleared of upper stratum species are considered as derived or lower quality versions of the PCTs which are recorded in the immediate vicinity.

The study area lies within the Lachlan River catchment.

The proposal will largely occur in cleared, cropped and ploughed farmland within the footprint of the approved Quorn Park Solar Farm (QPSF) development.

3.1.1 IBRA bioregion and subregions

The proposal overlaps the NSW South Western Slopes IBRA Region and Lower Slopes subregion (Figure 1-3).

Bioregions are relatively large land areas characterised by broad, landscape-scale natural features and environmental processes that influence the functions of entire ecosystems. They capture the large-scale geophysical patterns across Australia. These patterns in the landscape are linked to fauna and flora assemblages and processes at the ecosystem scale, thus providing a useful means for simplifying and reporting on more complex patterns of biodiversity. Subregions, as described by Morgan and Terrey (1992), are 'based on finer differences in geology, vegetation and other biophysical attributes and are the basis for determining the major regional ecosystems'.

The Interim Biogeographic Regionalisation of Australia (IBRA), and IBRA subregion inform the identification of PCTs and habitat suitability for threatened species. Biodiversity does not recognise administrative boundaries, which is another reason to use a bioregional approach to assess all land across the region.

3.1.2 NSW Landscapes (Mitchell Landscapes)

The study area traverses two different Michell Landscapes, the Bimbi Plains and Goonumbla Hills (Figure 3-1). These are summarised in Table 3-1.

NSW (Mitchell) Landscapes were developed for conservation planning and reserve establishment purposes and to provide consistent state-wide ecological units finer than the existing bioregions and sub-regions. They have relatively homogeneous geomorphology, soils and broad vegetation types, and help to provide site context for the study area.

Table 3-1: NSW Landscapes descriptions

Name	Description	Percent cleared
Bimbi Plains	Bimbi Plains landscape includes the Bimbi land system. Quaternary alluvial plains from bedrock hills and ridges of the Gobondery/Gillenbine and the Belmont/Brooklyn land systems. General elevation 200 to 250m, local relief 30m. Gravelly clay loams and red brown clays, red-brown texture-contrast soils on higher slopes grading to red-brown gradational and uniform profiles of clay loams and clays along creeks. Grey box (*Eucalyptus microcarpa*) and white cypress pine (*Callitris glaucophylla*) originally dominant, sparse bimble box (*Eucalyptus populnea*) along creek lines. Mostly cleared and cultivated.	93
Goonumbla Hills	Rounded low hills on Ordovician and Silurian sandstone, andesite, siltstone and phyllite with a partial blanket of Tertiary(?) quartz gravels and sands. General elevation 290 to 390m, local relief 70m. Stony yellow earths on the sands, thin brown structured loams on the hills merging with red-brown and red texture-contrast soils on the flats. Open forest of grey box (*Eucalyptus microcarpa*), white cypress pine (*Callitris glaucophylla*), with bimble box (*Eucalyptus populnea*) in the creeks and red ironbark (*Eucalyptus sideroxylon*) with shrubs on the gravels. Extensively cleared, grazed and cultivated.	92

3.1.3 Waterways

Landscape features such as distance to water and land-use can greatly influence the ecology of an area and consequently the likelihood that protected matters are present.

No waterways in the study area were mapped in the Directory of Important Wetlands or as part of a Ramsar site, however other waterways occurring in the study area are shown in.

Two ephemeral waterways occur in the Development footprint (Figure 3-2). The overhead powerlines will intersect Ridgey Creek, a 4th Strahler Order stream. The creek is highly modified/disturbed and is unlikely to support fish species through lack of permanent water. The channel is not well defined and in poor condition, surrounded by heavily ploughed agricultural land, and comprises mostly sedge and introduced grass species.

The proposed access road intersects an unnamed drainage channel, adjacent to Back Trundle Road.

3.1.4 Land use

Land uses are mapped, representing a range of historic land use impacts, from cropping to nature conservation (Figure 3-3).

Land use mapping captures how the landscape in NSW is being used for food production, forestry, nature conservation, infrastructure, and urban development. It can be used to monitor changes in the landscape and identify impacts on biodiversity values and individual ecosystems.

Figure 3-1: NSW (Mitchell) Landscapes

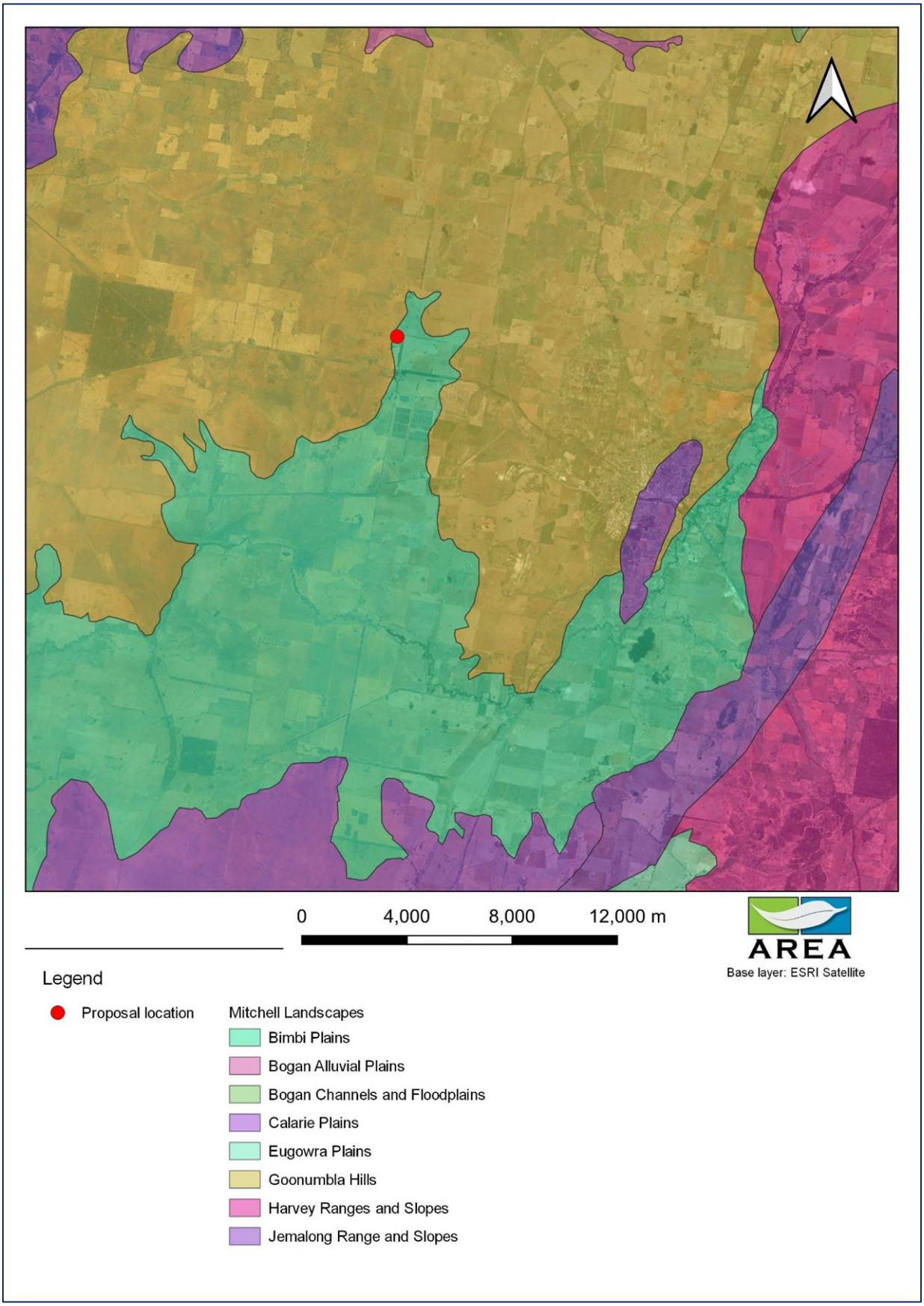


Figure 3-2: Waterways

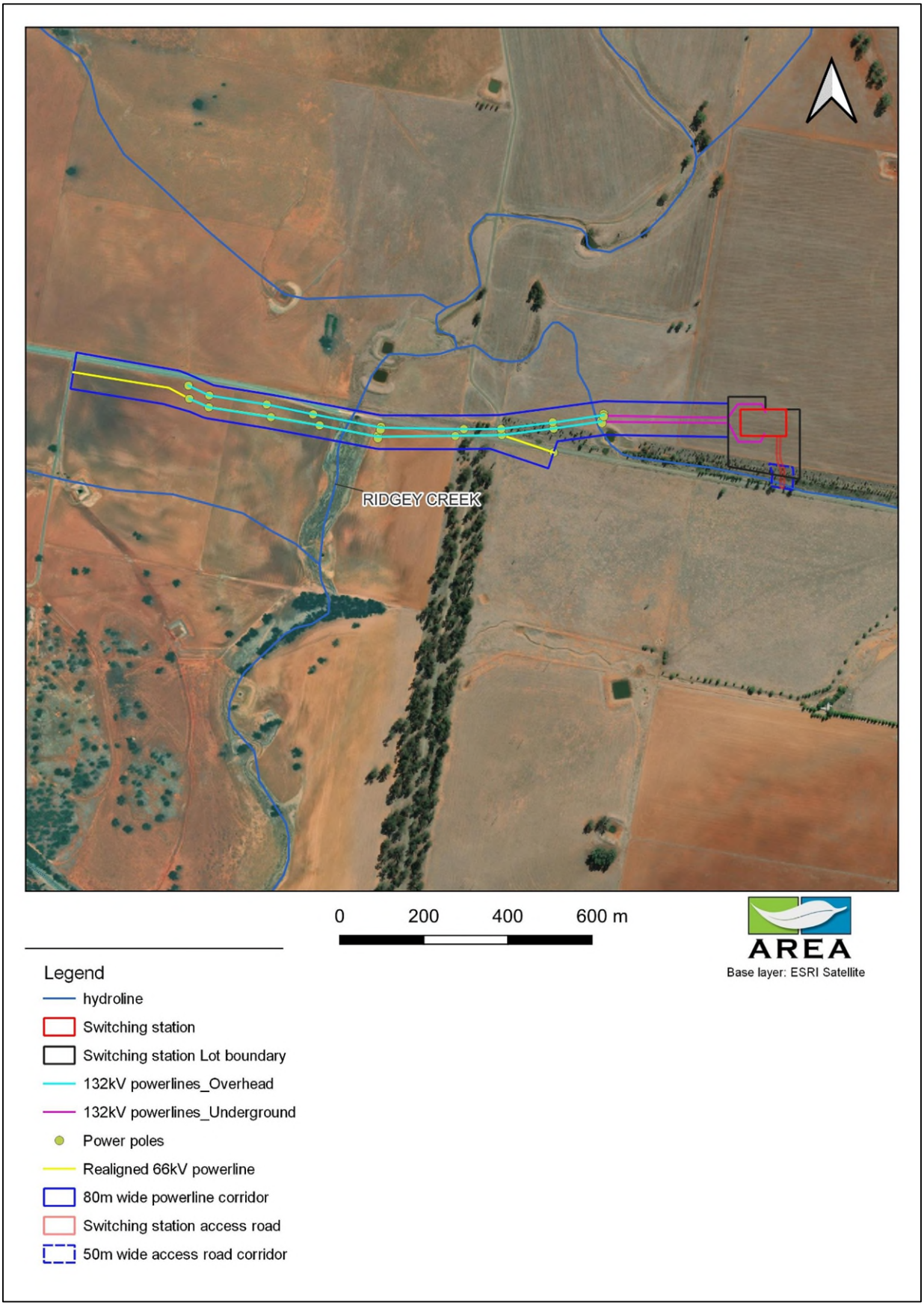


Figure 3-3: Land use mapped in the study area

3.1.5 Climate

The long-term climate statistics were collected from the Parkes Airport (Table 3-2). Weather conditions during the field survey were fine and sunny.

Table 3-2: Climate statistics for Parkes Airport (BoM, 2023)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean Max (°C)	33.6	32.0	28.7	24.2	18.9	15.1	14.3	15.9	20.0	24.1	28.0	31.0	23.8
Mean Min (°C)	17.7	17.0	14.1	9.6	5.3	3.7	2.4	2.4	4.5	7.8	12.0	14.5	9.3
Mean Rain (mm)	64.1	57.0	54.3	33.2	45.9	51.9	47.6	45.7	45.4	53.8	64.8	52.0	637.8

red = highest value blue = lowest value

3.2 Ecological context

3.2.1 EPBC Protected Matters

An EPBC Protected Matters Report generated for this proposal considered environmental matters within a 1500 metre buffer of the proposal. This report is provided in Appendix B and summarised in Table 3-3.

Potential impacts to species and communities highlighted are considered in the following sections of this report.

Table 3-3: EPBC Protected Matters Report summary

MNES	Result	Relevance to this assessment
World Heritage Properties	None	-
National Heritage Places	None	-
Wetlands of International Importance	4	N/A - All are more than 500km upstream of the proposal.
Great Barrier Reef Marine Park	None	-
Commonwealth Marine Area	None	-
Listed Threatened Ecological Communities	4	Section 4.2.2 and Section 5.1.3
Listed Threatened Species	31	Section 4.4 and Section 5.1.4
Listed Migratory Species	10	Section 5.1.5
Commonwealth Land	None	-
Commonwealth Heritage Places	None	-
Listed Marine Species	17	All birds, considered as Migratory Species, Section 5.1.5
Whales and Other Cetaceans	None	-
Critical Habitats	None	-
Commonwealth Reserves Terrestrial	None	-
Australian Marine Parks	None	-
Habitat Critical to the survival of Marine Turtles	None	-
State and Territory Reserves	None	-
Regional Forest Agreements	None	-
Nationally Important Wetlands	None	-
EPBC Act Referrals	1	Unrelated referral

MNES	Result	Relevance to this assessment
Key Ecological Features (Marine)	None	-
Biologically Important Areas	None	-
Bioregional Assessments	None	-
Geological and Bioregional Assessments	None	-

3.2.2 Predicted species

Desktop results using the IBRA Lower Slopes subregion threatened species search, identified a total of 105 EPBC and or BC listed species predicted to occur in the subregion overlapping the proposal (Appendix B).

Of these, three species have previously been recorded within 1500 meters of the proposal (Table 3-4 and Figure 3-4) (NSW DPE 2023).

Table 3-4: BioNet results within 1500 meter buffer

V = Vulnerable E = Endangered CE = Critically Endangered M = Migratory

Scientific name	Common name	NSW status	Commonwealth status
Aves			
Polytelis swainsonii	Superb Parrot	V	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-
Flora			
Austrostipa wakoolica	A spear-grass	E	E

A full of list of threatened species with potential to occur in the development footprint is provided in Appendix B.

3.2.3 Plant Community Types

State Vegetation Map (SVM) SVM4468 PCTs with a 500 meter buffer applied, was used to determine PCTs with potential to occur within the development footprint (Figure 3-5).

Six PCTs including not native vegetation were mapped as potentially occurring as described in Table 3-5.

Table 3-5: Plant Community Types mapped within 500 m

PCT ID	PCT Name	Formation	Class
0	Not Native	Not Native	Not Native
45	Plains Grass grassland on alluvial mainly clay soils in the Riverina Bioregion and NSW South Western Slopes Bioregion	Grasslands	Riverine Plain Grasslands
76	Western Grey Box tall grassy woodland on alluvial loam and clay soils in the NSW South Western Slopes and Riverina Bioregions	Grassy Woodlands	Floodplain Transition Woodlands
201	Fuzzy Box Woodland on alluvial brown loam soils mainly in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands
250	Derived tussock grassland of the central western plains and lower slopes of NSW	Grasslands	Western Slopes Grasslands
267	White Box - White Cypress Pine - Western Grey Box shrub/grass/forb woodland in the NSW South Western Slopes Bioregion	Grassy Woodlands	Western Slopes Grassy Woodlands

Most of the vegetation within the development footprint reflects historic ground surface disturbance and is highly altered from agricultural clearing and cropping. Native and not native vegetation exists throughout the study area.

Figure 3-4: BioNet records within 1500m of the proposal

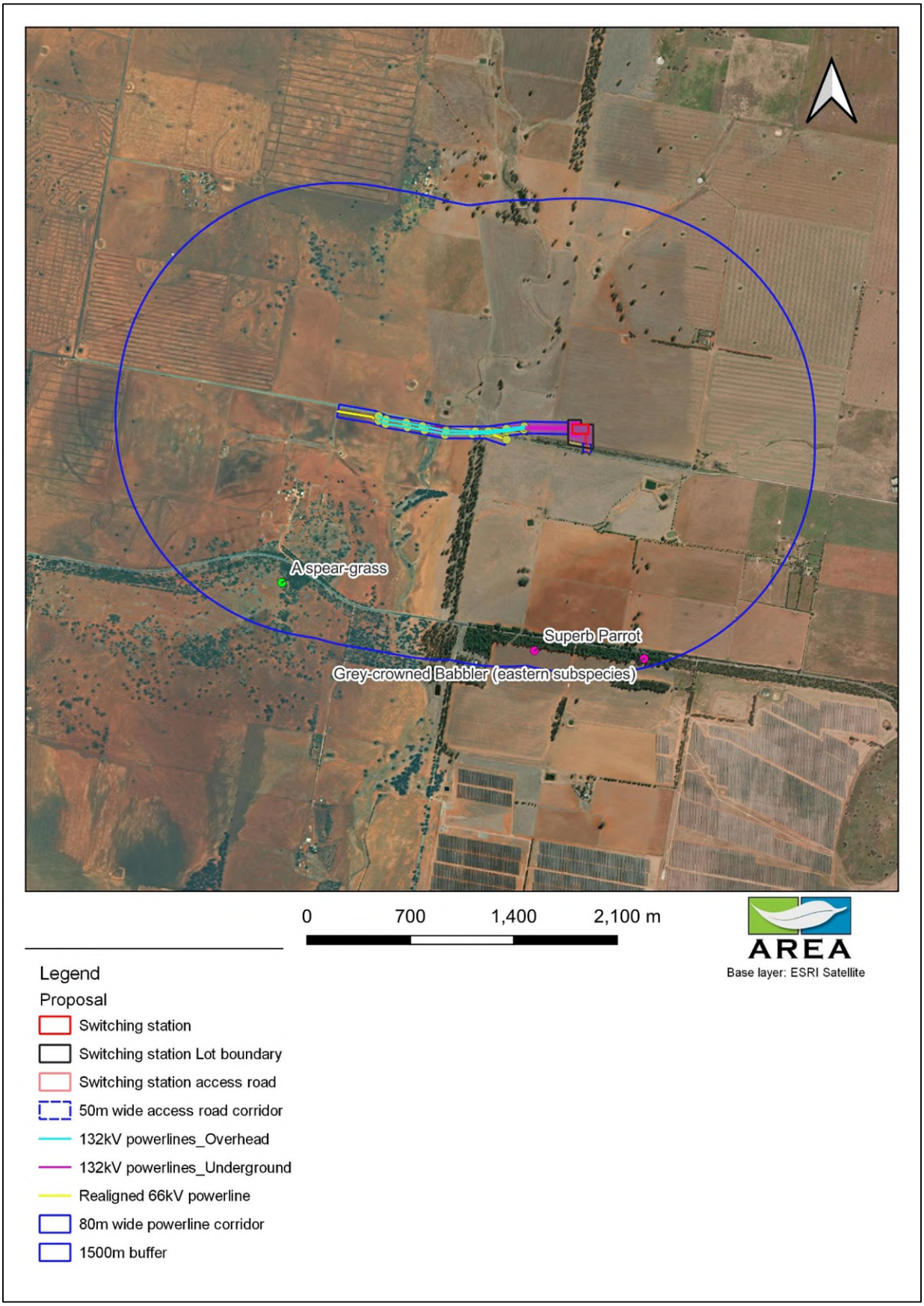
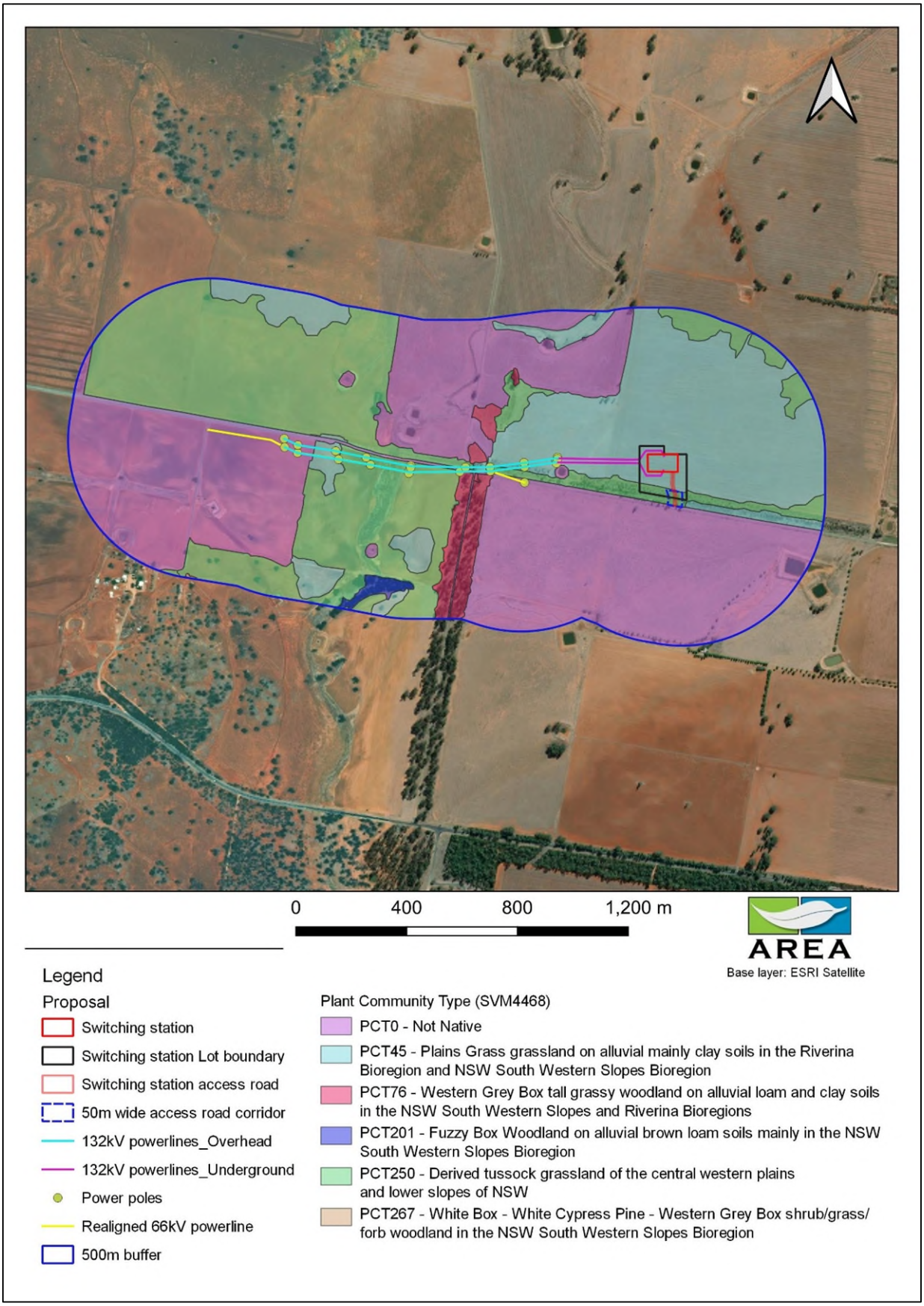


Figure 3-5: Plant Community Types from State Vegetation Mapping 4468



3.2.4 Threatened Ecological Communities

IBRA and MNES database searches identified ten TECs as potentially occurring in the development footprint (Table 3-6).

Table 3-6: Predicted Threatened Ecological Communities

Threatened Ecological Community	NSW status	Commonwealth status
Poplar Box Grassy Woodland on Alluvial Plains (CID 141)	-	Endangered Ecological Community
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (CID 43)	-	Critically Endangered Ecological Community
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (CID 86)	-	Endangered Ecological Community
Weeping Myall Woodlands (CID 98)	-	Endangered Ecological Community
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Endangered Ecological Community	-
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Endangered Ecological Community	-
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Endangered Ecological Community	-
Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia	Critically Endangered Ecological Community	-
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	Endangered Ecological Community	-
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered Ecological Community	-

Field survey combined with desktop assessment results determined if any TECs are present and likely to be impacted by the development (Section 5.1.3).

3.2.5 Biodiversity Values Map

The proposal intersects biodiverse riparian land mapped on the NSW Biodiversity Values Map[1] in one location beneath the proposed overhead powerlines (Figure 3-6). Pole placement for the powerlines will occur approximately 30 metres either side of the riparian land minimising impact to the areas mapped.

[1] https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

Under Part 5 of the EP&A Act, impact to native vegetation in areas mapped on the Biodiversity Values Map does not trigger assessment under the Biodiversity Offset Scheme. However, this mapping can provide information about the vulnerability of the threatened species and communities in the region.

3.2.6 Key Fish Habitat

Key Fish Habitat within Ridgey Creek intersects the proposal in two locations (Figure 3-7).

3.2.7 Environmental Conservation zones

The NSW Planning Portal maps the development footprint as RU1 Primary Production.

3.2.8 Groundwater dependant ecosystems

The Bureau of Meteorology (BoM 2019) Atlas of Groundwater Dependant Ecosystems map was checked for Groundwater Dependent Ecosystems (GDEs). Results are provided in Appendix B.

The **terrestrial groundwater dependence** map shows the proposal passes through areas with low potential for groundwater dependent ecosystems. Given the limited scope, and temporary nature of impacts related to the proposal and level of existing ground surface disturbance from agriculture and other infrastructure, impacts to terrestrial groundwater dependent ecosystems are unlikely.

No **aquatic groundwater dependent ecosystems** are mapped as occurring in the study area.

There are no ecosystems analysed in the study area for **subterranean GDE.**

3.2.9 Native Vegetation Regulatory (NVR) mapping

One point of the proposal overlaps an area mapped as Category 2 - Vulnerable Regulated Land (Figure 3-8). No areas of the proposal overlap Land Excluded from the *Local Land Services Act 2013*.

Areas mapped as Category 2 – Vulnerable Regulated Land indicate areas likely to contain steep or highly erodible land, protected riparian land or special category land. Impact to native vegetation has been assessed as required under EPBC Act and BC Act pathways. Remediation of any potential impact will be described in Section 6.

Figure 3-6: NSW Biodiversity Values Map

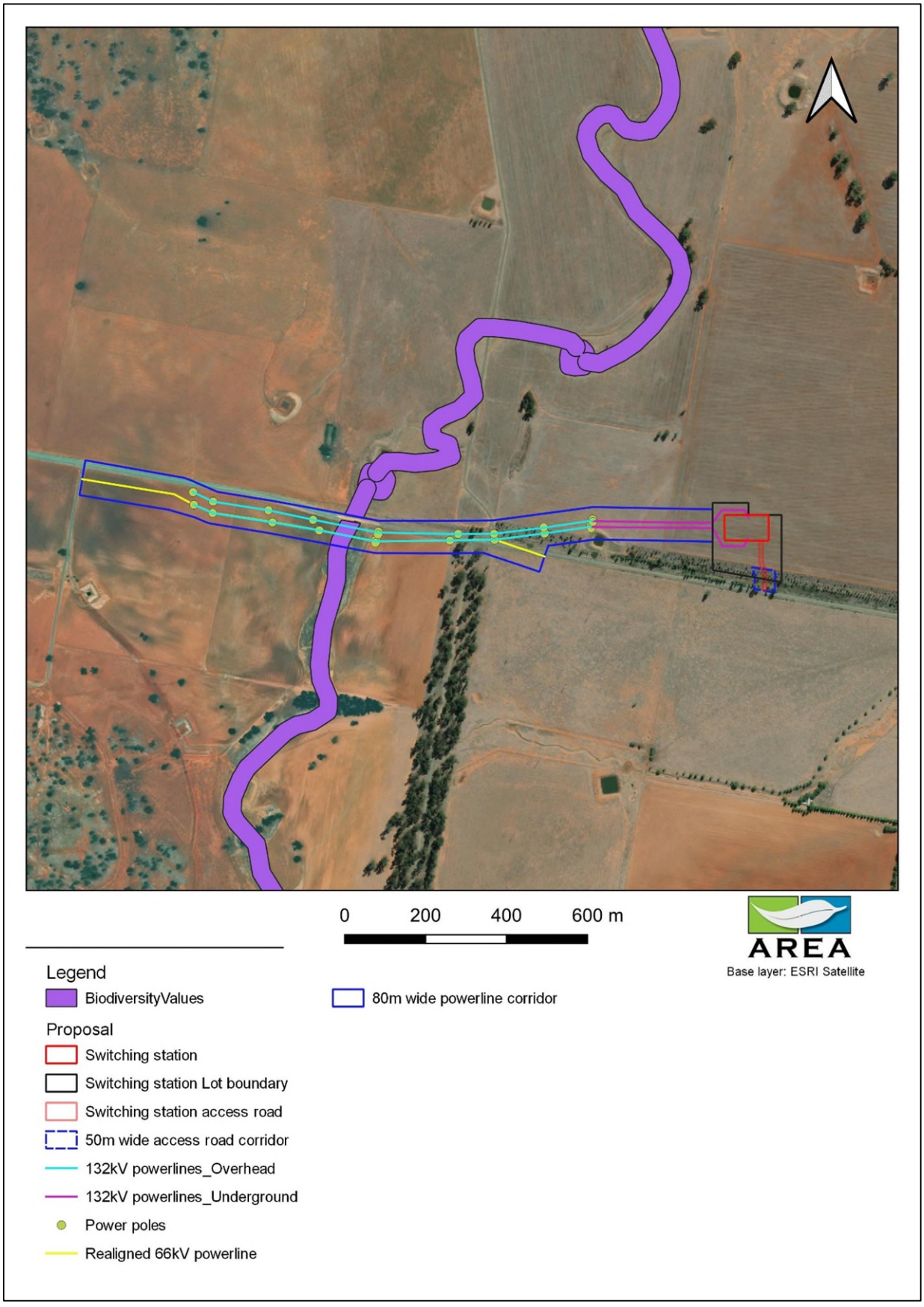


Figure 3-7: Key Fish Habitat

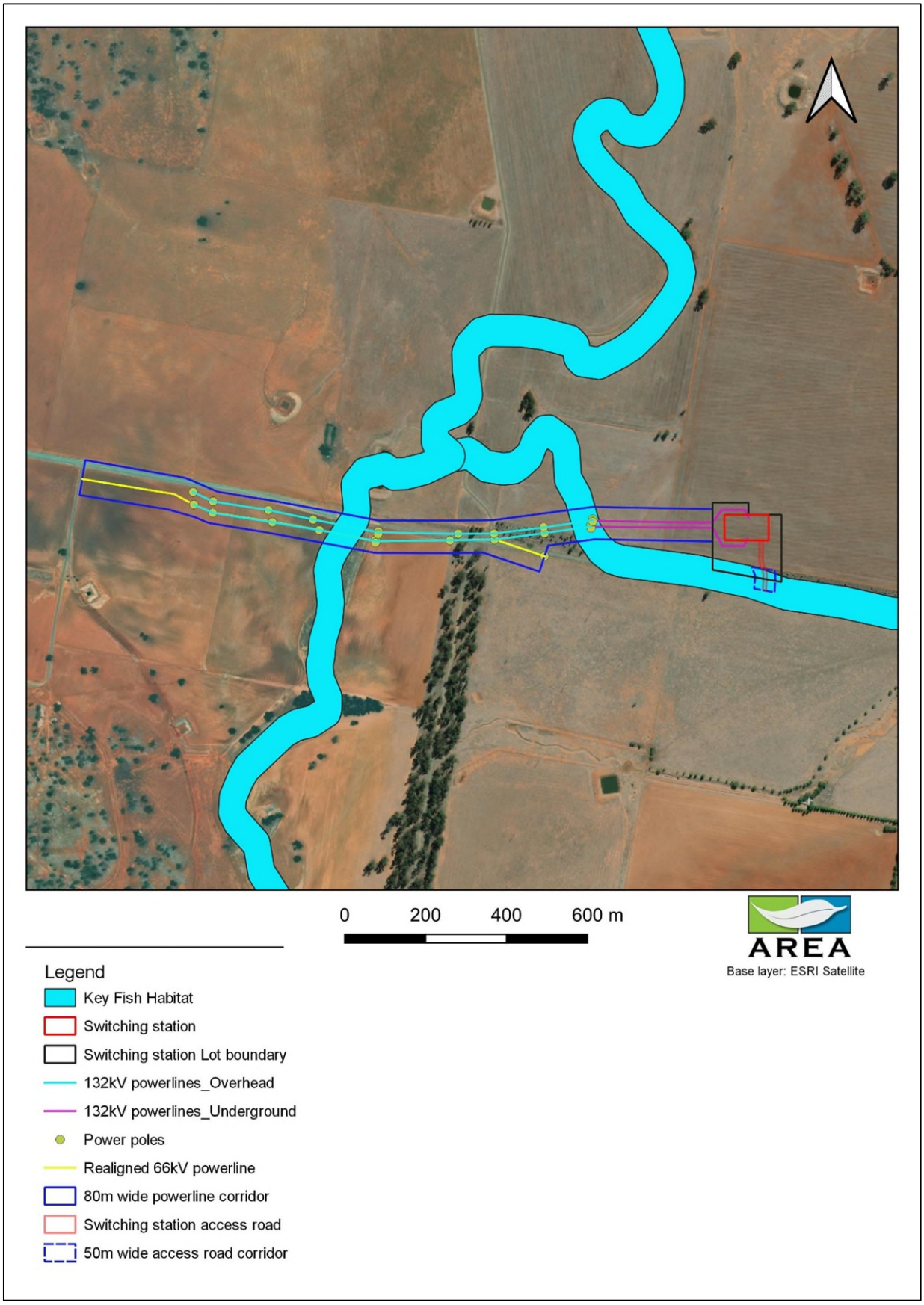
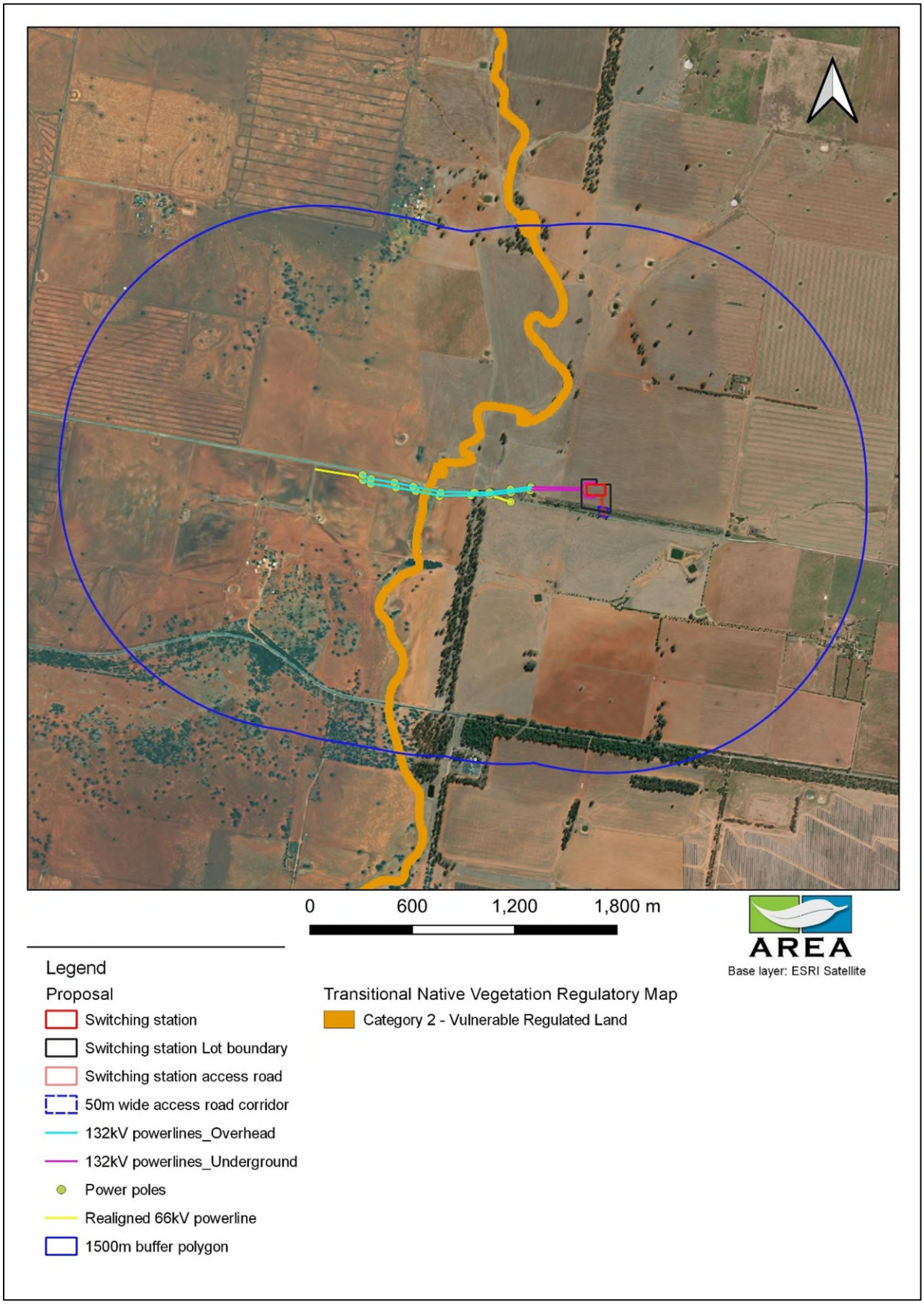


Figure 3-8: Native Vegetation Regulatory mapping



4 Field survey results

4.1 Search effort

The fieldwork component of this assessment was undertaken on 27 April 2023 using methods outlined in section 2.2 (Figure 4-1 and Figure 4-2).

Essential Energy staff present confirmed the location of the proposal and the likely impact footprint, setting a 50 meter wide clearance corridor along the proposed switching station access road to accommodate future infrastructure, and an 80 meter wide powerline corridor. The assessment took into account environmental values within the whole development footprint including the corridors defined.

Areas of the proposal comprising highly disturbed agricultural land, where impacts to native vegetation, biodiversity values were determined unlikely, were not assessed in detail.

4.2 Vegetation communities

4.2.1 Plant Community Types

Plant Community Types mapped were corrected in the development footprint based on field observations of mid, upper, and ground stratum species and landform. The vegetation assessment undertaken as part of the overlapping Quorn Park Solar Farm project was also used in defining PCTs present (Premise Australia, 2019). PCTs confirmed as occurring within the development footprint are outlined in Table 4-1 and Figure 4-3.

All PCTs are associated with a TEC (section 4.2.2). Areas of planted native vegetation comprised a mixture of ground, mid and upper stratum species that were not consistent with any of the PCTs identified. Examples of each PCT is provided in Table 4-2.

Table 4-1: Plant Community Types recorded within the study area

PCT ID	PCT Name	Class
0	Not-Native – areas comprising largely exotic species/areas used for agriculture or unvegetated areas e.g., existing roads, tracks etc.	Non-Native
81	PCT 81 - Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands	Floodplain Transition Woodlands
82	PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	Floodplain Transition Woodlands
278	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	Western Slopes Grassy Woodlands

Figure 4-1: Survey effort 1 of 2

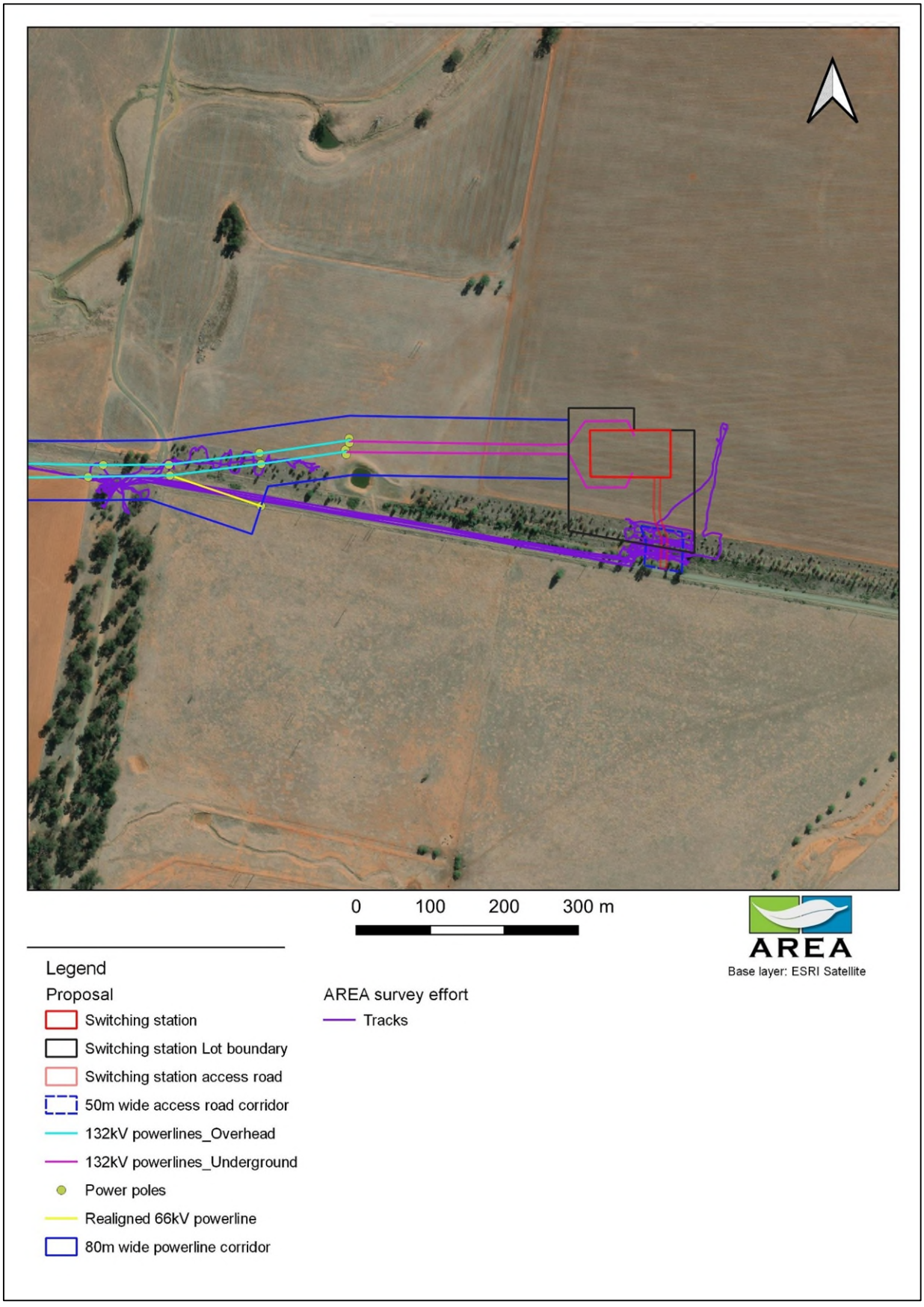


Figure 4-2: Survey effort 2 of 2

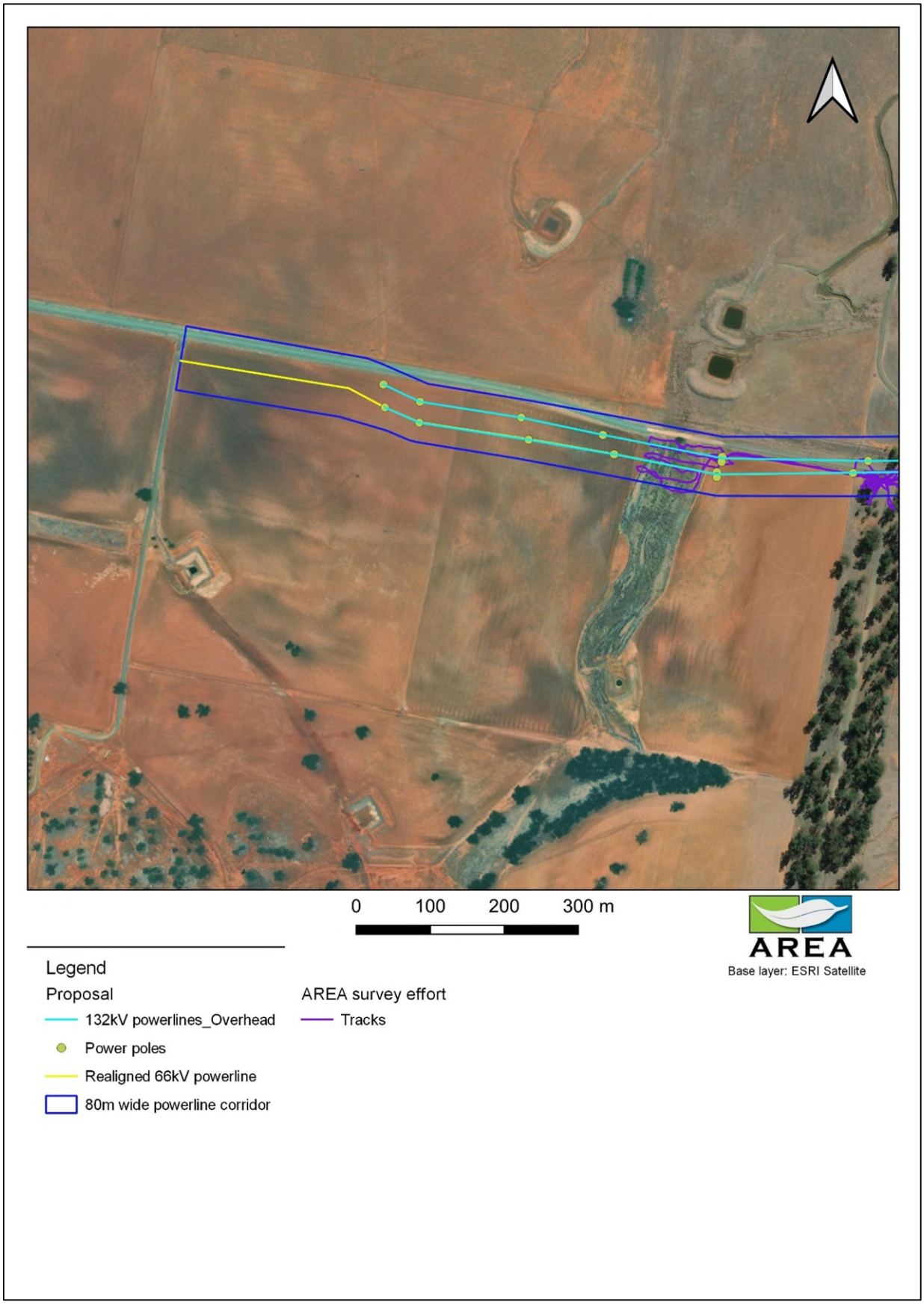


Figure 4-3: Plant Community Types surveyed

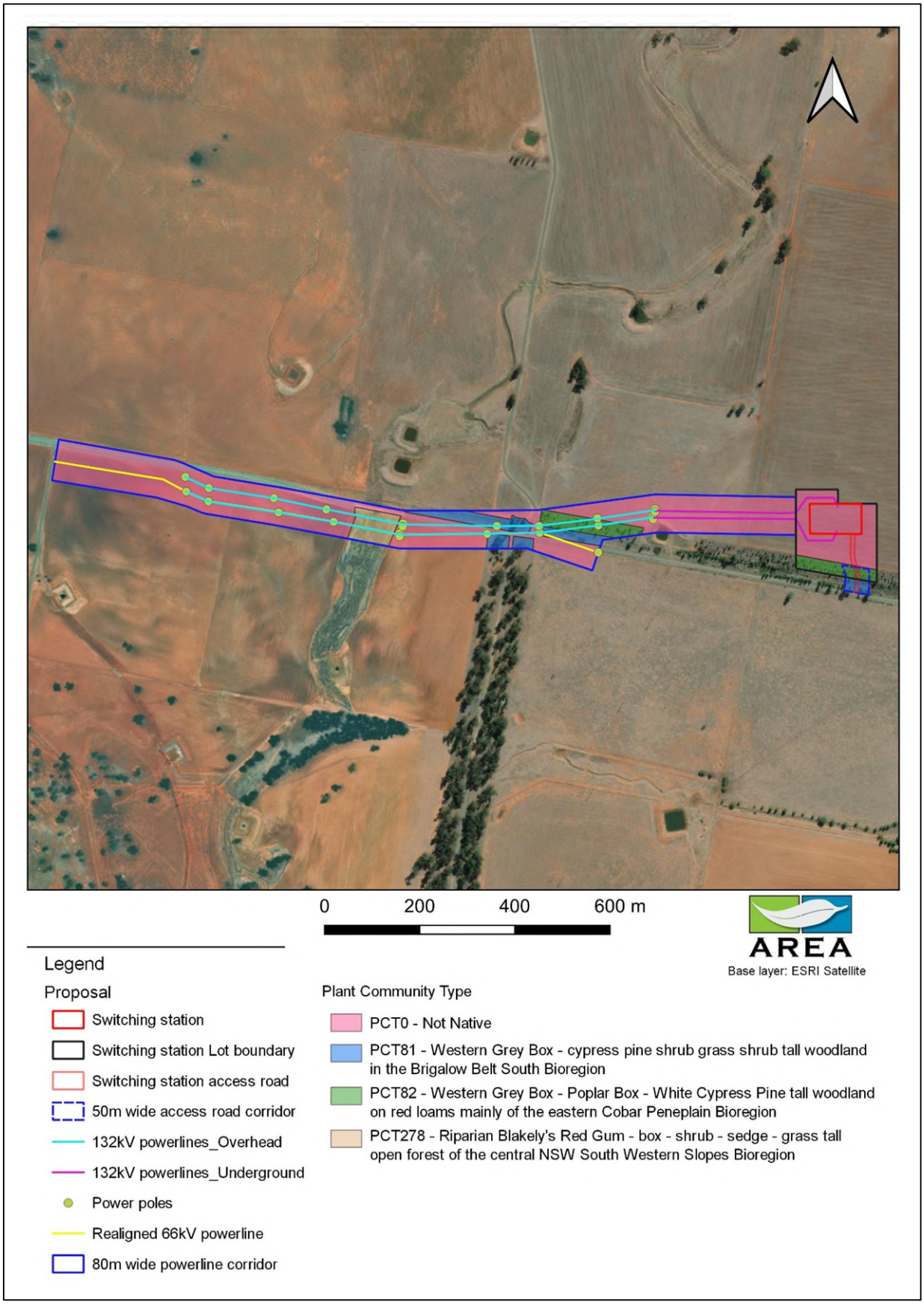


Table 4-2: Plant Community Types recorded in the study area

PCT ID and name	Representative photo
PCT 81 *Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands*	
PCT 82 *Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion*	
PCT 278 *Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion*	

PCT ID and name	Representative photo
PCT 0 Not Native	

4.2.2 Threatened Ecological Communities

Of the 10 TECs highlighted by database searches (section 3.2.4), three were determined present in the study area based on TEC description (including community composition and condition) and presence of associated PCT (Figure 4-4). Those determined not present, were inconsistent with the TEC determination. Table 4-3 provides assessment of the TECs presence in the development footprint.

Table 4-3: Threatened Ecological Community assessment table*

Threatened Ecological Community	NSW status	EPBC status	Associated PCT	Presence (Yes/No)
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	-	EEC	81,82	Yes. Associated PCT present and upper and ground stratum composition consistent with the description for this TEC.
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion	EEC	-	81,82	Yes. Associated PCT present
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	-	CEEC	278	No. Does not meet the condition requirements of the determination where ground layer is dominated by native species containing at least 12 native, non-grass understory species.
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	CEEC	-	278	Potentially.

***V = Vulnerable, E = Endangered, CE = Critically Endangered**

A Test of Significance under the BC Act and Assessments of Significance under the EPBC Act (Appendix D) concluded impacts to TECs would not be significant due to the limited scale and temporary nature of impacts, and the fact that the proposal mostly occurs in cleared agricultural land with a small amount of native vegetation impacted three hectares.

Figure 4-4: Terrestrial Threatened Ecological Communities

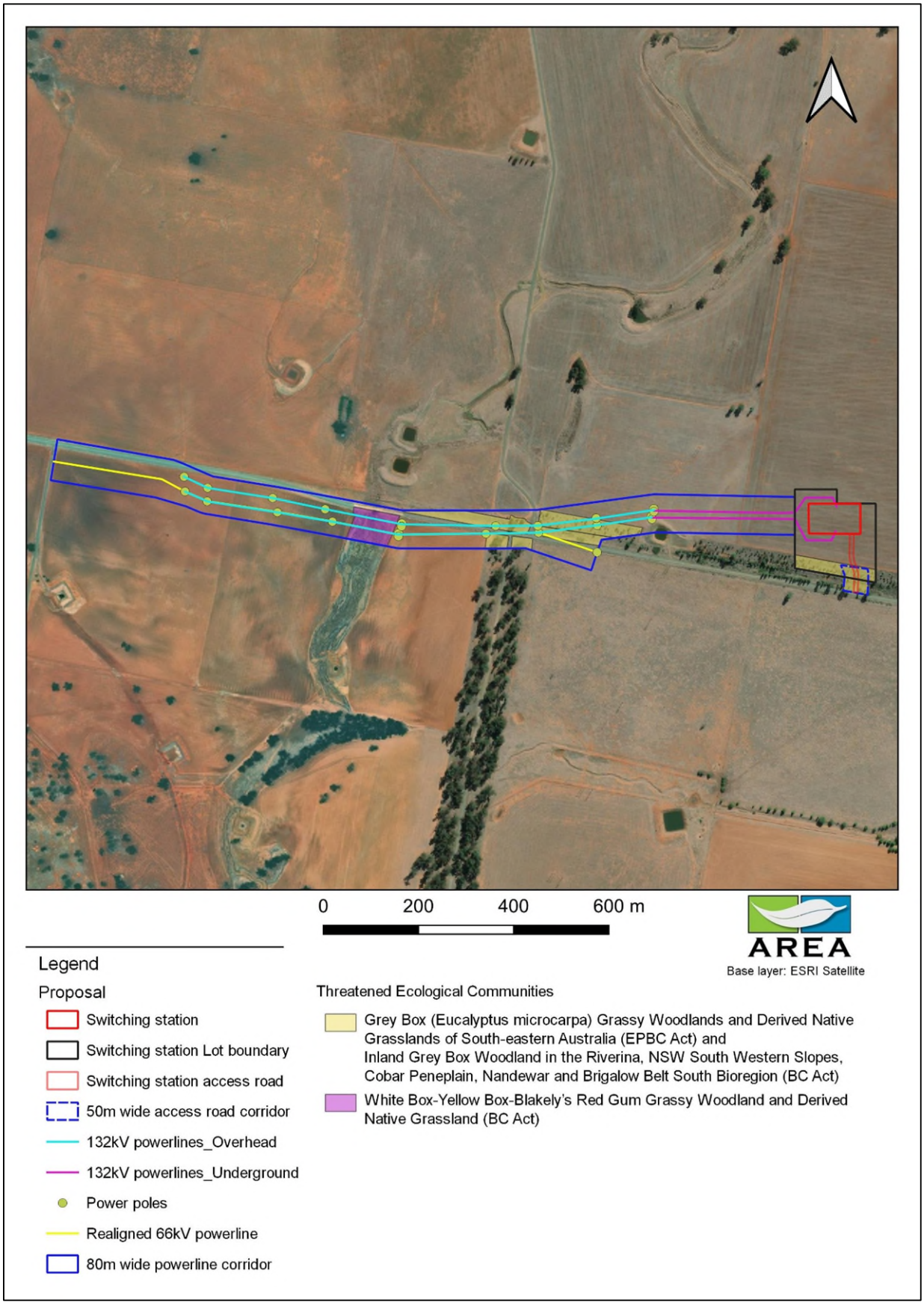


Table 4-4: Terrestrial Threatened Ecological Communities surveyed

TEC	Representative photo
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC Act) and Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion (BC Act)	 
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act) and White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (BC Act)	

4.3 Habitat

One waterway (Ridgey Creek) was confirmed as occurring in the development footprint under the proposed overhead powerlines. The creek channel is not well defined and in poor condition surrounded by ploughed agricultural land with no permanent water (Plate 4-1).

Five hollow bearing trees including four mature Grey box (*Eucalyptus macrocarpa)* on the corner of McGrath Lane and Back Trundle Road, and one deceased tree in Ridgey Creek were recorded within the corridor of the proposed overhead powerlines. Habitat forming logs were also recorded in Ridgey Creek.

No hollow bearing trees were recorded in the proposed road access corridor, switching station or underground powerline footprints.

Plate 4-1: Ridgey creek habitat

4.4 Threatened species

No listed flora species were recorded during the field assessment. Predicted listed species are assumed to occur in the development footprint where suitable habitat exists and where the survey was not sufficient to confirm the species was not present.

Suitable habitat for listed species (tree hollows, logs, waterways), was recorded in the development footprint (Figure 4-5).

4.5 Aquatic communities

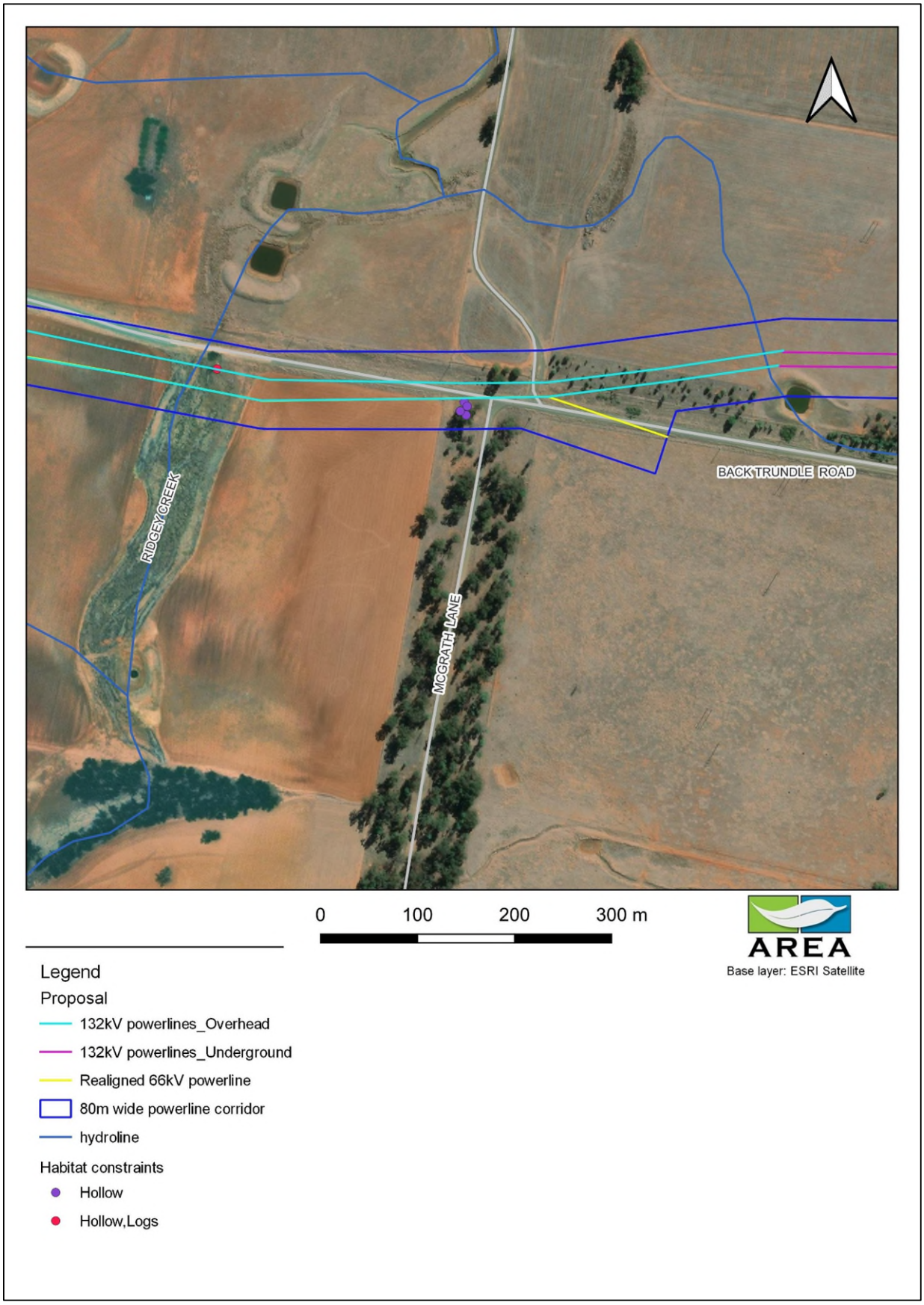
The overhead powerline component of the proposal crosses Ridgey Creek (Plate 4-1) and the proposed access road will intersect an unnamed waterway. Both are ephemeral, fourth Strahler Order streams and although highly degraded, most likely form part of the Aquatic

ecological community in the natural drainage system of the lowland catchment of the Lachlan River (NSW DPI 2006).

4.6 Pests, weeds and disease

No high threat exotic species were recorded in the development footprint.

Figure 4-5: Habitat constraints surveyed



5 Impact analysis

5.1 Direct impact

Direct impacts are a direct result of construction activities. Direct impacts predicted to occur by the development are considered in the following sections. Safeguards and mitigation measures to reduce potential impacts are outlined in Section 6.

5.1.1 Habitat, connectivity, and fragmentation

All native vegetation mapped in the study area has some role in habitat connectivity. Some clearing associated with the proposed access road will fragment a strip of planted windbreak and road corridor within a 50 metre clearance corridor. No habitat constraints or evidence of threatened species were recorded during the survey period, and vegetation within this patch has little connectivity to surrounding habitat. The corridor occurs in an already highly disturbed and fragmented agricultural landscape and is therefore unlikely to act as an important corridor for wildlife.

Some obstacles to wildlife movement may exist during the construction phase of the development as created by machinery and construction activities. These will be temporary and where an individual's movement may be disrupted this will not exclude the animal from habitat or its ability to more through the development footprint during or post construction.

Connectivity will not be substantially reduced by the proposal.

5.1.2 Native vegetation

Small areas of native vegetation will be impacted by the construction of the SS, powerlines and the SS access road (Figure 4-3). Impacts to native vegetation could result in the following outcomes:

- cause death or harm to fauna present in habitat during clearing
- remove ground layer foraging, nesting and feeding habitat for native species.

The area of impact to PCTs recorded in the development footprint is described in Table 5-1.

Table 5-1: Native vegetation impacted by the proposal

PCT ID	PCT name	Impact (ha)
0	Not-Native – areas comprising largely exotic species/areas used for agriculture or unvegetated areas e.g., existing roads, tracks etc.	13.2
81	PCT 81 - Western Grey Box - cypress pine shrub grass shrub tall woodland in the Brigalow Belt South Bioregion Formation – Grassy Woodlands	1.25
82	PCT 82 - Western Grey Box - Poplar Box - White Cypress Pine tall woodland on red loams mainly of the eastern Cobar Peneplain Bioregion	1.13
278	Riparian Blakely's Red Gum - box - shrub - sedge - grass tall open forest of the central NSW South Western Slopes Bioregion	0.62
Total		**16.20**
Total impact to native vegetation		**3.00**

5.1.3 Threatened Ecological Communities

Assessments of significance under the BC Act, EPBC Act, and FM Act were completed for all TECs found to occur in the development footprint (Appendix D). A significant impact to the following TECs was considered unlikely:

- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC Act),
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion (BC Act); and,
- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions (BC Act).
- Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River (FM Act)

Mitigation measures outlined in Section 6 further aim to minimise any impacts to TECs.

5.1.4 Threatened species

No threatened species were identified as being significantly impacted by the proposal.

Tests of significance undertaken in Appendix D show a significant impact to threatened species from the proposal is considered unlikely. Outcomes of this assessment are summarised in Table 5-2.

Table 5-2: Test of significance summary for threatened species potentially impacted

Scientific name	Common name	NSW status	EPBC status	Likelihood of occurrence in development footprint	Significant impact under the BC and or EPBC Acts (yes/no)
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential, Species habitat occurs within a small section of the alignment	No - the proposal will not result in a significant impact to these species. Although some habitat trees (5) will be removed, better quality habitat is available outside the development footprint.
Vespadelus baverstocki	Inland Forest Bat	V	-	Potential, Known to roost in very small hollows in stunted trees only a few metres high	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Potential, Species roosts in tree hollows and can utilise mammal burrows in treeless areas. Species also forages for insects above the tree canopy and lower in open country	
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	Potential, species nesting habitat of small hollow bearing trees occurs within a small section of the development footprint	No - the proposal will not result in a significant impact to these species or an important population. A small number (5) habitat trees will be cleared with better quality breeding and foraging habitat represented outside the development footprint.
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Potential, Species can be found in farmland most often at the edge of a forest or woodland.	
Hieraaetus morphnoides	Little Eagle	V	-	Potential Nests in tall living trees within remnant patch. Recorded within 10km	
Circus assimilis	Spotted Harrier	V	-	Potential, Species occurs in grassy open woodland, most commonly in native grassland and can be found in agricultural land	

Scientific name	Common name	NSW status	EPBC status	Likelihood of occurrence in development footprint	Significant impact under the BC and or EPBC Acts (yes/no)
Polytelis swainsonii	Superb Parrot	V	V	Potential, Species nest in the hollows of large trees 6cm or wider which do occur within the development footprint	
Neophema pulchella	Turquoise Parrot	V	-	Potential, Species Lives on the edges of eucalypt woodland adjoining clearings and nests in tree hollows which do occur within the development footprint.	
Phascolarctos cinereus	Koala	E	E (combined populations of Queensland, New South Wales and the Australian Capital Territory)	Potential. No scats or scratches on trees observed	No - The proposal will not result in a significant impact to this species. No population of this species is known to occur in the study area. Disturbance will be temporary with more favourable habitat available outside the development footprint.

V = Vulnerable, E = Endangered

5.1.5 Migratory species

A significant impact to migratory bird species under the EPBC Act is considered unlikely.

Ten EPBC listed migratory birds' species were identified as potentially occurring in the development footprint (Appendix B) and have been considered against the significance criteria in Table 5-3.

Table 5-3: Assessment of Significance, Migratory birds

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
Criteria	**Response**
I. substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	There is little evidence to suggest that the development footprint supports 'important habitat' for migratory species given the absence of permanent water and high disturbance levels within the landscape. The lack of proximity of wetlands of international importance reduces the likelihood that habitat in the development footprint is 'important habitat'. The proposal is therefore unlikely to substantially modify, alter, destroy or isolate important habitat for migratory species.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
Criteria	**Response**
II. result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	The local area has a history of habitat modification for agriculture. The proposal is unlikely to further contribute to establishment of invasive species beyond that which may already exist.
III. seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The development footprint is not an area of 'important habitat' for migratory birds, whether they are wetland or terrestrial species. It is unlikely that an ecological significant proportion of migratory birds would rely on habitat in the development footprint.

5.1.6 Impact to groundwater dependent communities

The study area contains small areas of native vegetation with low potential for groundwater interaction. The proposal is not expected to place any component of groundwater-dependent communities at risk of local extinction given the small scale of the development, which will predominantly occur in cleared agricultural land.

5.1.7 Impact to hollow bearing trees

Five hollow bearing trees are likely be impacted by construction of the overhead powerlines (section 4.3).

5.1.8 Fragmentation of habitat

Vegetation in the surrounding landscape is already highly fragmented from previous disturbances. The proposal will further contribute to fragmentation by impacting small patches of native vegetation within the road reserves of Back Trundle Road and McGrath Lane, as well as planted wind break vegetation along the southern SS lot boundary.

Given the location of the patches within the broader landscape, they are unlikely to act as an important corridor for the movement of fauna.

5.1.9 Soils and drainage

Soils will be disturbed during construction and maintenance. Disturbed soils have the potential to move off the development footprint and impact waterways if not appropriately managed. Ridgey Creek beneath the proposed overhead powerlines and an unnamed waterway in the road access corridor, have potential to be impacted by soil disturbance and runoff (section 3.1.3). Soil disturbance will be managed using standard processes to avoid long term impacts (Section 6).

Standard remediation processes applied to the area after construction will ensure no long-term impact to the biodiversity values. The development will not have long term or lasting impact on the hydrology at any scale.

5.2 Indirect impact

Indirect impacts are those which are not a direct result of the proposal, often produced away from, or as a result of, a complex impact pathway. They can be hard to predict and difficult to manage. Indirect impacts are considered in the following sections and mitigation measures outlined in Section 6.

5.2.1 Injury to wildlife

Injury to wildlife is unlikely, but possible, during the construction phase of this proposal. Contact with wildlife and suitable habitat will be avoided wherever possible. Local wildlife rescue organisation should be contacted in the event wildlife requires rescue or removal.

5.2.2 Spread of pests, weeds and disease

The risk of spreading pests and disease is unlikely. Without adequate safeguards, the spread of weeds is likely given the extent of high threat exotic weed presence along the proposed alignment. Standard safeguard measures should be applied Table 6-1.

5.2.3 Changes to hydrology and groundwater dependent ecosystems

Construction of the proposed overhead powerlines and access road has the potential to marginally influence waterflow within the ephemeral waterway on the northern side of Back Trundle Road, via the construction of the SS access road. Impact will be minimised by the inclusion of culverts, which will allow waterflow beneath the access road. Ridgey Creek will be spanned by the overhead component of the powerline and therefore no impacts are anticipated to this waterway or groundwater dependent ecosystems.

5.2.4 Noise, light and vibration

Construction noise, light and vibration during construction may disturb fauna or prevent them using habitat in the study area. This impact would be short term. Safeguards and mitigation measures have been provided in Section 6.

5.2.5 Weeds

Presence and control of weeds and pests have been considered in this assessment, see below.

Invasion and spread of weeds

Soil disturbance may result in new weed populations. Introduction or spread of weeds through the study area may be associated with these actions:

- removing native vegetation
- excavation, soil stripping and construction or demolition.

Management of weed dispersion is considered in Section 6. If safeguards in Section 6 are followed the risk of weed colonisation in the study area will be minimised.

5.3 Impact on Key Threatening Processes

Key Threatening Processes (KTPs) listed under the BC Act, EPBC Act and FM Act were reviewed in Table 5-4. Four will be negligibly exacerbated by the proposal:

- clearing of native vegetation
- invasion of native plant communities by exotic perennial grasses
- loss of hollow-bearing trees
- anthropogenic climate change.

Table 5-4: Review of proposed impacts to Key Threatening Processes

KTP	Implication for proposal
BC Act KTPs	
Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands.	**Neutral.** The proposal would avoid impact to named waterways and disturbance of unnamed ephemeral drainage lines would be managed to minimise this risk. Control measures would be followed to prevent alternation of waterways.
Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala*	**Neural.** The proposal is unlikely to influence Noisy Miner abundance
Alteration of habitat following subsidence due to longwall mining	**Not applicable**
Anthropogenic Climate Change	**Possibly increased**. The proposal would result in the loss of a carbon sink consisting of native vegetation. The proposal would generate CO_2 emissions from construction machinery. Ground cover and low growing vegetation would be allowed to revegetate where it currently exists.
Bushrock Removal	**Neutral.** Bush rock would be left in the immediate vicinity of the proposal if disturbed.
Clearing of native vegetation	**Increased.** A small amount of native vegetation will be impacted (3ha)
Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus* (L.)	**Neutral.** The proposal is unlikely to influence feral rabbit numbers.
Competition and habitat degradation by Feral Goats, *Capra hircus* Linnaeus 1758	**Neutral.** The proposal is unlikely to influence feral goat numbers.
Competition from feral honeybees, *Apis mellifera* L.	**Neutral.** The proposal is unlikely to influence feral bee numbers.
Death or injury to marine species following capture in shark control programs on ocean beaches	**Not applicable**
Entanglement in, or injection of anthropogenic debris in marine and estuarine environments	**Not applicable**
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	**Not applicable**
Habitat degradation and loss by Feral Horses (brumbies, wild horses), *Equus caballus* Linnaeus 1758	**Neutral.** The proposal is unlikely to influence feral horses.
Herbivory and environmental degradation caused by feral deer	**Neutral.** The proposal is unlikely to influence feral deer numbers.
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	**Neutral.** The proposal is low impact and is unlikely to result in accidental fire and associated disruption to native vegetation.
Importation of Red Imported Fire Ants *Solenopsis invicta* Buren 1972	**Neutral.** The proposal is unlikely to increase the abundance of Red Imported Fire Ants.
Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species	**Neutral.** The proposal is unlikely to influence any part of the beak and feather disease life cycle.
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	**Neutral.** The proposal is unlikely to result in transmission of this fungus. No named waterways would be impacted by this proposal.

KTP	Implication for proposal
Infection of native plants by *Phytophthora cinnamomi*	**Neutral.** The proposal is unlikely to result in the introduction or spread of *Phytophthora cinnamomic*. It is not known to occur in the study area.
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family *Myrtaceae*	**Neutral.** The proposal is unlikely to result in the spread of Exotic Rust Fungi as the proposal footprint is outside the area of occupation for these fungi.
Introduction of the Large Earth Bumblebee *Bombus terrestris* (L.)	**Neutral.** The proposal is unlikely to result in the spread of *Bombus terrestris* as this species is not known to occur in NSW.
Invasion and establishment of exotic vines and scramblers	**Neutral.** The proposal is unlikely to result in the invasion and establishment of exotic vines and scramblers as the main species of this KTP are not present in the study area and weed control measures would be followed to prevent invasion and establishment of exotic vines and scramblers.
Invasion and establishment of Scotch Broom (*Cytisus scoparius*)	**Neutral.** The proposal is unlikely to result in the invasion and establishment of Scotch Broom as it is not known to occur in the study area. Standard weed control measures employed by Telstra would be followed to prevent invasion and establishment of Scotch Broom.
Invasion and establishment of the Cane Toad	**Not relevant**
Invasion of native plant communities by African Olive *Olea europaea subsp. cuspidata* (Wall. ex G. Don) Cif.	**Neutral.** The proposal is unlikely to result in the invasion and establishment of African Olive. European Olives are farmed in the study area, but African Olive is not known to occur. Standard weed control measures would be followed to prevent invasion and establishment of African Olive.
Invasion of native plant communities by *Chrysanthemoides monilifera*	**Neutral.** The proposal is unlikely to result in the importation of Boneseed or Bitou Bush and these species are not known to occur in the study area. Standard control measures would be followed to prevent importation.
Invasion of native plant communities by exotic perennial grasses	**Possible**. The proposal will possibly result in the introduction and establishment of exotic perennial grasses. Exotic grasses are already present in the proposal footprint however standard weed control measures employed by the proponent would be followed to exacerbation of invasion by exotic perennial grasses.
Invasion of the Yellow Crazy Ant, *Anoplolepis gracilipes* (Fr. Smith) into NSW	**Neutral.** The Yellow Crazy Ant is not known to occur in the study area, as they are more likely to occur in Northern Australia.
Invasion, establishment and spread of *Lantana camara*	**Neutral.** The proposal is unlikely to result in the invasion and establishment of *Lantana camara* as this species was not present in the study area and weed control measures would be followed to prevent invasion and establishment of all exotic vines and scramblers.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	**Unlikely but possible.** The proposal could result in the invasion and establishment of escaped garden plants. However, weed control measures would be followed to prevent establishment.
Loss and/or degradation of sites used for hill-topping by butterflies	**Not relevant**
Loss of Hollow-bearing Trees	**Likely.** A small number of hollow bearing trees will be impacted by the proposal (5). Mitigation measures will ensure impact is minimal and dead wood and trees disturbed by the proposal would not be removed from the immediate environment.

KTP	Implication for proposal
Predation and hybridisation by Feral Dogs, *Canis lupus familiaris*	**Not relevant**
Predation by the European Red Fox	**Neutral.** The proposal is unlikely to influence European red fox numbers.
Predation by the Plague Minnow (*Gambusia holbrooki*)	**Neutral.** The proposal is unlikely to influence Plague Minnow numbers.
Predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island	**Not relevant**
Predation by feral cats	**Neutral.** The proposal is unlikely to influence feral cat numbers.
Predation, habitat degradation, competition and disease transmission by Feral Pigs, *Sus scrofa* Linnaeus 1758	**Neutral.** The proposal is unlikely to influence feral pig numbers.
Removal of dead wood and dead trees	**Neutral.** Dead wood and trees disturbed by the proposal would not be removed from the immediate environment.
FM Act KTPs	
Alteration to the Natural Flow Regimes of Rivers and Streams	**Negligible.** The proposal is unlikely to influence flow regimes of rivers and streams provided control measures are followed to prevent alternation of waterways.
Alteration to the Natural Temperature of Rivers and Streams	**Neutral.** The proposal is unlikely to influence the temperature of rivers and streams.
Increased Sediment Input to Rivers and Streams Due to Human Activities	**Neutral.** Soil disturbance as a result of the proposal would be managed to prevent movement of sediment, and the likelihood of active erosion establishing.
Introduction of Live Fish into Waters Outside their Natural Range after 1770	**Neutral.** The proposal is unlikely to influence introduction of Live Fish into Waters Outside their Natural Range after 1770.
Removal of Large Woody Debris from Rivers and Streams	**Neutral.** The proposal will not result in removal of large woody debris from rivers and streams.
The Prevention of Passage of Aquatic Biota as a Result of the Presence of Instream Structures	**Neutral.** The proposal is unlikely to prevent aquatic biota passage.
EPBC Act KTPs	
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	**Neutral.** The proposal is unlikely to increase exclusion by Noisy Miners.
Competition and land degradation by rabbits	**Neutral.** The proposal is unlikely to influence feral rabbit numbers.
Competition and land degradation by unmanaged goats	**Neutral.** The proposal is unlikely to influence feral goat numbers.
Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)	**Neutral.** The proposal is unlikely to result in the introduction or spread of *Phytophthora cinnamomic* due to elevation above area of occupation.
Incidental catch (bycatch) of Sea Turtle during coastal otter-trawling operations within Australian waters north of 28 degrees South	**Not applicable**
Incidental catch (or bycatch) of seabirds during oceanic longline fishing operations	**Not applicable**
Infection of amphibians with chytrid fungus resulting in chytridiomycosis	**Neutral.** The proposal is unlikely to result in transmission of this fungus. The proposal would not disturb any named waterways.

KTP	Implication for proposal
Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris	**Not applicable**
Invasion of northern Australia by Gamba Grass and other introduced grasses	**Not applicable**
Land clearance	**Increased.** A small amount of native vegetation will be impacted (3ha) which includes groundcover in historically cleared and disturbed agricultural land and road corridors.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	**Negligible.** The proposal could result in the invasion and establishment of escaped garden plants. Mitigation measures will minimise potential.
Loss of biodiversity and ecosystem integrity following invasion by the Yellow Crazy Ant (*Anoplolepis gracilipes*) on Christmas Island, Indian Ocean	**Not applicable**
Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases	**Negligible**. The proposal would result in minor, temporary loss of a carbon sink consisting of native vegetation. The proposal would generate CO_2 emissions.
Novel biota and their impact on biodiversity	**Negligible**. The proposal is unlikely to influence novel biota numbers. All relevant weeds, invasive species, pathogens etc have been discussed in their specific KTP.
Predation by European red fox	**Neutral.** The proposal is unlikely to influence European red fox numbers.
Predation by exotic rats on Australian offshore islands of less than 1000 km2 (100,000 ha)	**Not applicable**
Predation by feral cats	**Neutral.** The proposal is unlikely to influence feral cat numbers.
Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs	**Neutral.** The proposal is unlikely to influence feral pig numbers.
Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species	**Neutral.** The proposal is unlikely to influence any part of the beak and feather disease life cycle.
The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Bufo marinus*)	**Not relevant**
The reduction in the biodiversity of Australian native fauna and flora due to the red imported fire ant, *Solenopsis invicta* (fire ant)	**Neutral.** Fire ants are not known to occur in the study area and the proposal is unlikely to result in the importation of Fire Ants. Control measures would be followed to prevent importation.

5.4 Cumulative impact

Impacts from the proposal are considered unlikely to result in a permanent cumulative impact to native species, populations and communities given the activity will largely occur in an historically cleared and degraded landscape and a range of measures will be taken to avoid, minimise and mitigate potential impacts as set out in Section 6.

6 Environmental safeguards and mitigation measures

The proposal has followed the principles of 'avoid, minimise, mitigate' to reduce the impact on local biodiversity values.

6.1 Avoid impact

The following avoidance measures have been made:

- the development footprint is largely located within land previously cleared for agricultural grazing or cropping and road corridors, and
- removal of native vegetation will be avoided where practical.

6.2 Minimise impact

The following measures have been made to minimise impact to the environment:

- The majority of the proposal will occur on previously cleared land, and
- the site selection for the proposed access road is designed to avoid areas of higher habitat value, and rather will impact vegetation with little habitat value and lowest plant density.

6.3 Mitigate impact

The environmental safeguards in Table 6-1 are recommended for minimising the impact of the proposal.

6.4 Offset impact

No offsetting requirement is triggered by this proposal.

Table 6-1: Environmental safeguards

Impact	Environmental safeguards	Responsibility	Timing
General	• Any change in design affecting land outside the development footprint assessed in this report will require further ecological survey - notwithstanding minor changes where the ecological values have been assessed for this proposal.	Proponent	Pre-construction, construction, operation
Clearing and prevention of over-clearing	• All personnel would be inducted to be aware any stand of native vegetation outside the development footprint has legislative consequences if deliberately or accidentally impacted without approval. Evidence of all personnel receiving an induction would be kept on file (signed induction sheets etc.). The extent of the clearing footprint is to be confined to the assessed areas. No clearing is permitted outside this area without further assessment. • Ensure groundcover disturbance would be kept to a minimum and within the assessed areas. • Where possible, vegetation to be removed would be mulched on-site and re-used to stabilise disturbed areas.	Contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
Soil Management	• Erosion and Sediment Control measures would be in accordance with Landcom's Managing Urban Stormwater, Soils & Construction Guidelines (The Blue Book. Landcom 2004) and documented in a Construction Environmental Management Plan (CEMP) to be prepared for the work.	Contractor	Pre-construction and during construction
Damage to native vegetation outside of impact zone	• Stockpile and compound sites would be located using the following criteria: o At least 40 m away from the nearest waterway o In areas of low ecological conservation significance (i.e., previously disturbed land) o On relatively level ground o Outside the one in 10-year Average Recurrence Interval (ARI) floodplain. • Stockpiling materials and equipment and parking vehicles would be avoided within the dripline (extent of foliage cover) of any tree.	Contractor	Construction
Introduction and spread of noxious weeds and pathogens	• Essential Energy has a general biosecurity duty under the Biosecurity Act 2015 to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable. Field crews shall follow procedures as outlined in Essential Energy's Operational Guideline: Biosecurity Risk Management (CERM1000.96) to prevent, eliminate or minimise biosecurity risk so far as is reasonably practicable, with particular reference to vehicle and equipment hygiene practises.	Contractor	Construction
Disturbance to fallen timber, dead wood and bush rock	• Any fallen timber, dead wood and bush rock (if present) encountered on site would be left in situ or relocated to a suitable place nearby.	Contractor	Construction
Removal and replacement of native vegetation	• Prior to clearing, inspect trees with bird nests or hollows before pushing or felling to ensure the nests are vacant. Inspection would occur immediately before pushing or felling. If a bird is in the nest, clear the trees around it first to see if the animal will disperse. If the bird is a nestling (baby bird confined to the nest) all measures would be taken to collect the bird and remove to a safe location. • Cleared areas, once stabilised would be allowed to naturally regenerate with ground cover and low growing species. • Segments of trees removed from tree lopping to be placed in adjoining habitat without damaging it.	Proponent, contractor	Construction and post-construction
Disturbance to waterways	• Access the waterway in a way that minimises harm to banks or native vegetation. • Keep machinery away from banks of the waterway (where possible). • Do not refuel, store or decant chemicals within 50m of a waterway.	Proponent, contractor	Pre-construction and construction
Attracting fauna to the study area	• All food scraps and rubbish are to be appropriately disposed of in sealed receptacles to prevent providing forage habitats for foxes, rats, dogs and cats.	Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
Fauna management	• Immediately prior to commencement of any vegetation removal involving machinery and/or tree-felling the area of clearing work is to be inspected for fauna • If fauna is detected, the animal is to be allowed to leave the site without any coercion or a local wildlife rescue service is to be contacted to facilitate the safe removal of the animal from the worksite.	Contractor	Construction

7 Conclusion

The proposal will not result in a significant impact to the ecological values present in the development footprint. The impact to listed threatened species, populations or communities recorded or presumed to occur in the development footprint was assessed as not significant.

Safeguards and mitigation measures have been provided to minimise harm to the environment. If these are implemented then the proposal is unlikely to have a significant impact to species populations and communities listed under the EPBC Act, FM Act, or BC Act.

8 References

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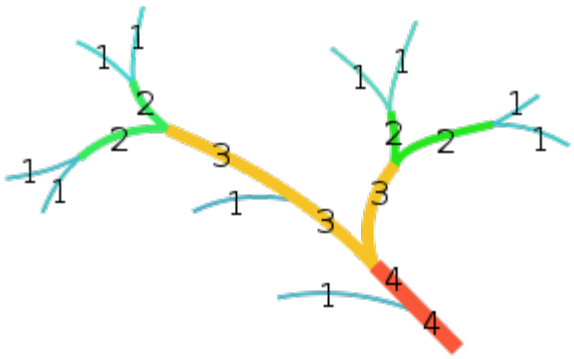
Appendix A: Terms and abbreviations used in this report

Terms and abbreviations used in this report.

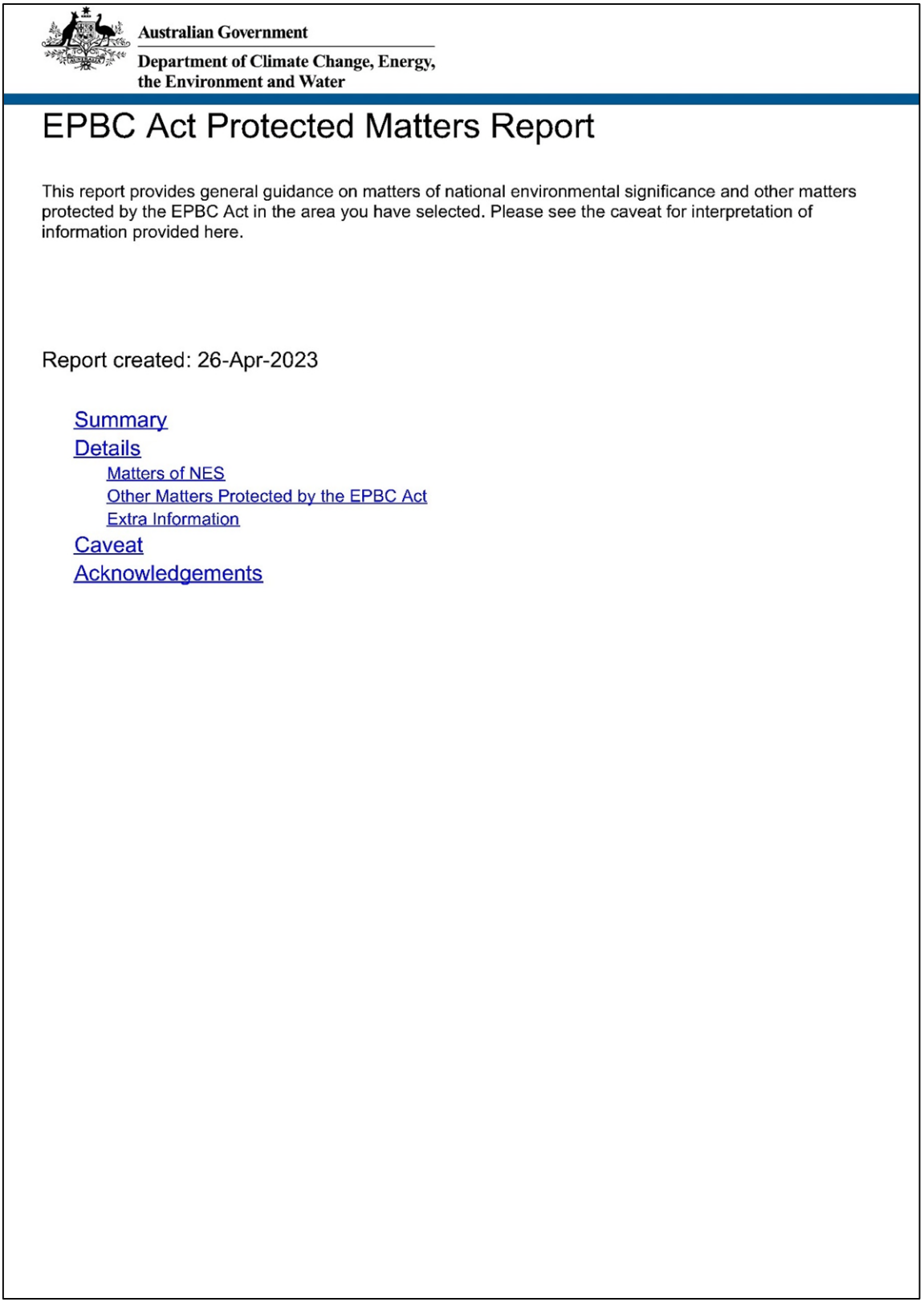
Abbreviation	Terminology	Description
	Assessment or test of significance	The Assessment of Significance refers to the factors that must be considered by decision makers to assess whether a Proposal is likely to have a significant effect on threatened biodiversity. These mechanisms are contained in s5A of the EP&A Act and s94 of the BC Act.
BoM	Australian Bureau of Meteorology	The Bureau of Meteorology is Australia's national weather, climate and water agency.
	Critical habitat	Critical habitat is defined as an area crucial to the survival of an endangered species, population or ecological community. The declaration of critical habitat provides greater protection and stricter controls over activities in the area.
	Cumulative impacts	Impacts, when considered together, lead to a stronger impact than any impact in isolation.
Development footprint		Encompasses all land which the Development Consent will apply to. This is the area to be impacted by the development and is the focus of this report.
	Direct impacts	Directly affect the habitat and individuals. They include, but are not limited to, death through predation, trampling, poisoning of the animal/plant itself and the removal of suitable habitat. When applying each factor, consideration must be given to all of the likely direct impacts of the proposed activity or development.
DCCEEW	Department of Climate Change, Energy, and the Environment	The DCCEEW protects Australia's natural environment and heritage sites as well as help Australia respond to climate change and carefully manage our water and energy resources.
EEC	Endangered Ecological Community	An ecological community identified by relevant legislation likely to become extinct or is in immediate danger of extinction.
TEC	Threatened Ecological Community	An ecological community identified by relevant legislation to be classed as threatened and or is in immediate danger of becoming endangered.
	Environment	The environment includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings.
BC Act	*Biodiversity Conservation Act 2016*	Provides for the protection of the environment, especially matters of state environmental significance, and provides a state assessment and approvals process.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).	Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
GDA	Geocentric Datum of Australia	The Geocentric Datum of Australia (GDA) is the latest Australian coordinate system, replacing the Australian Geodetic Datum (AGD). The GDA is a part of a global coordinate reference frame and is directly compatible with the Global Navigation Satellite Systems.
GDE	Groundwater Dependent Ecosystems	Six types of groundwater dependent ecosystems are conventionally recognised in Australia: Terrestrial vegetation relies on the availability of shallow groundwater. Wetlands such as paperbark swamp forests and mound springs ecosystems. River base flow systems where a groundwater discharge provides a base flow component to the river's discharge. Aquifer and cave ecosystems where life exists independent of sunlight Terrestrial fauna, both native and introduced, dependant on groundwater as a source of drinking water.

Abbreviation	Terminology	Description
		Estuarine and near shore marine systems, such as some coastal mangroves, salt marshes and sea grass beds, which rely on the submarine discharge of groundwater.
	Habitat	The area occupied, or periodically or occasionally occupied, by any threatened species, population or ecological community and includes all the different aspects (both biotic and abiotic) used by species during the different stages of their life cycles.
IBRA	Interim Biogeographic Regionalisation of Australia	The Interim Biogeographic Regionalisation for Australia (IBRA) is a biogeographic regionalisation of Australia developed by the Australian Government's Department of the Environment. Each region is a land area made up of a group of interacting ecosystems repeated in similar form across the landscape.
	Indirect impacts	Occur when project-related activities affect species, populations or ecological communities in a manner other than direct loss. Indirect impacts can include loss of individuals through starvation, exposure, predation by domestic and/or feral animals, loss of breeding opportunities, loss of shade/shelter, deleterious hydrological changes, increased soil salinity, erosion, inhibition of nitrogen fixation, weed invasion, fertiliser drift, or increased human activity within or directly adjacent to sensitive habitat areas. As with direct impacts, consideration must be given, when applying each factor, to all of the likely indirect impacts of the proposed activity or development.
KTP	Key Threatening Process	A key threatening process is defined as a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities. A requirement of their listing on the Act is that the process adversely affects two or more threatened species, populations or ecological communities, or may cause species, populations or ecological communities not threatened to become threatened.
LGA	Local Government Area	The relevant LGA is Governed by Council who are the determining authority for this development application.
	Local population	The population occurs in the study area. The assessment of the local population may be extended to include individuals beyond the study area if it can be clearly demonstrated contiguous or interconnecting parts of the population continue beyond the study area. The local population of a threatened plant species comprises those individuals occurring in the study area, or the cluster of individuals extend into habitat adjoining and contiguous with the study area could reasonably be expected to be cross-pollinating with those in the study area. The local population of resident fauna species comprises those individuals known or likely to occur in the study area, as well as any individuals occurring in adjoining areas (contiguous or otherwise) are known or likely to utilise habitats in the study area. The local population of migratory or nomadic fauna species comprises those individuals likely to occur in the study area from time to time.
	Local population (EEC)	The ecological community present within the study area. However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of the ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated.
MNES	Matters of national environmental significance.	Refers to the seven matters of national environmental significance outlined under the EPBC Act.
RAMSAR	Convention on Wetlands of International Importance	The Ramsar Convention's broad aims are to halt the worldwide loss of wetlands and to conserve, through wise use and management, those remaining. This requires international cooperation, policy making, capacity building and technology transfer.
Significant impact		A ‘significant impact’ is an impact which is important, notable, or of consequence, having regard to its context or intensity.
Study area		Study area means the development footprint and any additional areas which are likely to be affected by the Proposal, either directly or

Abbreviation	Terminology	Description
		indirectly. The study area should extend as far as is necessary to take all potential impacts into account.
Strahler stream order		Strahler stream order and are used to define stream size based on a hierarchy of tributaries. 

Appendix B: Database search results

EPBC Protected Matters Search



Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 26-Apr-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	4
Listed Threatened Species:	31
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	1
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Banrock station wetland complex	700 - 800km upstream from Ramsar site
Hattah-kulkyne lakes	500 - 600km upstream from Ramsar site
Riverland	600 - 700km upstream from Ramsar site
The coorong, and lakes alexandrina and albert wetland	800 - 900km upstream from Ramsar site

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		

Scientific Name	Threatened Category	Presence Text
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat may occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Lophochroa leadbeateri leadbeateri Major Mitchell's Cockatoo (eastern), Eastern Major Mitchell's Cockatoo [82926]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat likely to occur within area
FISH		
Macquaria australasica Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area
FROG		
Crinia sloanei Sloane's Froglet [59151]	Endangered	Species or species habitat may occur within area
MAMMAL		
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT)		
Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat likely to occur within area
Pteropus poliocephalus		
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area
PLANT		
Androcalva procumbens		
[87153]	Vulnerable	Species or species habitat may occur within area
Austrostipa metatoris		
[66704]	Vulnerable	Species or species habitat may occur within area
Austrostipa wakoolica		
[66623]	Endangered	Species or species habitat known to occur within area
Lepidium aschersonii		
Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area
Lepidium monoplocoides		
Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area
Vincetoxicum forsteri listed as Tylophora linearis		
[92384]	Endangered	Species or species habitat may occur within area
REPTILE		
Aprasia parapulchella		
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

IBRA predicted threatened species and communities search

Threatened species and communities predicted to occur in the Lower Slopes IBRA subregion (NSW DPE 2023)

Scientific name	Common name	NSW status	Commonwealth status
Amphibian			
Crinia sloanei	Sloane's Froglet	Vulnerable	Endangered
Litoria raniformis	Southern Bell Frog	Endangered	Vulnerable
Bird			
Anseranas semipalmata	Magpie Goose	Vulnerable	-
Anthochaera phrygia	Regent Honeyeater	Critically Endangered	Critically Endangered
Artamus cyanopterus cyanopterus	Dusky Woodswallow	Vulnerable	-
Botaurus poiciloptilus	Australasian Bittern	Endangered	Endangered
Burhinus grallarius	Bush Stone-curlew	Endangered	-
Calidris ferruginea	Curlew Sandpiper	Endangered	Critically Endangered,Migratory
Callocephalon fimbriatum	Gang-gang Cockatoo	Vulnerable	Endangered
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable	Vulnerable (South-eastern)
Calyptorhynchus lathami - endangered population	Glossy Black-Cockatoo, Riverina population	Endangered Population	-
Certhionyx variegatus	Pied Honeyeater	Vulnerable	-
Chthonicola sagittata	Speckled Warbler	Vulnerable	-
Cinclosoma castanotum	Chestnut Quail-thrush	Vulnerable	-
Circus assimilis	Spotted Harrier	Vulnerable	-
Climacteris affinis - endangered population	White-browed Treecreeper population in Carrathool local government area south of the Lachlan River and Griffith local government area	Endangered Population	-
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	Vulnerable	Vulnerable
Daphoenositta chrysoptera	Varied Sittella	Vulnerable	-
Drymodes brunneopygia	Southern Scrub-robin	Vulnerable	-
Epthianura albifrons	White-fronted Chat	Vulnerable	-
Falco hypoleucos	Grey Falcon	Vulnerable	Vulnerable
Falco subniger	Black Falcon	Vulnerable	-
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	Vulnerable	-
Glossopsitta pusilla	Little Lorikeet	Vulnerable	-
Grantiella picta	Painted Honeyeater	Vulnerable	Vulnerable
Grus rubicunda	Brolga	Vulnerable	-
Haliaeetus leucogaster	White-bellied Sea-Eagle	Vulnerable	-
Hamirostra melanosternon	Black-breasted Buzzard	Vulnerable	-
Hieraaetus morphnoides	Little Eagle	Vulnerable	-
Hylacola cautus	Shy Heathwren	Vulnerable	-
Lathamus discolor	Swift Parrot	Endangered	Critically Endangered
Leipoa ocellata	Malleefowl	Endangered	Vulnerable
Limosa limosa	Black-tailed Godwit	Vulnerable	-
Lophochroa leadbeateri	Major Mitchell's Cockatoo	Vulnerable	Endangered (Eastern)
Lophoictinia isura	Square-tailed Kite	Vulnerable	-
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	Vulnerable	Endangered
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	Vulnerable	-
Neophema pulchella	Turquoise Parrot	Vulnerable	-
Ninox connivens	Barking Owl	Vulnerable	-
Oxyura australis	Blue-billed Duck	Vulnerable	-
Pachycephala inornata	Gilbert's Whistler	Vulnerable	-
Pedionomus torquatus	Plains-wanderer	Endangered	Critically Endangered

Scientific name	Common name	NSW status	Commonwealth status
Petroica boodang	Scarlet Robin	Vulnerable	-
Petroica phoenicea	Flame Robin	Vulnerable	-
Polytelis swainsonii	Superb Parrot	Vulnerable	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	Vulnerable	-
Rostratula australis	Australian Painted Snipe	Endangered	Endangered
Stagonopleura guttata	Diamond Firetail	Vulnerable	Vulnerable
Stictonetta naevosa	Freckled Duck	Vulnerable	-
Tyto novaehollandiae	Masked Owl	Vulnerable	-
Bat			
Chalinolobus dwyeri	Large-eared Pied Bat	Vulnerable	-
Chalinolobus picatus	Little Pied Bat	Vulnerable	-
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Vulnerable	-
Miniopterus orianae oceanensis	Large Bent-winged Bat	Vulnerable	-
Myotis macropus	Southern Myotis	Vulnerable	-
Nyctophilus corbeni	Corben's Long-eared Bat	Vulnerable	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox	Vulnerable	Vulnerable
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	Vulnerable	-
Scoteanax rueppellii	Greater Broad-nosed Bat	Vulnerable	-
Vespadelus baverstocki	Inland Forest Bat	Vulnerable	-
Marsupial			
Cercartetus nanus	Eastern Pygmy-possum	Vulnerable	-
Dasyurus maculatus	Spotted-tailed Quoll	Vulnerable	Endangered
Petaurus norfolcensis	Squirrel Glider	Vulnerable	-
Petaurus norfolcensis - endangered population	Squirrel Glider in the Wagga Wagga Local Government Area	Endangered Population	-
Phascolarctos cinereus	Koala	Endangered	Endangered
Sminthopsis macroura	Stripe-faced Dunnart	Vulnerable	-
Reptiles			
Aprasia parapulchella	Pink-tailed Legless Lizard	Vulnerable	Vulnerable
Plants			
Acacia ausfeldii	Ausfeld's Wattle	Vulnerable	-
Amphibromus fluitans	Floating Swamp Wallaby-grass	Vulnerable	Vulnerable
Austrostipa metatoris	A spear-grass	Vulnerable	Vulnerable
Austrostipa wakoolica	A spear-grass	Endangered	Endangered
Brachyscome muelleroides	Claypan Daisy	Vulnerable	Vulnerable
Brachyscome papillosa	Mossgiel Daisy	Vulnerable	Vulnerable
Caladenia arenaria	Sand-hill Spider Orchid	Endangered	Endangered
Caladenia concolor	Crimson Spider Orchid	Endangered	Vulnerable
Cullen parvum	Small Scurf-pea	Endangered	-
Diuris sp. (Oaklands, D.L. Jones 5380)	Oaklands Diuris	Endangered	-
Diuris tricolor	Pine Donkey Orchid	Vulnerable	-
Eleocharis obicis	Spike-Rush	Vulnerable	Vulnerable
Grevillea ilicifolia subsp. ilicifolia	Holly-leaf Grevillea	Critically Endangered	-
Kippistia suaedifolia	Fleshy Minuria	Endangered	-
Lepidium aschersonii	Spiny Peppercress	Vulnerable	Vulnerable
Lepidium monoplocoides	Winged Peppercress	Endangered	Endangered
Leptorhynchos orientalis	Lanky Buttons	Endangered	-
Philotheca angustifolia subsp. angustifolia	Philotheca angustifolia	Extinct	-
Pilularia novae-hollandiae	Austral Pillwort	Endangered	-
Pomaderris cocoparrana	Cocoparra Pomaderris	Endangered	Endangered
Senecio garlandii	Woolly Ragwort	Vulnerable	-
Swainsona murrayana	Slender Darling Pea	Vulnerable	Vulnerable
Swainsona recta	Small Purple-pea	Endangered	Endangered
Swainsona sericea	Silky Swainson-pea	Vulnerable	-
Tylophora linearis	Tylophora linearis	Vulnerable	Endangered
Wilsonia rotundifolia	Round-leafed Wilsonia	Endangered	-

Predicted communities

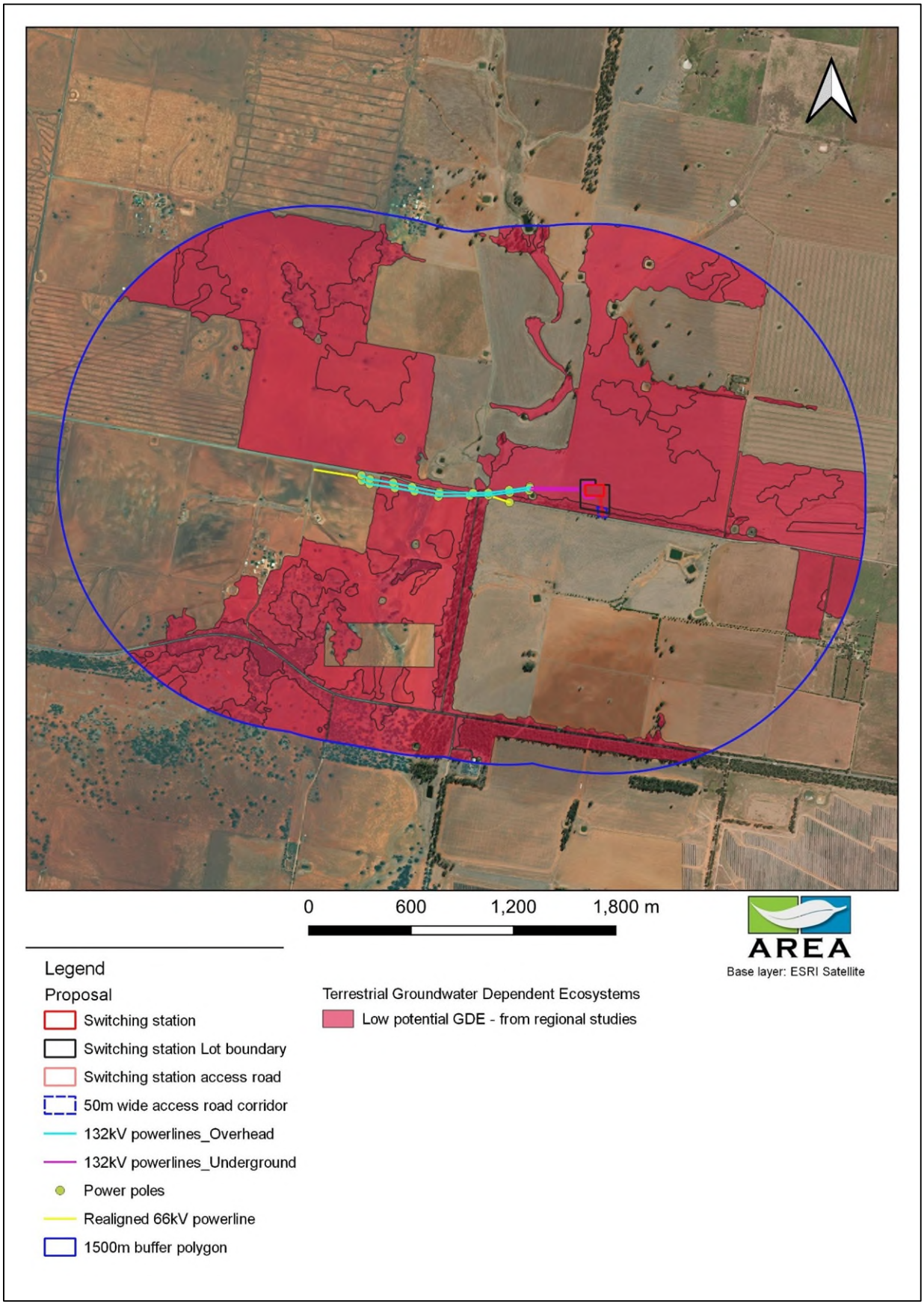
Scientific name	Common name	NSW status
Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Fuzzy Box Woodland on alluvial Soils of the South Western Slopes, Darling Riverine Plains and Brigalow Belt South Bioregions	Endangered Ecological Community
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions	Endangered Ecological Community
Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia, in the NSW South Western Slopes Bioregion	Mallee and Mallee-Broombush dominated woodland and shrubland, lacking Triodia	Critically Endangered Ecological Community
Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions	Endangered Ecological Community
Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	Sandhill Pine Woodland in the Riverina, Murray-Darling Depression and NSW South Western Slopes bioregions	Endangered Ecological Community
White Box - Yellow Box - Blakelys Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions	Box-Gum Woodland	Critically Endangered Ecological Community

BioNet – species recorded within 1500m

V = Vulnerable E = Endangered CE = Critically Endangered M = Migratory

Class Name	Scientific Name	Common Name	NSW Status	Comm Status
Aves	*Polytelis swainsonii*	Superb Parrot	V	V
Aves	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V	
Flora	*Austrostipa wakoolica*	A spear-grass	E	E
Flora	*Austrostipa wakoolica*	A spear-grass	E	E

Groundwater dependant ecosystems - Terrestrial



Appendix C: Predicted threatened species assessment

Likelihood of impact to threatened species identified by database searches (IBRA, MNES and BioNet) and field survey is considered in the following table:

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Amphibians							
Crinia sloanei	Sloane's Froglet	V	E	Unlikely, The alignment intersects a creek line. However, the creek line is ephemeral and highly degraded showing no evidence of a permanent water way	Unlikely, Creek line will largely be avoided by impact as power poles will be placed approximately 30 meters from top of bank each side	No	No
Litoria raniformis	Southern Bell Frog	E	V	Unlikely, The alignment intersects a creek line. However, the creek line is ephemeral and highly degraded showing no evidence of a permanent water way	Unlikely, Creek line will largely be avoided by impact as power poles will be placed approximately 30 meters from top of bank each side	No	No
Bats							
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Potential, Species habitat occurs within a small section of the alignment	Unlikely. Other work in the region shows the only known viable local population is in Goobang NP. Therefore, transient individuals use the study area and are not affected by tree hollow removal.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential, Species habitat occurs within a small section of the alignment	Potential	Yes	No
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Unlikely, Species is most commonly found in tall wet forest and forages for beetles and slow flying insects along creek and river corridors.	Unlikely, Species preferably habitat does not meet that of the habitat identified within the alignment	No	No
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	No - only camp and breed along major waterways	Unlikely	No	No
Vespadelus baverstocki	Inland Forest Bat	V	-	Potential, Known to roost in very small hollows in stunted trees only a few metres high	Potential, Species habitat occurs within a small section of the alignment.	Yes	No
Miniopterus orianae oceanensis	Large Bent-winged Bat	V	-	Unlikely, Species primary roosting habitat of caves, derelict mines, storm water tunnels, buildings and other manmade structures do not occur along the alignment.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Unlikely, Species predominantly roosts within caves entrances, cliff crevices, old mine workings. Species preferred habitat is not consistent with the alignment.	Unlikely, Area surveyed. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Chalinolobus picatus	Little Pied Bat	V	-	Unlikely, Species has potential to roost in tree hollows which are present in the development footprint in two areas in low numbers. However the species preferably roosts in caves, rock outcrops, mineshafts, tunnels and buildings. Species also requires access to nearby open water not consistent with the alignment.	Unlikely, Species preferably habitat does not meet that of the habitat identified within the alignment	No	No
Myotis macropus	Southern Myotis	V	-	Unlikely, Species preferably roosts close to water required for foraging within caves and mine.	Unlikely, Species preferably habitat does not meet that of the habitat identified within the alignment	No	No
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Potential, Species roosts in tree hollows and can utilise mammal burrows in treeless areas. Species also forages for insects above the tree canopy and lower in open country	Potential, Species habitat occurs within the alignment.	Yes	No
Aves							
Botaurus poiciloptilus	Australasian Bittern	E	E	Unlikely, Species prefers permanent freshwater wetlands with tall, dense vegetation, not consistent with the alignment	Unlikely, Area surveyed. No suitable habitat present.	No	No
Rostratula australis	Australian Painted Snipe	E	E	Unlikely, Species preferred habitat consists of swamp fringes, dams and nearby marshy areas	Unlikely, Area surveyed. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Ninox connivens	Barking Owl	V	-	Unlikely, Species roosting habitat of large hollows in old trees were not identified to occur within the development footprint	Unlikely, Area surveyed. No suitable habitat present.	No	No
Falco subniger	Black Falcon	V	-	Unlikely, Species roosting habitat of large hollows in old trees required for nesting and hunting were not identified to occur within the development footprint	Unlikely, Area surveyed. No suitable habitat present.	No	No
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Unlikely, Species preferred breeding habitat along timbered watercourses which was not identified during the field survey	Unlikely, Area surveyed. No suitable habitat present.	No	No
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)	V	-	Unlikely, The species does not persist in remnants less than 200ha in area.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Limosa limosa	Black-tailed Godwit	V	-	Unlikely, Species preferred habitat consists of sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Oxyura australis	Blue-billed Duck	V	-	Unlikely, Species preferred habitat includes deep water in large permanent wetlands and swamps with dense vegetation.	Unlikely, Area surveyed. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Neophema chrysostoma	Blue-winged Parrot	-	V	Unlikely, Species distribution varies from coastal to semi-arid zones however wetlands both near coastal zones and semi-arid zones are utilised for foraging and staging.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Grus rubicunda	Brolga	V	-	Unlikely, Species is dependent on wetlands for both nesting and foraging. No wetlands were identified within the development footprint.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V	V	Potential, species nesting habitat of small hollow bearing trees occurs within a small section of the development footprint	Potential	Yes	No
Burhinus grallarius	Bush Stone-curlew	E	-	Unlikely - considered as locally extinct.	Unlikely	No	No
Cinclosoma castanotum	Chestnut Quail-thrush	V	-	Unlikely, Species occurs almost exclusively in mallee communities not found in the development footprint	Unlikely, Species preferred habitat is not consistent with the alignment	No	No
Actitis hypoleucos	Common Sandpiper	-	M	Unlikely, Species nests on the ground close to permanent fresh water. Species also uses shallow fresh water to forage for insects, crustaceans and other invertebrates.	Unlikely, Area surveyed. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Calidris ferruginea	Curlew Sandpiper	E	CE, M	Unlikely, Species requires littoral/estuarine habitats and intertidal mudflats of sheltered coasts in Nes South Wales.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Stagonopleura guttata	Diamond Firetail	V	V	Potential, Species sometimes occurs in lightly wooded farmland	Unlikely, Species requires dense shrubs for nesting which were not identified during the field survey	No	No
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Potential, Species can be found in farmland most often at the edge of a forest or woodland.	Potential, Species potential habitat occurs along the alignment	Yes	No
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	-	CE,M	Unlikely, Species preferred habitat of coastal lakes, inlets, bays and estuarine habitats. Within NSW species also requires intertidal mudflats and occasionally saltmarsh of sheltered coasts.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Petroica phoenicea	Flame Robin	V	-	Unlikely, Species breeds in upland tall moist eucalypt forests and woodlands often on ridges and slopes. May forage in pastures and native grasslands with or without scattered trees. Not recorded within 1500m.	Unlikely, Areas of potential foraging may be affected short term, Suitable habitat is well represented outside the impact area.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Apus pacificus	Fork-tailed Swift	-	M	Unlikely, Species is a non-breeding migratory visitor to Australia. During migration the species is almost exclusively aerial and is known to be insectivorous	Unlikely, Species breeding and foraging habitat is unlikely to be affected by the development footprint.	No	No
Stictonetta naevosa	Freckled Duck	V	-	Unlikely Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. Not recorded within 1500m	Unlikely, Area surveyed. No suitable habitat present.	No	No
Callocephalon fimbriatum	Gang-gang Cockatoo	V	E	Unlikely, Species prefers old growth forest and woodland attributes, the development footprint is located in a highly degraded agricultural setting	Unlikely, Area surveyed. No suitable habitat present.	No	No
Pachycephala inornata	Gilbert's Whistler	V	-	Unlikely, Species occurs in areas with dense shrub layer including Belah woodlands and River Red Gum Forests.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	Vulnerable, Endangered Population (Riverina population)	V	Unlikely, Casuarina and Allocasuarina species are an important food source for this species which do not occur within the development footprint.	Unlikely, Area surveyed. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Falco hypoleucos	Grey Falcon	V	V	Unlikely, Species is usually restricted to shrubland, grassland and wooded watercourses of arid-semi-arid regions.	Unlikely, Area surveyed. No suitable habitat present.	No	No
Pomatostomus temporalis temporalis	Grey-crowned Babbler (eastern subspecies)	V	-	Potential, Species Inhabits open box woodlands on alluvial plains. Recorded within 1500m.	Unlikely, Area surveyed. No individuals identified to be present. Species are usually unable to cross large open areas as flight is laborious.	No	No
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)	V	E	Unlikely, Requires structurally diverse habitats. Not recorded within 1500m.	Unlikely Area surveyed and suitable habitat complexity absent.	No	No
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-	M	Unlikely Occurs in permanent and ephemeral wetlands with low dense vegetation.	Unlikely Area surveyed and no suitable habitat present.		
Hieraaetus morphnoides	Little Eagle	V	-	Potential Nests in tall living trees within remnant patch. Recorded within 10km	Potential	Yes	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Glossopsitta pusilla	Little Lorikeet	V	-	Potential, Small hollows are used for nesting which occur within the development footprint.	Unlikely, Species prefers riparian habitats for nesting and foraging. Area surveyed and no riparian habitats were identified to occur within the development footprint	No	No
Anseranas semipalmata	Magpie Goose	V	-	Unlikely, Mainly found in shallow wetlands (less than 1m deep) with dense growth of rushes or sedges. May occur in temporarily inundated in areas however is likely transitory.	Unlikely Area surveyed and no suitable habitat present.	No	No
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	E (Eastern)	Potential Nests in tree hollows, feeds on the ground. Potential foraging habitat impacted.	Unlikely Area surveyed, and no suitable nesting habitat observed, hollows identified were. Foraging habitat is well represented outside the impact area.	No	No
Leipoa ocellata	Malleefowl	E	V	Unlikely, Species predominantly inhabits mallee communities along with light sandy to sandy loam soils.	Unlikely Area surveyed and no suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Tyto novaehollandiae	Masked Owl	V	-	Species, roosts and breeds in moist eucalypt forested gullies and requires large tree hollows. This species sometimes also uses caves for nesting	Unlikely Area surveyed and no suitable habitat present.	No	No
Grantiella picta	Painted Honeyeater	V	V	Potential Inhabits Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands. Potential foraging habitat impacted.	Unlikely Suitable habitat along impact footprint is present however, it is sparse. Suitable habitat is well represented outside the impact area.	No	No
Calidris melanotos	Pectoral Sandpiper	-	M	Unlikely, Species does not breed in Australia and prefers shallow fresh to saline wetlands for foraging	Unlikely Area surveyed and no suitable habitat present.	No	No
Certhionyx variegatus	Pied Honeyeater	V	-	Potential, Inhabits wattle shrub, primarily Mulga (*Acacia aneura*), mallee, spinifex and eucalypt woodlands	Unlikely Area surveyed and no suitable habitat present.	No	No
Pedionomus torquatus	Plains-wanderer	E	CE	Unlikely, Species preferred habitat typically comprises 50% bare ground, 10% fallen litter, and 40% herbs, forbs and grasses.	Unlikely Area surveyed and no suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Glossopsitta porphyrocephala	Purple-crowned Lorikeet	V	-	Unlikely, Species is unknown to occur in NSW and is not known to occur in the area. The closest previously recorded sighting is approximately 200km South West of the alignment	Unlikely, development footprint is not within the species distribution	No	No
Anthochaera phrygia	Regent Honeyeater	CE	CE	Unlikely - habitat eliminates would not support a viable local population or transient individuals.	Potential	No	No
Myiagra cyanoleuca	Satin Flycatcher	-	M	Unlikely, Species prefers moist, taller eucalypt forests, often near wetlands or watercourses and breed at elevations of more than 600 m above sea level.	Unlikely Area surveyed and no suitable habitat present.	No	No
Petroica boodang	Scarlet Robin	V	-	Unlikely. This species is heavily dependent on habitat complexity. This study area is not complex enough to support a viable local population.	Unlikely Area surveyed and no suitable habitat present.	No	No
Calidris acuminata	Sharp-tailed Sandpiper	-	M	Unlikely, Species is migratory and breeds in northern Siberia. When migration to Australia occurs, the species preferred foraging habitat includes muddy edges of shallow fresh wetlands, with inundated or emergent sedges, grass with other low vegetation and saltmarsh	Unlikely Area surveyed and no suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Hylacola cautus	Shy Heathwren	V	-	Unlikely, Species habitat consists of mallee woodland with a dense understory of shrubs	Unlikely Area surveyed and no suitable habitat present.	No	No
Drymodes brunneopygia	Southern Scrub-robin	V	-	Unlikely, Species habitat consists of mallee woodland with a dense understory of shrubs	Unlikely Area surveyed and no suitable habitat present.	No	No
Aphelocephala leucopsis	Southern Whiteface	-	V	Unlikely - not shrubby enough to support a viable local population.	Unlikely	No	No
Chthonicola sagittata	Speckled Warbler	V	-	Unlikely Large, relatively undisturbed remnants are required for the species to persist in an area.	Unlikely Area surveyed and suitable habitat complexity absent.	No	No
Circus assimilis	Spotted Harrier	V	-	Potential, Species occurs in grassy open woodland, most commonly in native grassland and can be found in agricultural land	Potential	Yes	No
Lophoictinia isura	Square-tailed Kite	V	-	Unlikely, Species has a particular preference for timbered watercourses which do not occur within the development footprint	Unlikely Area surveyed and no suitable habitat present.	No	No
Polytelis swainsonii	Superb Parrot	V	V	Potential, Species nest in the hollows of large trees 6cm or wider which do occur within the development footprint	Potential, Species records occur within 10km of the alignment	Yes	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Lathamus discolor	Swift Parrot	E	CE	Unlikely, Species breeds in Tasmania and migrates to south eastern Australia in the Autumn and winter months. In NSW the species mostly occurs on the coast and south west slopes.	Unlikely Area surveyed, and suitable foraging habitat is sparse. Suitable habitat is well represented outside the impact area.	No	No
Neophema pulchella	Turquoise Parrot	V	-	Potential, Species Lives on the edges of eucalypt woodland adjoining clearings and nests in tree hollows which do occur within the development footprint.	Potential	Yes	No
Daphoenositta chrysoptera	Varied Sittella	V	-	Possible Inhabits eucalypt forests and woodlands.	Unlikely Area surveyed and is predominately grassland and highly disturbed.	No	No
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	-	Unlikely, Species occurs widespread across NSW including major rivers, swamps, lakes and the sea.	Unlikely Area surveyed and no suitable habitat present.	No	No
Climacteris affinis - endangered population	White-browed Treecreeper population in Carrathool local government area south of the Lachlan River and Griffith local	E Population	-	Unlikely, Species mainly occur in tall shrublands, and low woodlands dominated by acacias and Belah	Unlikely Area surveyed and no suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
	government area						
Epthianura albifrons	White-fronted Chat	V	-	Unlikely, Species is usually found foraging for food on bare or grassy ground in wetland areas	Unlikely Area surveyed and no suitable habitat present.	No	No
Hirundapus caudacutus	White-throated Needletail	-	V,M	Unlikely, Species is migratory and does not breed in Australia, species is predominantly recorded occurring in coastal areas from October to April	Unlikely Area surveyed and no suitable habitat present.	No	No
Motacilla flava	Yellow Wagtail	-	M	Unlikely, Species is migratory and breeds in Europe and Asia. Potential foraging habitat may occur within the development footprint.	Unlikely Area surveyed, and suitable foraging habitat is is sparse. Suitable habitat is well represented outside the impact area.	No	No
Mammals							
Cercartetus nanus	Eastern Pygmy-possum	V	-	Unlikely	Area surveyed and no suitable habitat present.	No	No
Phascolarctos cinereus	Koala	E	E (combined populations of Queensland, New South Wales and the Australian Capital Territory)	Potential. No scats or scratches on trees observed	Unlikely	Yes	No
Dasyurus maculatus	Spotted-tailed Quoll	V	E	No - not sufficient patch size and complexity to support a viable local population.	Unlikely	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Petaurus norfolcensis	Squirrel Glider	V, E Population (in the Wagga Wagga Local Government Area)	-	Potential. Precautionary principle applied.	Potential, Due to the removal of tree hollows.	Yes	No
Sminthopsis macroura	Stripe-faced Dunnart	V	-	No - not sufficient patch size and complexity to support a viable local population.	Unlikely	No	No
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V	No - unsuitable habitat	Unlikely	No	No
Fish							
Macquaria australasica	Macquarie Perch	E	E	Unlikely The alignment intersects a creek line. However, the creek line is ephemeral and highly degraded showing no evidence of a permanent water way	Unlikely, Creek line will be largely avoided by impact as power poles will be place approx. 30 meters from top of bank each side	No	No
Flora							
Vincetoxicum forsteri	null	V	E (listed as *Tylophora linearis*)	Unlikely Grows in dry scrub and open forest in low-altitude sedimentary flats in dry woodlands. The alignment does not occur between the recorded altitude range of 300-400m.	Unlikely Area surveyed and species not identified. No suitable habitat present.	No	No
Tylophora linearis	*Tylophora linearis*	V	E	Unlikely Grows in dry scrub and open forest in low-altitude sedimentary flats in dry woodlands. The alignment does not occur between the recorded altitude range of 300-400m.	Unlikely Area surveyed and species not identified. No suitable habitat present.	No	No
Pilularia novae-hollandiae	Austral Pillwort	E	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Austrostipa metatoris	A spear-grass	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Austrostipa wakoolica	A spear-grass	E	E	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Brachyscome muelleroides	Claypan Daisy	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Amphibromus fluitans	Floating Swamp Wallaby-grass	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Leptorhynchos orientalis	Lanky Buttons	E	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Brachyscome papillosa	Mossgiel Daisy	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Androcalva procumbens	null	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Swainsona sericea	Silky Swainson-pea	V	-	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Swainsona murrayana	Slender Darling Pea	V	V	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Swainsona recta	Small Purple-pea	E	E	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Cullen parvum	Small Scurf-pea	E	-	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Eleocharis obicis	Spike-Rush	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Lepidium aschersonii	Spiny Peppercress	V	V	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Lepidium monoplocoides	Winged Peppercress	E	E	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Senecio garlandii	Woolly Ragwort	V	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Caladenia concolor	Crimson Spider Orchid	E	V	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Diuris sp. (Oaklands, D.L. Jones 5380)	Oaklands Diuris	E	-	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Diuris tricolor	Pine Donkey Orchid	V	-	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Caladenia arenaria	Sand-hill Spider Orchid	E	E	Unlikely- Not observed during a field assessment and no suitable habitat is present	Unlikely. No suitable habitat present.	No	No
Acacia ausfeldii	Ausfeld's Wattle	V	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Pomaderris cocoparrana	Cocoparra Pomaderris	E	E	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Kippistia suaedifolia	Fleshy Minuria	E	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Grevillea ilicifolia subsp. ilicifolia	Holly-leaf Grevillea	CE	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No
Philotheca angustifolia subsp. angustifolia	Philotheca angustifolia	Extinct	-	Unlikely- Not observed during a field assessment and species is known to be extinct	Unlikely. Species is extinct.	No	No
Wilsonia rotundifolia	Round-leafed Wilsonia	E	-	Unlikely- Not observed during a field assessment	Unlikely. No suitable habitat present.	No	No

Scientific Name	Common Name	NSW Status	EPBC Status	Likelihood of occurrence in development footprint	Likelihood of impact	Test of significance required	Significant impact from proposal
Threatened Ecological Community							
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia		-	EEC	Potential, Associated PCT present and upper and ground stratum composition consistent with the description for this TEC.	Potential	Yes	No
Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion		EEC	-	Potential, Associated PCT present.	Potential	Yes	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland		-	CEEC	Unlikely, Does not meet the condition requirements of the determination where ground layer is dominated by native species containing at least 12 native, non-grass understory species.	Unlikely	No	No
White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions		CEEC	-	Potential, Associated PCT present.	Potential	Yes	No

V = Vulnerable, E = Endangered, CE = Critically Endangered, M = Migratory

Appendix D: Tests and Assessments of significance

EPBC Act Assessments of Significance

MNES – Critically Endangered and Endangered communities:

- Endangered Ecological Community - *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*

Significant impact criteria: An action is likely to have a significant impact on a threatened community if there is a real chance or possibility that it will:

Statement	Response
• reduce the extent of an ecological community	The proposal is unlikely to reduce the extent of this community long-term. While a small number of trees will be removed to make way for the access road and overhead powerlines, groundcover and low growing vegetation beneath the powerlines will be allowed to re-establish.
• fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	The proposal will not fragment or increase fragmentation of this community long-term. The groundcover and low growing vegetation will be allowed to re-establish where it currently occurs.
• adversely affect habitat critical to the survival of an ecological community	The proposal will not reduce the habitat critical to the survival of these communities long-term. The study area is already disturbed and vegetation The area of clearance is small. While a small number of trees will be removed to make way for the access road and overhead powerlines, groundcover and low growing vegetation beneath the powerlines will be allowed to re-establish.
• modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposal is a low impact facility. No substantial alteration to abiotic factors, groundwater or surface drainage patterns is likely to occur.
• cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The proposal will not change the composition of these communities long-term. While a small number of trees will be removed to make way for the access road and overhead powerlines, groundcover and low growing vegetation beneath the powerlines will be allowed to re-establish.
• cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or – causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	The proposal is unlikely to cause a substantial reduction in the quality or integrity of these communities. The mitigation measures discussed in Section 6 will reduce the likelihood of these factors increasing from current levels of risk.
• interfere with the recovery of an ecological community.	The proposal will not interfere with the recovery of these communities. Where disturbance occurs, the vegetation will be allowed to regenerate. The proposal will not change the capacity of these communities to increase its area of occupancy.

Summary statement: The proposal will not result in a significant impact to this TEC. The development will largely occur in cleared highly disturbed agricultural land. Impacts will largely be temporary in nature, and groundcover and low growing vegetation will re-establish where it currently occurs.

What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

• key source populations either for breeding or dispersal
• populations that are necessary for maintaining genetic diversity, and/or
• populations that are near the limit of the species range.

What is an invasive species?

An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

What is habitat critical to the survival of a species or ecological community?
'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:
• for activities such as foraging, breeding, roosting, or dispersal
• for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
• to maintain genetic diversity and long-term evolutionary development, or
• for the reintroduction of populations or recovery of the species or ecological community.
Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

MNES – Endangered mammal species considered:

- *Phascolarctos cinereus* - **Koala**

Significant impact criteria

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

Statement	Response
• lead to a long-term decrease in the size of a population	The proposal will not affect a significant area of habitat and will not result in a long-term decrease in the size of a population of this species as no population of koala was detected, nor is known to occur in the development footprint. The proposal occurs on previously cleared and disturbed land and will only temporarily impact a small amount of potential foraging habitat for this species. A long-term decrease in the size of a population is unlikely.
• reduce the area of occupancy of the species	A small amount of suitable habitat will be impacted (3ha) within a highly fragmented and already disturbed landscape. Vegetation within the development footprint is unlikely to provide important habitat for this species.
• fragment an existing population into two or more populations	The proposal is unlikely to fragment an existing population into two or more populations. No populations of koala were observed during field surveys and more favourable habitat for this species is available outside the development footprint.
• adversely affect habitat critical to the survival of a species	Critical habitat for this species is not impacted; the development footprint is highly disturbed, and this species is not known to occur nor was it detected in the development footprint.
• disrupt the breeding cycle of a population	The proposal will not disrupt the breeding cycle of this species, as no population of this species was found to occur in the development footprint.
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline. The proposal occurs on previously cleared and disturbed land, vegetation disturbance is minimal and temporary and there is more suitable habitat available in the surrounding areas.
• result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The proposal will not result in invasive species that are harmful to threatened species becoming established in the threatened species' habitat, any more than is already occurring. The development footprint is already disturbed, and further vegetation disturbance is minimal.
• introduce disease that may cause the species to decline, or	The proposal will not result in disease that is harmful to threatened species becoming established in the threatened species' habitat. The development footprint is already highly altered and disturbed.
• interfere substantially with the recovery of the species.	The proposal will not interfere substantially with the recovery of this species. Koalas were not observed in the development footprint with more suitable habitat available elsewhere.

Summary statement:
The proposal will not result in a significant impact to Koala. No population of this species is known to occur in the study area. Disturbance will be temporary with more favourable habitat available outside the development footprint.

What is an important population of a species?
An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:
• key source populations either for breeding or dispersal
• populations that are necessary for maintaining genetic diversity, and/or
• populations that are near the limit of the species range.

What is an invasive species?

An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources, or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.
What is habitat critical to the survival of a species or ecological community? 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary: • for activities such as foraging, breeding, roosting, or dispersal • for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators) • to maintain genetic diversity and long term evolutionary development, or • for the reintroduction of populations or recovery of the species or ecological community. Such habitat may be but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

MNES - Vulnerable fauna species:

- ***Climacteris picumnus victoriae*** **- Brown Treecreeper (eastern subspecies)**
- ***Polytelis swainsonii*** **- Superb Parrot**

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Statement	Response
• lead to a long-term decrease in the size of an important population of a species	The proposal is unlikely to lead to a long-term decrease in the size of an important population of this species. No individuals were recorded within the impact footprint. The proposal will only be affecting a small area of potential habitat for these species. Suitable habitat is well represented and available in the surrounding areas.
• reduce the area of occupancy of an important population	The proposal will not affect the area of occupancy of this species. No individuals were identified to occur within the impact area at the time of the survey. Suitable habitat is well represented and available in the surrounding areas.
• fragment an existing important population into two or more populations	The proposal will not fragment an existing important population of this species. No important populations were recorded within the impact footprint. The proposal largely avoids suitable habitat for this species and habitat is well represented outside the impact footprint.
• adversely affect habitat critical to the survival of a species	Adverse impacts on critical habitat are unlikely as suitable foraging habitat will largely be avoided. . Suitable habitat is well represented and available in the surrounding areas.
• disrupt the breeding cycle of an important population	The proposal will not disrupt the breeding cycle as breeding habitat is well represented and available outside the impact footprint.
• modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal will not modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that these species are likely to decline. Suitable foraging habitat will largely be avoided.
• result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal will not result in invasive species that are harmful to threatened species becoming established in the threatened species' habitat. The development footprint is already disturbed in places and mitigation measures discussed in Section 6 will reduce the likelihood of these factors increasing from current levels of risk.
• introduce disease that may cause the species to decline, or	The proposal will not result in the introduction of disease that may cause the species to decline. The development footprint is already disturbed in places and mitigation measures discussed in Section 6 will reduce the likelihood of these factors increasing from current levels of risk.
• interfere substantially with the recovery of the species.	The proposal will not interfere substantially with the recovery of these species. Any impacts will be temporary, suitable foraging habitat will be largely avoided and measures will be taken to minimise impact from key threatening processes.

Summary statement:

The proposal will not result in a significant impact to these species or an important population. A small number (5) habitat trees will be cleared with better quality breeding and foraging habitat represented outside the development footprint.

What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

What is an invasive species?

An 'invasive species' is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long-term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

BC Act Tests of Significance

BC Act Threatened Species Test of Significance for mammal species: • ***Phascolarctos cinereus* Koala**	
Significant impact criteria - An action is likely to have a significant impact on a protected matter if there is a real chance or possibility that it will have:	
Statement	**Response**
Adverse effects on the life cycle of a species (a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The proposal will not affect a significant area of habitat nor disrupt the lifecycle of this species. No population was observed within the development footprint during survey. The proposal occurs on previously cleared and disturbed land and will only temporarily impact a small amount of potential foraging habitat for this species. A long-term decrease in the size of a population is unlikely.
Adverse effects on ecological communities (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A
Adverse effects on habitats (c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality	The proposal will not modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that this species is likely to decline. The proposal occurs on previously cleared and disturbed land, vegetation disturbance is minimal and temporary and there is more suitable habitat available in the surrounding areas.
Adverse effects on areas of outstanding biodiversity value (d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.
Key threatening processes (e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	The proposal may exacerbate removal of native vegetation and invasion of native plant communities by exotic perennial grasses and have a negligible contribution to human made climate change.
Summary statement: The proposal will not result in a significant impact to Koala. No population of this species is known to occur in the study area. Disturbance will be temporary with more favourable habitat available outside the development footprint.	
In determining the nature and magnitude of an impact, matters were considered such as: • pre-construction, construction and occupation/maintenance phases • all on-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones • all direct and indirect impacts • the frequency and duration of each known or likely impact/action • the total impact which can be attributed to that action over the entire geographic area affected, and over time • the sensitivity of the receiving environment • the degree of confidence with which the impacts of the action are known and understood. All factors should be considered as well as any other information considered relevant to the test. Sources and currency of data and information are to be documented and referenced. Limitations, uncertainties and known gaps in information are also to be documented to inform the decision-maker	

BC Act Test of Significance for fauna (bat) species: • ***Falsistrellus tasmaniensis* - Eastern False Pipistrelle** • ***Vespadelus baverstocki* - Inland Forest Bat** • ***Saccolaimus flaviventris* - Yellow-bellied Sheathtail-bat**	
Significant impact criteria - An action is likely to have a significant impact on a protected matter if there is a real chance or possibility that it will have:	
Statement	**Response**
Adverse effects on the life cycle of a species (a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The proposal is temporary and unlikely to have an adverse effect on the lifecycle of these species. While a few trees (5) with hollows will be removed, habitat for these species is well represented outside the development footprint. Therefore the proposal is unlikely to place a viable local population of these species at risk of extinction.
Adverse effects on ecological communities (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A
Adverse effects on habitats (c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality	While a few trees (5) with hollows will be removed, habitat for these species is well represented outside the development footprint. Removal of these trees is unlikely to Impact the long-term survival of these species.
Adverse effects on areas of outstanding biodiversity value (d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.
Key threatening processes (e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	The proposal will impact a small area of native vegetation (3ha). Mitigation measures discussed in Section 6 will reduce the likelihood of this factor increasing from current levels of risk.
Summary statement: The proposal will not result in a significant impact to these species. Although some habitat trees (5) will be removed, better quality habitat is available outside the development footprint.	
In determining the nature and magnitude of an impact, matters were considered such as: • pre-construction, construction and occupation/maintenance phases • all on-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones • all direct and indirect impacts • the frequency and duration of each known or likely impact/action • the total impact which can be attributed to that action over the entire geographic area affected, and over time • the sensitivity of the receiving environment • the degree of confidence with which the impacts of the action are known and understood. All factors should be considered as well as any other information considered relevant to the test. Sources and currency of data and information are to be documented and referenced. Limitations, uncertainties and known gaps in information are also to be documented to inform the decision-maker	

BC Act Test of Significance for fauna (bird) species:

- ***Climacteris picumnus victoriae* - Brown Treecreeper (eastern subspecies)**
- ***Artamus cyanopterus cyanopterus* - Dusky Woodswallow**
- ***Hieraaetus morphnoides* - Little Eagle**
- ***Circus assimilis* - Spotted Harrier**
- ***Polytelis swainsonii* - Superb Parrot**
- ***Neophema pulchella* - Turquoise Parrot**

Significant impact criteria - An action is likely to have a significant impact on a protected matter if there is a real chance or possibility that it will have:

Statement	Response
Adverse effects on the life cycle of a species (a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	The proposal is temporary and unlikely to have an adverse effect on the lifecycle of these species. While a few trees (5) with hollows will be removed, habitat for these species is well represented outside the development footprint. Therefore, the proposal is unlikely to place a viable local population of these species at risk of extinction.
Adverse effects on ecological communities (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	N/A
Adverse effects on habitats (c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality	While a few trees (5) with hollows will be removed, habitat for these species is well represented outside the development footprint. Removal of these trees is unlikely to Impact the long-term survival of these species.
Adverse effects on areas of outstanding biodiversity value (d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.
Key threatening processes (e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	The proposal will impact a small area of native vegetation (3ha). Mitigation measures discussed in Section 6 will reduce the likelihood of this factor increasing from current levels of risk.

Summary statement:
The proposal will not result in a significant impact to these species or an important population. A small number (5) habitat trees will be cleared with better quality breeding and foraging habitat represented outside the development footprint.

In determining the nature and magnitude of an impact, matters were considered such as:

- pre-construction, construction and occupation/maintenance phases
- all on-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones
- all direct and indirect impacts
- the frequency and duration of each known or likely impact/action
- the total impact which can be attributed to that action over the entire geographic area affected, and over time
- the sensitivity of the receiving environment
- the degree of confidence with which the impacts of the action are known and understood.

All factors should be considered as well as any other information considered relevant to the test. Sources and currency of data and information are to be documented and referenced. Limitations, uncertainties and known gaps in information are also to be documented to inform the decision-maker

BC Act Test of Significance for threatened ecological communities:

- Endangered Ecological Community - *Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregion*
- Critically Endangered Ecological Community - *White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland in the NSW North Coast, New England Tableland, Nandewar, Brigalow Belt South, Sydney Basin, South Eastern Highlands, NSW South Western Slopes, South East Corner and Riverina Bioregions*

Significant impact criteria - An action is likely to have a significant impact on a protected matter if there is a real chance or possibility that it will have:

Statement	Response
Adverse effects on the life cycle of a species (a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	N/A
Adverse effects on ecological communities (b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity: (i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or (ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	The proposal is unlikely to reduce the extent of these communities long-term. While a small number of trees and groundcover will be removed to make way for the access road and overhead powerlines, the vegetation beneath the powerlines will be allowed to re-establish. The community is represented outside the development footprint, as such the proposal is unlikely to place these communities at risk of extinction.
Adverse effects on habitats (c) in relation to the habitat of a threatened species or ecological community: (i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality	A small area of native vegetation (3ha) with limited habitat value will be impacted under the proposal. While a small number of trees and ground cover will be removed to make way for the access road and overhead powerlines, the vegetation beneath the powerlines will be allowed to re-establish where possible.
Adverse effects on areas of outstanding biodiversity value (d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly)	The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.
Key threatening processes (e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	The proposal will impact a small area of native vegetation (3ha). Mitigation measures discussed in Section 6 will reduce the likelihood of this factor increasing from current levels of risk.

Summary statement: The proposal will not result in a significant impact to these TECs. The study area is already disturbed in places with the development footprint largely occurring within cleared agricultural land. Any impacts will be temporary, and vegetation will re-establish where it currently occurs.

In determining the nature and magnitude of an impact, matters were considered such as:

- pre-construction, construction and occupation/maintenance phases
- all on-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones
- all direct and indirect impacts
- the frequency and duration of each known or likely impact/action
- the total impact which can be attributed to that action over the entire geographic area affected, and over time
- the sensitivity of the receiving environment
- the degree of confidence with which the impacts of the action are known and understood.

All factors should be considered as well as any other information considered relevant to the test. Sources and currency of data and information are to be documented and referenced. Limitations, uncertainties and known gaps in information are also to be documented to inform the decision-maker

FM Act Tests of Significance

Threatened species, populations or ecological communities, or their habitats • Endangered Ecological Community - *Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River*	
Significant impact criteria: An action is likely to have a significant impact on a protected matter if there is a real chance or possibility that it will have:	
Statement	**Response**
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	N/A
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: I. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or II. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction	Overhead powerlines will cross Ridgey Creek and the proposed access road will intersect an unnamed waterway. These are identified as Key Fish Habitat representative of this TEC. The importance of the community in the development footprint is questionable due to the existing high levels of disturbance and fragmentation from past and existing disturbances. Both waterways are highly degraded (weedy with little to no riparian vegetation). The proposal is therefore unlikely to have an adverse effect on the extent or composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
d) in relation to the habitat of a threatened species, population or ecological community: I. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and II. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and III. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality	The community in the development footprint representing this EEC occurs in a fragmentated landscape, separated by roads and cleared agricultural land. Both waterways are highly degraded (weedy with little to no riparian vegetation). The importance of the community in the development footprint is questionable due to the existing high levels of disturbance and fragmentation. Fragmentation and isolation will not be increased by the proposal.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	The proposal will not have an adverse effect on any declared area of outstanding biodiversity value.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There are no threat abatement plans or recovery plans for this community which the proposal is likely to be inconsistent with.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process	The proposal will contribute to the removal of native vegetation and have an insignificant contribution to human made climate change.
Summary statement: The proposal will not result in a significant impact to the Aquatic ecological community in the natural drainage system of the lowland catchment of the Lachlan River, given the poor quality and disturbed state of associated waterways, and small scale of the proposal.	
In determining the nature and magnitude of an impact, it is important to consider matters such as: • pre-construction, construction and occupation/maintenance phases • all on-site and off-site impacts, including location, installation, operation and maintenance of auxiliary infrastructure and fire management zones • all direct and indirect impacts • the frequency and duration of each known or likely impact/action • the total impact which can be attributed to that action over the entire geographic area affected, and over time • the sensitivity of the receiving environment • the degree of confidence with which the impacts of the action are known and understood.	

All factors should be considered as well as any other information considered relevant to the test. Sources and currency of data and information are to be documented and referenced. Limitations, uncertainties and known gaps in information are also to be documented to inform the decision-maker

Appendix B – AHIMS Searches and Site Cards

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : Quorn Park

Client Service ID : 772037

Essential Energy Land & Routes Port Macquarie

Date: 12 April 2023

8 Buller St
Port Macquarie New South Wales 2444

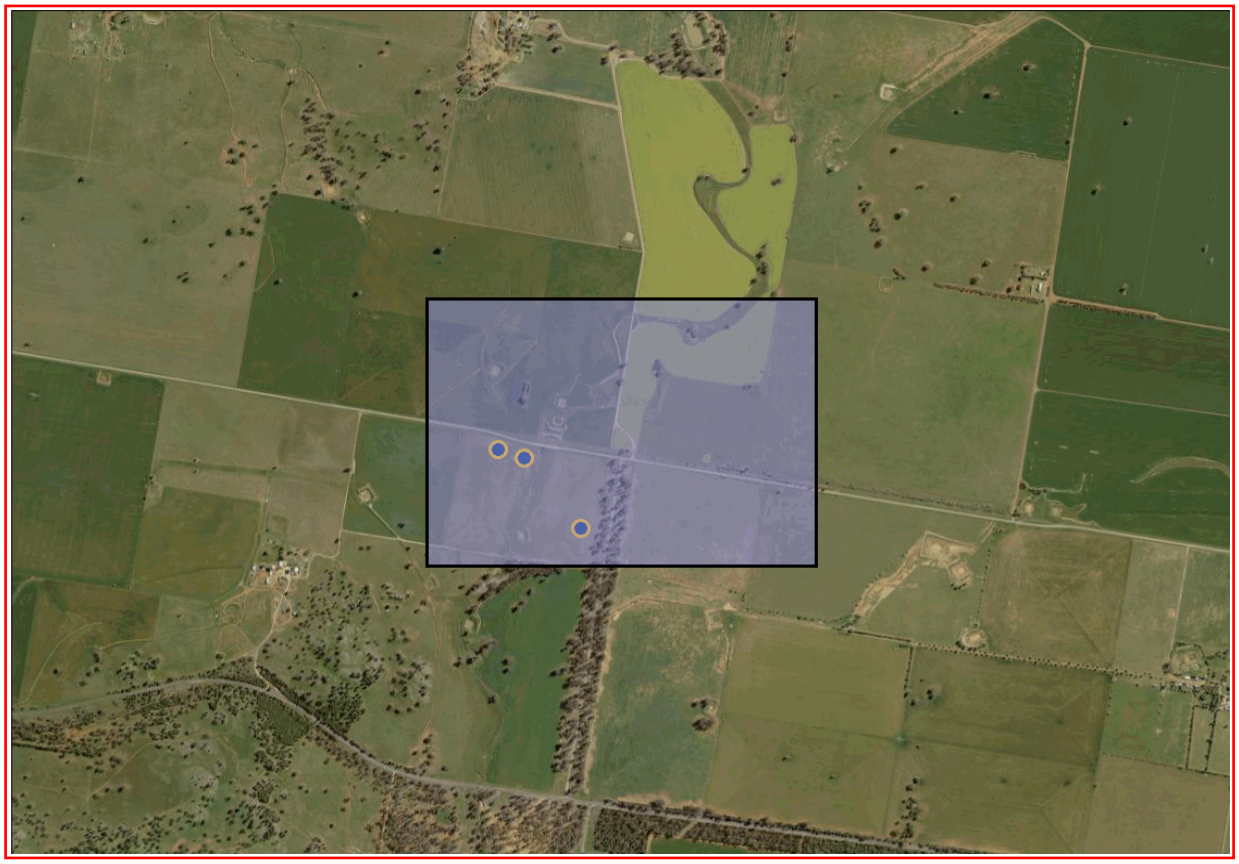
Attention: Nathan Hegerty

Email: nathan.hegerty@essentialenergy.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.0921, 148.0676 - Lat, Long To : -33.0831, 148.083, conducted by Nathan Hegerty on 12 April 2023.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

3	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : Quorn Park

Client Service ID : 772039

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
43-3-0144	Ridgey Creek-IF1	GDA	55	599898	6338425	Open site	Valid	Artefact : -		103975
	Contact	**Recorders**	OzArk Environmental and Heritage Management - Dubbo,Miss.Stephanie Rusden					**Permits**		
43-3-0153	Ridgey Creek-OS1	GDA	55	599997	6338393	Open site	Valid	Artefact : -		103975
	Contact	**Recorders**	OzArk Environmental and Heritage Management - Dubbo,Miss.Stephanie Rusden					**Permits**		
43-3-0145	Warrawee-IF1	GDA	55	600200	6338127	Open site	Valid	Artefact : -		103975
	Contact	**Recorders**	OzArk Environmental and Heritage Management - Dubbo,Miss.Stephanie Rusden					**Permits**		

**** Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 12/04/2023 for Nathan Hegerty for the following area at Lat, Long From : -33.0921, 148.0676 - Lat, Long To : -33.0831, 148.083. Number of Aboriginal sites and Aboriginal objects found is 3

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 43-3-0144 **Date recorded:** 19-10-2018

Site Location Information

Site name: Ridgey Creek-IF1

Easting: 599898 **Northing:** 6338425 **Coordinates must be in GDA (MGA)**

Horizontal Accuracy (m): 4

Zone: 55 **Location method:** Non-Differential GPS

Recorder Information

(The person responsible for the completion and submission of this form)

Title	Surname	First name
Ms.	Rusden	Stephanie

Organisation: OzArk EHM

Address: 145 Wingewarra Street Dubbo

Phone: 0268820118 **E-mail:** stephanie@ozarkehm.com.au

Site Context Information

Land Form Pattern: Plain **Land Use:** Pastoral/Grazing

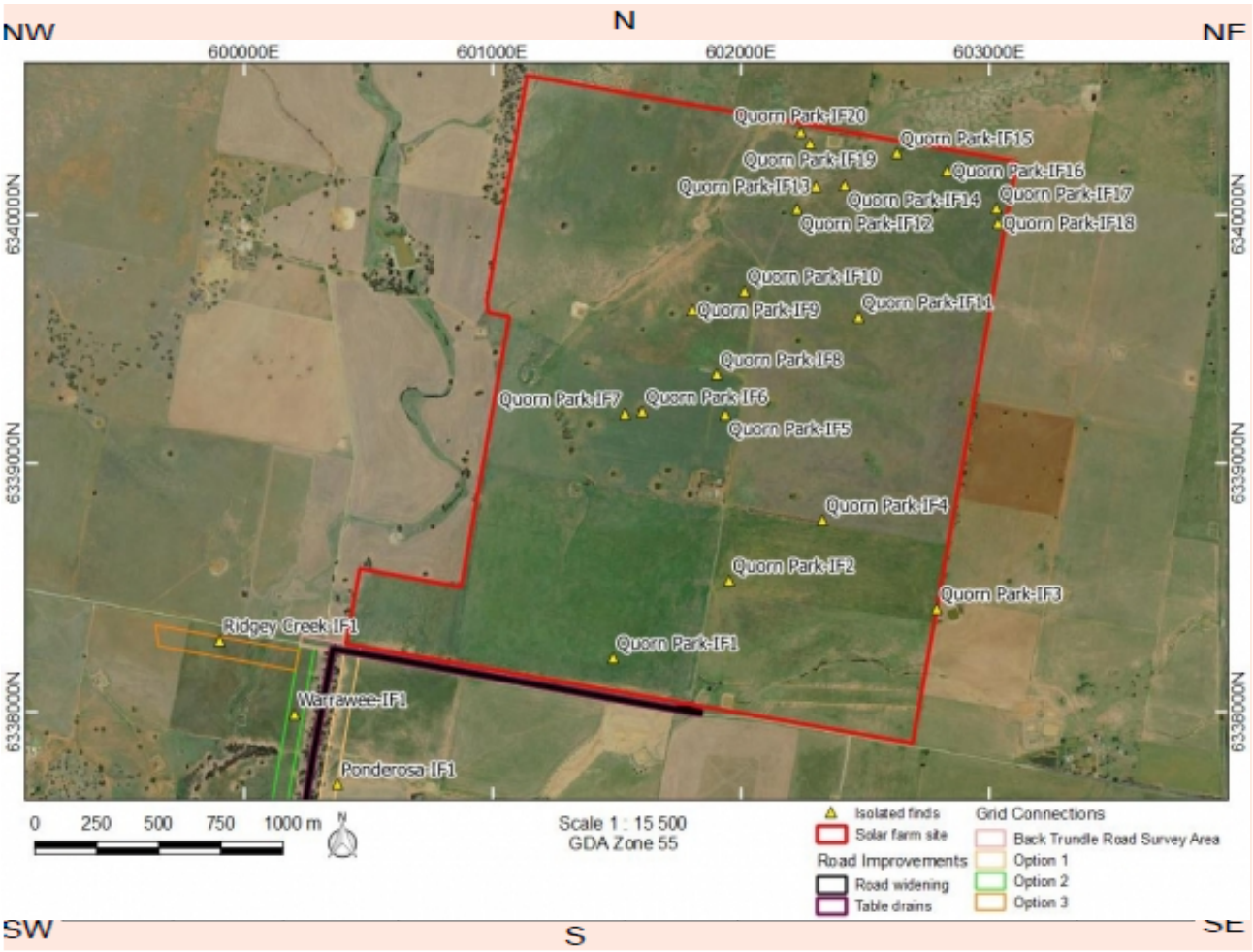
Land Form Unit: Flat **Vegetation:** Cleared

Distance to Water (m): 140 **Primary Report:** Quorn Park Solar Farm, Parkes LGA

How to get to the site: Within Lot 1 DP1090411; approximately 60m south of Back Trundle Road; 145m west of Ridgey Creek; and 450m of McGrath Lane. Located within a field used for agricultural cultivation.

Other site information: GSE high (70%), GSV 80%. Identified disturbances include continued ploughing and cultivation. Potential for subsurface archaeological deposits assessed as negligible.

Site location map



Site contents information

open/closed site: Open

Site condition: Disturbed

Features:

		Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Scarred Trees: Regrowth (cm)	Scarred Trees: Scar shape	Scarred Trees: Tree Species
1.	Artefact	1	1	1				

Description:

A single basalt flake located within a gently undulating plain landform, in a heavily ploughed field. Vegetation consisted of sparse grass cover and crops due to historical land clearing and cultivation. Artefact is complete, less than 50% cortex.

Features:

		Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Scarred Trees: Regrowth (cm)	Scarred Trees: Scar shape	Scarred Trees: Tree Species
2.								

Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
3.							

Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
4.							

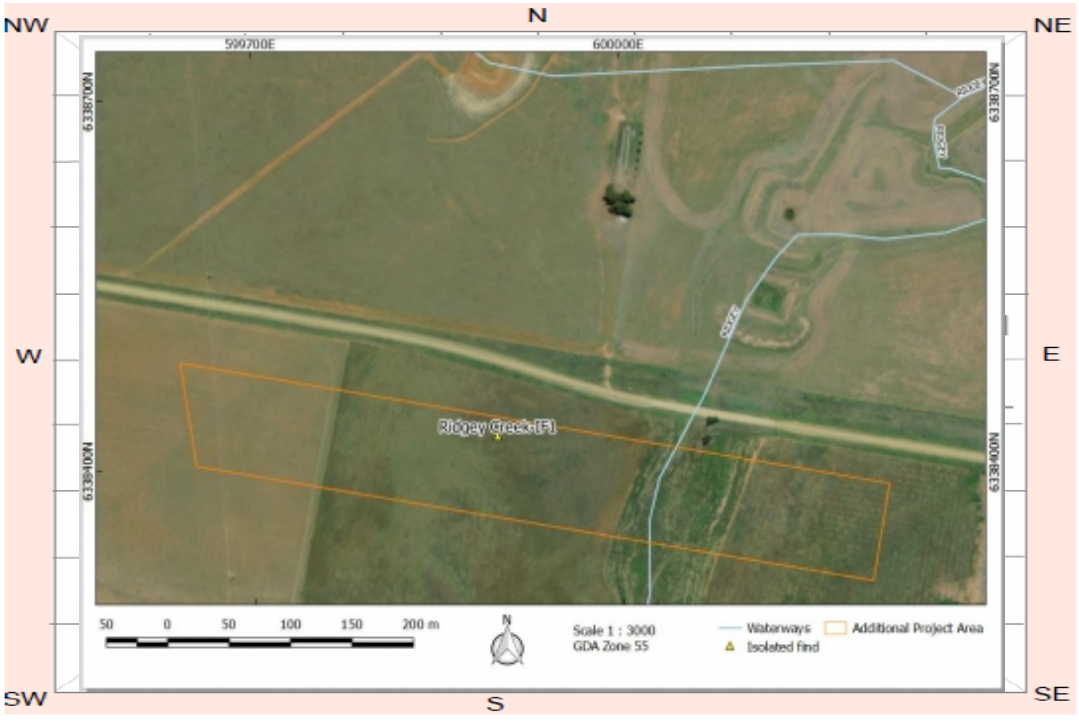
Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
5.							

Description:

Other Site Info: GSE high (70%), GSV 80%. Identified disturbances include continued ploughing and cultivation. Potential for subsurface archaeological deposits assessed as negligible.

Site plan



Site photographs

Description: Overview of Ridgey Creek-IF1 facing west towards Ridgey Creek.

Description: View of Ridgey Creek-IF1: a basalt flake.

Description:

Description:

Site restrictions

Do you want to Restrict this site?:

Restriction type: Gender General Location

Why is this site restricted?:

Further information contact

Title **Surname** **First name**

Organisation:

Address:

Phone: **E-mail:**

Aboriginal Site Recording Form

AHIMS Registrar
PO Box 1967, Hurstville 2220 NSW

AHIMS site ID: 43-3-0153 **Date recorded:** 19-10-2018

Site Location Information

Site name: Ridgey Creek-OS1

Easting: 599997 **Northing:** 6338393 **Coordinates must be in GDA (MGA)**

Horizontal Accuracy (m): 4

Zone: 55 **Location method:** Non-Differential GPS

Recorder Information

(The person responsible for the completion and submission of this form)

Title	Surname	First name
Ms.	Rusden	Stephanie

Organisation: OzArk EHM

Address: 145 Wingewarra Street Dubbo

Phone: 0268820118 **E-mail:** stephanie@ozarkehm.com.au

Site Context Information

Land Form Pattern: Plain **Land Use:** Pastoral/Grazing

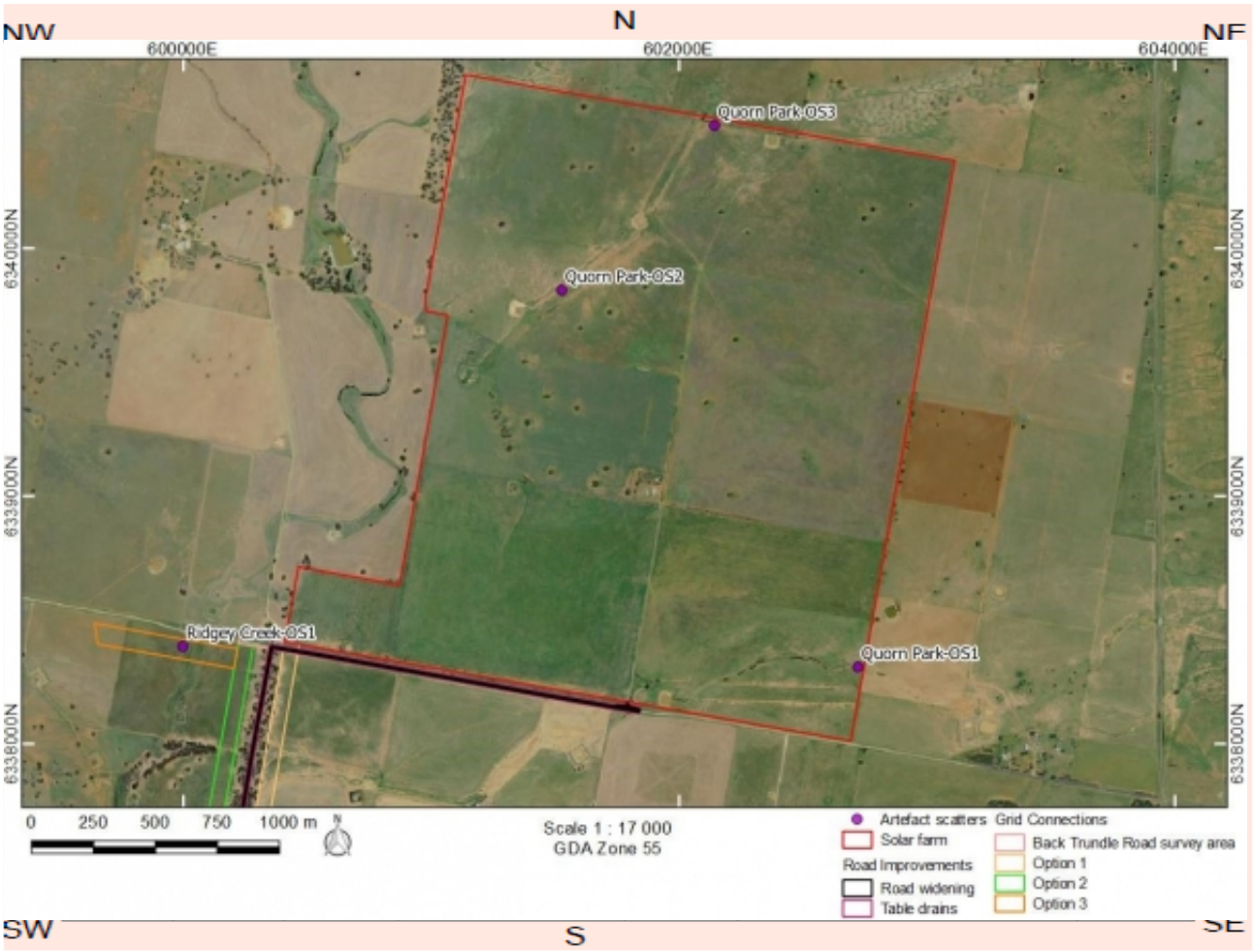
Land Form Unit: Flat **Vegetation:** Cleared

Distance to Water (m): 20 **Primary Report:** Quorn Park Solar Farm, Parkes LGA

How to get to the site: Approximately 335m west of McGrath Lane and 28m south of Back Trundle Road, Parkes. The site is located approximately 20m west of Ridgey Creek.

Other site information: GSE extremely high (100%), GSV 95%. Identified disturbances include continued ploughing and cultivation. Potential for subsurface archaeological deposits assessed as negligible as the artefacts have been displaced by ploughing.

Site location map



Site contents information

open/closed site: Open

Site condition: Disturbed

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Scarred Trees: Regrowth (cm)	Scarred Trees: Scar shape	Scarred Trees: Tree Species
1. Artefact	5	51	16				

Description:

Low-density artefact scatter comprising four flakes and a core with raw materials including basalt, silcrete and quartzite, located within a gently undulating plain within the ploughed field. Vegetation consisted of sparse grass cover due to historical land clearing for farming.

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Scarred Trees: Regrowth (cm)	Scarred Trees: Scar shape	Scarred Trees: Tree Species
2.							

Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
3.							

Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
4.							

Description:

Features:	Number of features	Length of feature(s) extent (m)	Width of feature (s) extent (m)	Scarred Trees: Scar Depth (cm)	Regrowth (cm)	Scar shape	Tree Species
5.							

Description:

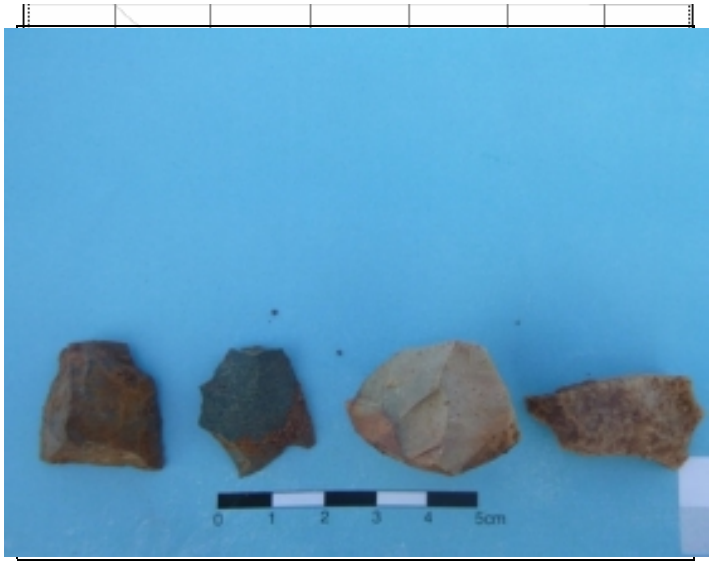
Other Site Info: GSE extremely high (100%), GSV 95%. Identified disturbances include continued ploughing and cultivation. Potential for subsurface archaeological deposits assessed as negligible as the artefacts have been displaced by ploughing.

Site plan

Site photographs

Description: Overview of Ridgey Creek-OS1 facing east towards Ridgey Creek.

Description: Overview of Ridgey Creek-OS1 facing south.



Description: View of Ridgey Creek-OS1 artefacts: (from left) basalt flakes; silcrete core; and quartzite flake.

Description: View of Ridgey Creek-OS1 basalt flake.

Site restrictions

Do you want to Restrict this site?: ☐

Restriction type: Gender ☐ General ☐ Location ☐

Why is this site restricted?:

Further information contact

Title	Surname	First name

Organisation:

Address:

Phone: **E-mail:**

Appendix C – Addressing the Principles of Crown Land Management

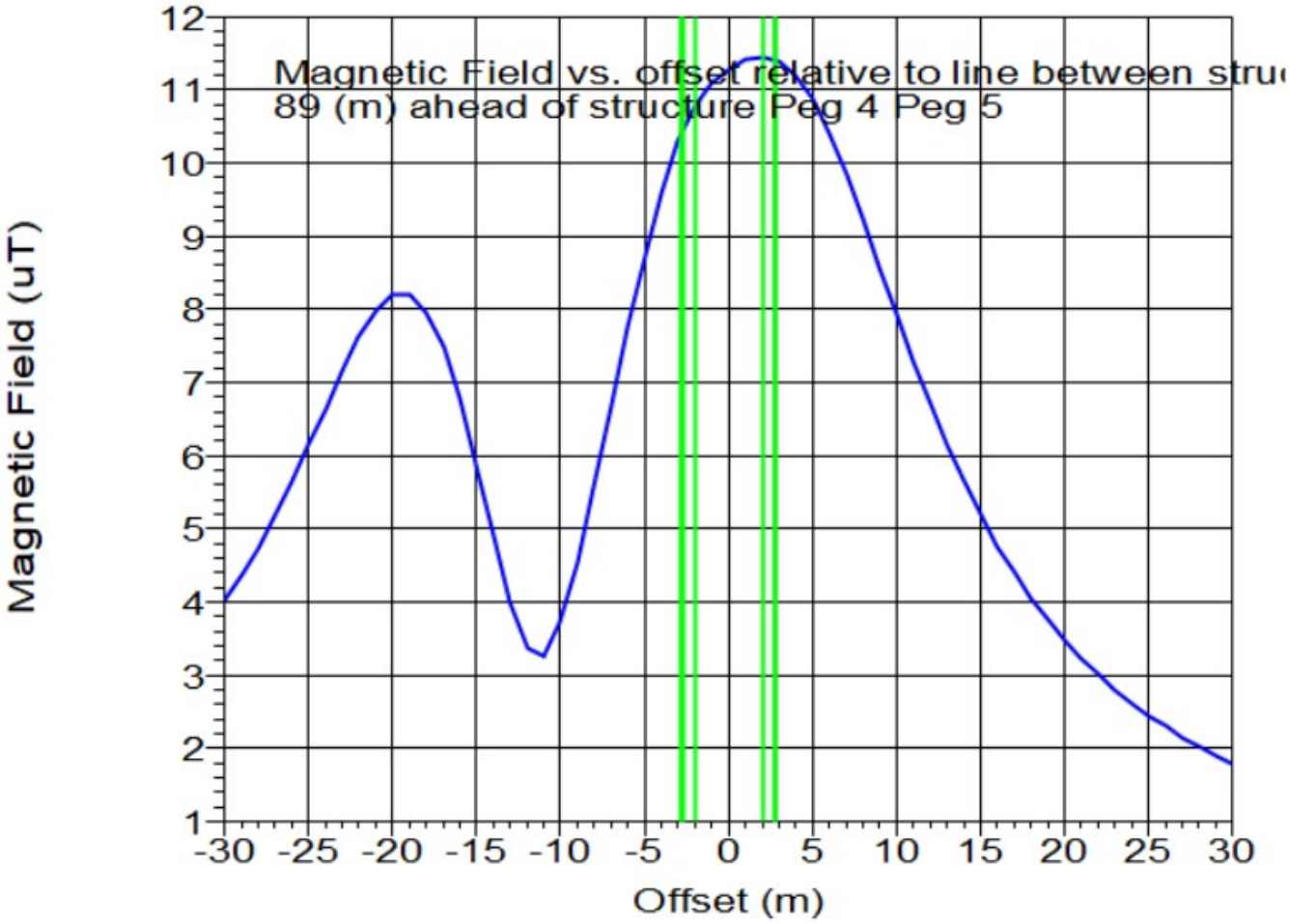
This Appendix documents the proposal's compliance with the six 'principles of Crown land management' as set out in section 1.4 of the Crown Land Management Act 2016.

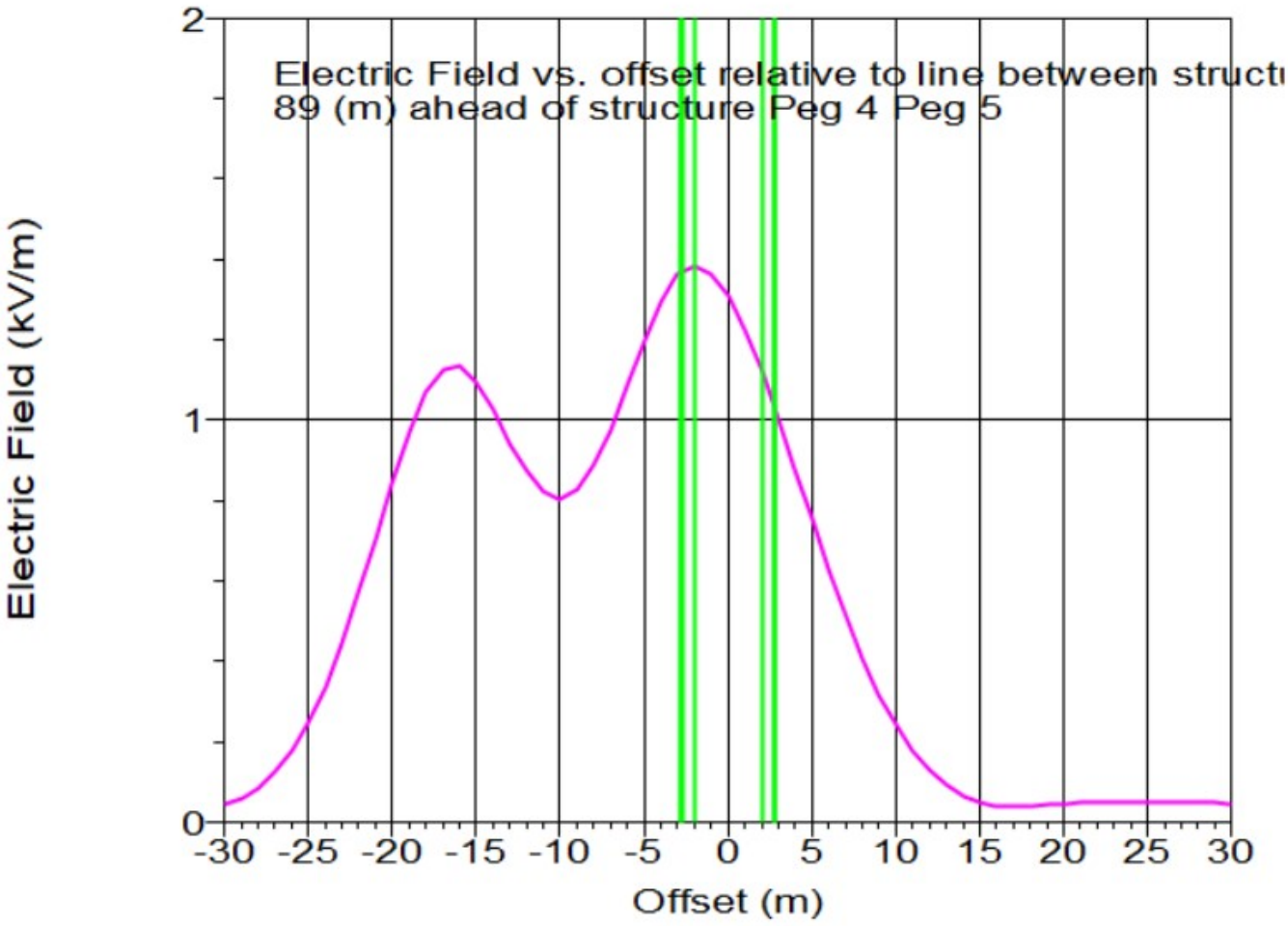
PRINCIPLES OF CROWN LAND MANAGEMENT	***COMPLIES?***	***COMMENTS***
a) that environmental protection principles be observed in relation to the management and administration of Crown land	*Yes*	*Essential Energy utilises the services of an Environmental Engineer and all environmental protection principles are observed and considered during the environmental impact assessment, management and administration of Crown land, as is reflected in the proposal's REF.*
b) that the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible	*Yes*	*The proposed powerline augmentation works have been designed to minimise impact on sensitive environmental features, with the SS site and proposed powerline augmentation works located predominately in highly disturbed and modified environments, comprising cleared grazing and cropping land, unsealed roads and adjoining road reserves. However, up to four mature Grey box (Eucalyptus macrocarpa) trees on the corner of McGrath Lane and Back Trundle Road, within the Currajong TSR (Crown Land) will require trimming or removal to accommodate a new section of 132kV powerline and realigned 66kV powerline. An ecological impact assessment (Appendix A of the REF) concluded the proposal is unlikely to have a significant impact to species, populations and communities listed under the EPBC Act, BC Act or FM Act. The impact of the proposal on other natural resources of Crown land will be minimal.*
c) that public use and enjoyment of appropriate Crown land be encouraged	*Yes*	*The powerline infrastructure itself is a benefit to the public as it will improve power supply and cater for future growth and development of the Parkes region. The design of the overhead powerlines has avoided encroachment into Crown Land and will not affect the use of Crown Land.*
d) that, where appropriate, multiple use of Crown land be encouraged	*Yes*	*The overhead powerlines have been designed to not encroach or interfere with the use of Crown Land. The TSR may continue to be used as a travelling stock route and for other purposes.*
e) that, where appropriate, Crown land should be used and managed in such a way that both the land and its resources are sustained in perpetuity	*Yes*	*The principles of Ecologically Sustainable Development (ESD) are incorporated into Essential Energy's policies and designs. The proposed works are predominately located on already highly disturbed and modified land. Where impact to trees on Crown Land was unavoidable, Essential Energy, through design of the powerline, has minimised such impact. The impact of the proposal on the land and its resources will be minimal.*

f) that Crown land be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles	*Yes*	*The design of the overhead powerlines have avoided encroachment into Crown Land and will not affect the use of Crown Land. The proposal will contribute to the safe and reliable operation of Essential Energy's electricity distribution network, and support planned development and economic growth in the Parkes region, which is an outcome that is in the best interests of the State.*

Appendix D – EMF Modelling

Mid-span cross section results between structures Peg 4 Peg 5 and Peg 6





3D EMF Point Results Span from Peg 4 Peg 5 to Peg 6:

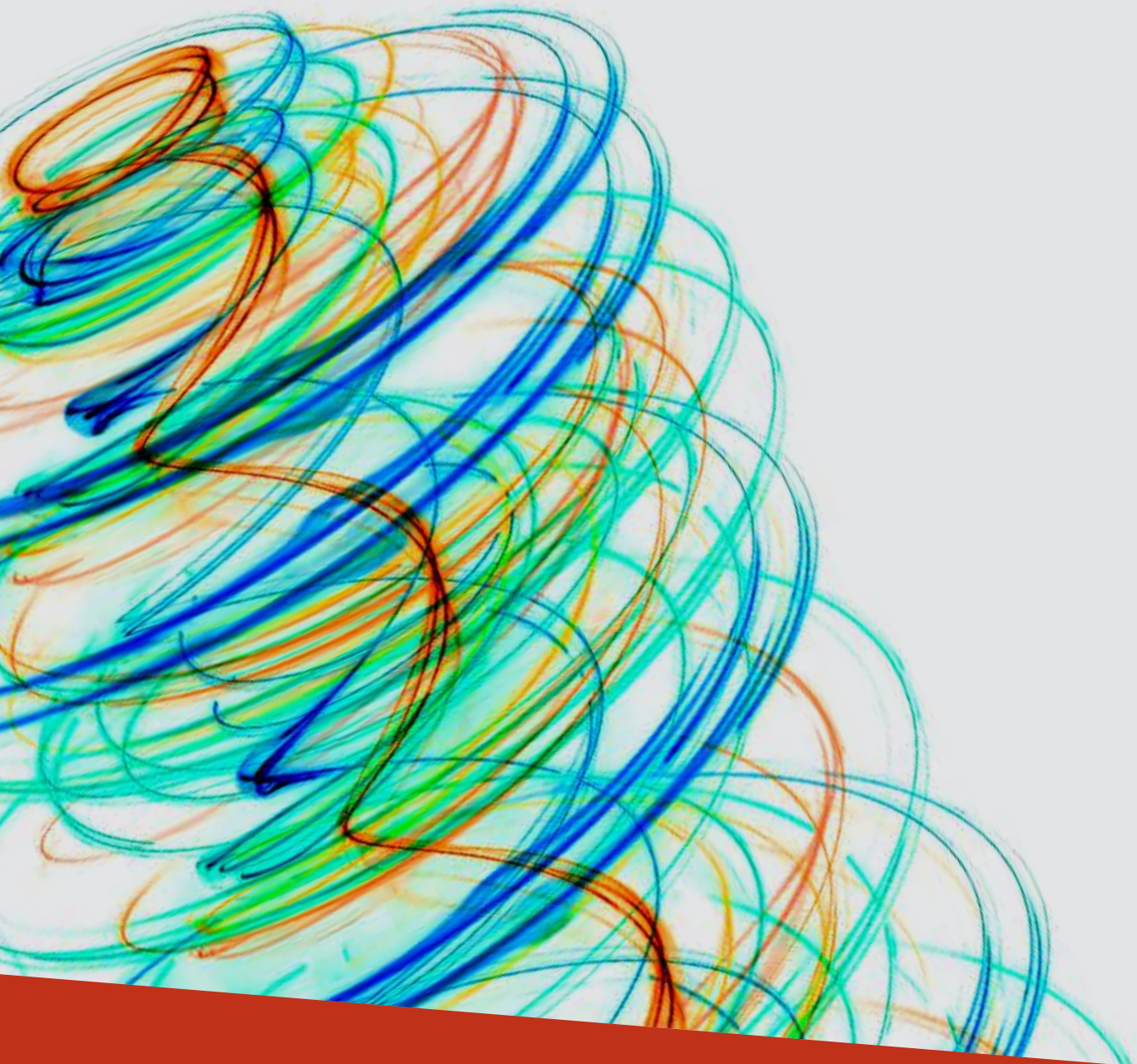
Measurement			B					H	EF					Space Potential			
X (m)	Y (m)	Z (m)	Real (uT)	Imaginary (uT)	Angle (deg)	Magnitude (uT)	Polarization Axial Ratio %	Magnitude (A/m)	Real (kV/m)	Imaginary (kV/m)	Angle (deg)	Magnitude (kV/m)	Polarization Axial Ratio %	Real (kV)	Imaginary (kV)	Angle (deg)	Magnitude (kV)
600209.2	6338423.9	274.6	3.409	2.131	32.0	4.020	4.5	3.199	0.025	0.037	56.3	0.045	47.9	0.031	-0.029	-44.0	0.042
600209.2	6338422.9	274.6	3.694	2.328	32.2	4.366	4.5	3.474	0.021	0.054	68.4	0.058	37.5	0.014	-0.047	-73.4	0.049
600209.2	6338421.9	274.7	3.999	2.544	32.5	4.740	4.6	3.772	0.037	0.076	63.9	0.084	22.1	-0.010	-0.069	81.6	0.070
600209.2	6338420.9	274.8	4.358	2.802	32.7	5.181	4.6	4.123	0.068	0.104	56.7	0.125	13.9	-0.047	-0.106	66.0	0.116
600209.2	6338419.9	274.9	4.752	3.093	33.1	5.670	4.6	4.512	0.111	0.141	51.9	0.180	9.1	-0.102	-0.159	57.3	0.188
600209.2	6338418.9	274.9	5.134	3.385	33.4	6.150	4.4	4.894	0.164	0.189	49.1	0.250	5.6	-0.165	-0.215	52.5	0.270
600209.2	6338417.9	274.9	5.524	3.694	33.8	6.645	4.1	5.288	0.229	0.248	47.3	0.338	3.4	-0.241	-0.284	49.6	0.373
600209.2	6338416.9	274.9	5.915	4.015	34.2	7.149	3.7	5.689	0.307	0.322	46.3	0.445	2.0	-0.335	-0.372	47.9	0.501
600209.2	6338415.9	274.9	6.274	4.323	34.6	7.619	3.1	6.063	0.397	0.408	45.8	0.569	1.0	-0.442	-0.474	47.0	0.648
600209.2	6338414.9	274.9	6.544	4.570	34.9	7.981	2.2	6.351	0.493	0.505	45.7	0.706	0.3	-0.544	-0.574	46.6	0.791
600209.2	6338413.9	274.8	6.691	4.724	35.2	8.190	1.1	6.518	0.590	0.605	45.7	0.845	0.0	-0.634	-0.666	46.4	0.919
600209.3	6338412.9	274.8	6.683	4.749	35.4	8.198	0.3	6.524	0.677	0.697	45.8	0.972	0.2	-0.704	-0.739	46.4	1.021
600209.3	6338411.9	274.7	6.493	4.616	35.4	7.966	2.0	6.339	0.745	0.770	45.9	1.071	0.3	-0.747	-0.784	46.4	1.083
600209.3	6338410.9	274.7	6.121	4.317	35.2	7.490	3.9	5.961	0.784	0.810	45.9	1.128	0.4	-0.766	-0.803	46.4	1.110
600209.3	6338409.9	274.6	5.569	3.849	34.7	6.770	6.1	5.388	0.790	0.813	45.8	1.134	0.5	-0.750	-0.783	46.2	1.084
600209.3	6338408.9	274.6	4.890	3.248	33.6	5.871	8.4	4.672	0.767	0.782	45.6	1.095	0.6	-0.707	-0.732	46.0	1.018
600209.3	6338407.9	274.5	4.162	2.566	31.7	4.890	10.3	3.891	0.722	0.727	45.2	1.025	0.7	-0.627	-0.640	45.6	0.896
600209.3	6338406.9	274.5	3.515	1.906	28.5	3.999	10.9	3.182	0.670	0.666	44.8	0.944	0.7	-0.581	-0.585	45.2	0.825
600209.3	6338405.9	274.5	3.082	1.387	24.2	3.380	6.7	2.689	0.622	0.610	44.4	0.871	0.7	-0.537	-0.533	44.8	0.757
600209.3	6338404.9	274.4	3.015	1.270	22.8	3.272	2.7	2.604	0.590	0.571	44.1	0.821	0.6	-0.508	-0.498	44.4	0.711
600209.3	6338403.9	274.4	3.340	1.636	26.1	3.719	9.9	2.960	0.580	0.558	43.9	0.805	0.4	-0.508	-0.493	44.1	0.708
600209.3	6338402.9	274.4	3.955	2.254	29.7	4.552	11.7	3.622	0.595	0.572	43.9	0.826	0.2	-0.548	-0.529	44.0	0.762
600209.3	6338401.9	274.4	4.740	2.963	32.0	5.590	10.7	4.448	0.637	0.615	44.0	0.885	0.2	-0.596	-0.577	44.1	0.830
600209.3	6338400.9	274.4	5.583	3.678	33.4	6.686	9.0	5.320	0.698	0.681	44.3	0.975	0.3	-0.656	-0.638	44.2	0.915
600209.3	6338399.9	274.4	6.426	4.370	34.2	7.771	7.4	6.184	0.773	0.761	44.6	1.085	0.4	-0.737	-0.722	44.4	1.032
600209.3	6338398.9	274.4	7.200	4.986	34.7	8.757	5.8	6.969	0.849	0.844	44.8	1.197	0.4	-0.810	-0.800	44.6	1.139
600209.3	6338397.9	274.4	7.866	5.498	35.0	9.596	4.4	7.637	0.915	0.916	45.0	1.295	0.5	-0.872	-0.866	44.8	1.230
600209.3	6338396.9	274.4	8.429	5.911	35.0	10.295	3.1	8.192	0.961	0.965	45.1	1.362	0.5	-0.938	-0.933	44.9	1.323
600209.3	6338395.9	274.4	8.831	6.182	35.0	10.780	2.1	8.578	0.978	0.981	45.1	1.385	0.5	-0.960	-0.954	44.8	1.354
600209.3	6338394.9	274.4	9.095	6.342	34.9	11.088	1.3	8.824	0.966	0.965	45.0	1.365	0.5	-0.946	-0.936	44.7	1.330
600209.3	6338393.9	274.4	9.264	6.438	34.8	11.282	0.8	8.978	0.927	0.922	44.8	1.308	0.5	-0.907	-0.893	44.6	1.273
600209.4	6338392.9	274.4	9.374	6.508	34.8	11.411	0.3	9.081	0.869	0.861	44.7	1.223	0.4	-0.860	-0.844	44.4	1.205
600209.4	6338391.9	274.4	9.404	6.535	34.8	11.452	0.1	9.113	0.796	0.787	44.7	1.120	0.3	-0.793	-0.776	44.4	1.110
600209.4	6338390.9	274.4	9.342	6.501	34.8	11.381	0.7	9.057	0.713	0.705	44.7	1.003	0.3	-0.711	-0.695	44.4	0.994
600209.4	6338389.9	274.4	9.184	6.392	34.8	11.189	1.3	8.904	0.624	0.618	44.8	0.878	0.3	-0.623	-0.611	44.4	0.873
600209.4	6338388.9	274.4	8.927	6.198	34.8	10.868	2.0	8.648	0.532	0.530	44.9	0.751	0.3	-0.537	-0.528	44.5	0.753
600209.4	6338387.9	274.4	8.565	5.915	34.6	10.409	2.7	8.283	0.443	0.444	45.1	0.627	0.6	-0.448	-0.443	44.7	0.631
600209.4	6338386.9	274.4	8.124	5.566	34.4	9.848	3.3	7.837	0.358	0.364	45.4	0.511	1.0	-0.364	-0.364	45.0	0.515
600209.4	6338385.9	274.4	7.636	5.180	34.2	9.227	3.8	7.343	0.282	0.292	46.0	0.406	1.6	-0.288	-0.294	45.6	0.412
600209.4	6338384.9	274.4	7.125	4.780	33.9	8.580	4.2	6.827	0.215	0.231	47.0	0.316	2.6	-0.222	-0.234	46.5	0.323
600209.4	6338383.9	274.4	6.608	4.383	33.6	7.929	4.5	6.310	0.159	0.180	48.6	0.240	4.1	-0.164	-0.183	48.1	0.246
600209.4	6338382.9	274.4	6.096	3.998	33.3	7.290	4.7	5.801	0.112	0.139	51.0	0.178	6.2	-0.115	-0.139	50.5	0.181
600209.4	6338381.9	274.4	5.611	3.640	33.0	6.689	4.8	5.323	0.075	0.105	54.7	0.129	9.5	-0.075	-0.104	54.2	0.129
600209.4	6338380.9	274.4	5.169	3.319	32.7	6.142	4.8	4.888	0.046	0.079	60.1	0.092	15.3	-0.045	-0.079	60.2	0.091
600209.4	6338379.9	274.4	4.760	3.028	32.5	5.641	4.8	4.489	0.025	0.059	66.8	0.064	25.1	-0.022	-0.059	70.0	0.063
600209.4	6338378.9	274.4	4.387	2.767	32.2	5.187	4.8	4.128	0.017	0.043	68.0	0.047	40.3	-0.003	-0.044	86.1	0.044
600209.4	6338377.9	274.4	4.047	2.533	32.0	4.774	4.7	3.799	0.023	0.031	53.9	0.038	48.7	0.012	-0.032	-70.0	0.034
600209.4	6338376.9	274.4	3.738	2.323	31.9	4.401	4.6	3.502	0.030	0.021	35.3	0.037	35.8	0.023	-0.022	-44.6	0.032
600209.4	6338375.9	274.4	3.457	2.135	31.7	4.063	4.5	3.233	0.037	0.014	21.1	0.040	22.3	0.031	-0.015	-25.7	0.035
600209.4	6338374.9	274.4	3.202	1.967	31.6	3.758	4.4	2.991	0.042	0.009	11.9	0.043	14.1	0.038	-0.009	-13.8	0.039
600209.4	6338373.9	274.5	2.972	1.816	31.4	3.483	4.3	2.771	0.046	0.005	6.3	0.046	9.3	0.042	-0.005	-6.5	0.043
600209.4	6338372.9	274.5	2.761	1.679	31.3	3.232	4.2	2.572	0.048	0.003	3.7	0.048	6.4	0.045	-0.001	-1.7	0.045
600209.5	6338371.9	274.5	2.573	1.558	31.2	3.008	4.1	2.394	0.050	0.004	4.1	0.050	4.7	0.048	0.001	1.7	0.048
600209.5	6338370.9	274.5	2.400	1.448	31.1	2.803	4.0	2.230	0.050	0.005	5.4	0.051	3.5	0.049	0.003	4.0	0.049
600209.5	6338369.9	274.5	2.241	1.348	31.0	2.616	3.9	2.082	0.050	0.006	6.7	0.051	2.6	0.049	0.005	5.8	0.049
600209.5	6338368.9	274.5	2.099	1.259	31.0	2.448	3.8	1.948	0.050	0.007	7.8	0.051	2.1	0.050	0.006	7.1	0.050
600209.5	6338367.9	274.5	1.969	1.178	30.9	2.294	3.7	1.826	0.050	0.008	8.7	0.050	1.7	0.050	0.007	8.2	0.050
600209.5	6338366.9	274.5	1.850	1.104	30.8	2.154	3.6	1.714	0.049	0.008	9.5	0.050	1.4	0.050	0.008	9.0	0.050
600209.5	6338365.9	274.5	1.740	1.036	30.8	2.026	3.5	1.612	0.048	0.008	10.1	0.049	1.1	0.049	0.008	9.7	0.050
600209.5	6338364.9	274.5	1.640	0.975	30.7	1.908	3.4	1.518	0.047	0.009	10.5	0.048	1.0	0.049	0.009	10.3	0.050
600209.5	6338363.9	274.5	1.548	0.918	30.7	1.800	3.3	1.432	0.046	0.009	11.0	0.046	0.8	0.048	0.009	10.7	0.049

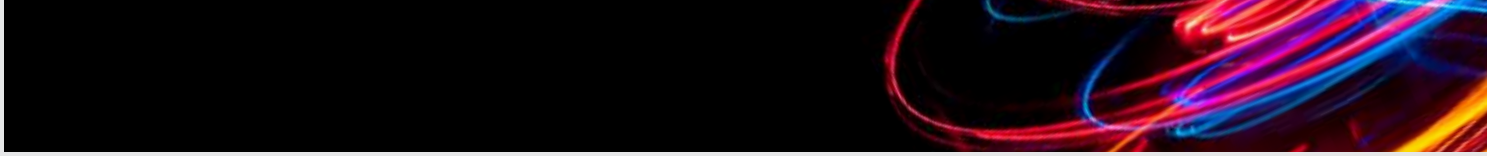
Appendix E – ENA EMF Guideline

energy networks association

EMF MANAGEMENT HANDBOOK

January 2016





DISCLAIMER

This document refers to various standards, guidelines, calculations, legal requirements, technical details and other information.

Over time, changes in Australian Standards, industry standards and legislative requirements, as well as technological advances and other factors relevant to the information contained in this document, may affect the accuracy of the information contained in this document. Accordingly, caution should be exercised in relation to the use of the information in this document.

The Energy Networks Association Limited (ENA) accepts no responsibility for the accuracy of any information contained in this document or the consequences of any person relying on such information.

Correspondence should be addressed to the CEO, Energy Networks Association, Level 1, 110 Giles Street, Kingston ACT 2604

CONTENTS

1. INTRODUCTION

ELECTRIC AND MAGNETIC FIELDS (EMF) ARE PART OF THE NATURAL ENVIRONMENT AND ELECTRIC FIELDS ARE PRESENT IN THE ATMOSPHERE AND STATIC MAGNETIC FIELDS ARE CREATED BY THE EARTH'S CORE.

EMF is also produced wherever electricity or electrical equipment is in use. Powerlines, electrical wiring, household appliances and electrical equipment all produce power frequency EMF. This handbook deals with power-frequency EMF (also known as extremely low frequency or ELF EMFs) which have a frequency of 50 Hertz (Hz).

Research on power frequency EMF and health has been conducted since the 1970's. This includes more than 2,900 studies at a cost of more than $490 million[1].

Based on the findings of credible public health authorities, the body of scientific research on EMF does not establish that exposure to EMF at levels below the recognised[2] guidelines cause or contribute to any adverse health effects. Some scientists however believe there is a need for further scientific research, although the World Health Organization has found that the body of research on EMF already is extensive.

The Energy Networks Association (ENA) is the peak national body representing gas distribution and electricity transmission and distribution businesses throughout Australia. The industry's position on EMF has been adopted in the light of authoritative reviews having concluded that no adverse health effects have been established from exposure to EMF below the recognised international guidelines. ENA recognizes that even so some members of the public continue to have concerns about the issue. The ENA position on EMF includes:

- recommending to its members that they design and operate their electricity generation, transmission and distribution systems in compliance with recognised international EMF exposure guidelines and to continue following an approach consistent with the concept of prudent avoidance,
- monitoring engineering and scientific research, including reviews by scientific panels, policy and exposure guideline developments, and overseas policy development, especially with regard to the precautionary approach,
- communicating with all stakeholders including assisting its members in conducting community and employee education programs, distributing information material including newsletters, brochures, booklets and the like, liaising with the media and responding to enquiries from members of the public, and
- cooperating with bodies established by governments in Australia to investigate and report about power frequency electric and magnetic fields.

1 Repacholi M, "Concern that 'EMF' magnetic fields from power lines cause cancer." Sci Total Environ (2012), doi:10.1016/j.scitotenv.2012.03.030, page 3. [citing PubMed]

2 The World Health Organisation recognises the following two international EMF exposure guidelines:

Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz), issued by the International Commission on Non Ionizing Radiation Protection (ICNIRP). - Health Physics 99(6):818-836; and Standard C95.6 - Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0–3 kHz. issued by the IEEE International Committee on Electromagnetic Safety (see Section 6 below)

2. PURPOSE AND SCOPE

THE PURPOSE OF THIS HANDBOOK IS TO PROVIDE COMMON, INDUSTRY-WIDE INFORMATION FOR GUIDANCE TO THE AUSTRALIAN ELECTRICITY DISTRIBUTION AND TRANSMISSION INDUSTRY TO ADDRESS THE EMF ISSUE.

The handbook is aimed at engineers and professionals within the industry who have an understanding of electricity transmission and distribution. Members of the public may find information in this handbook useful; however, some of the content is industry specific and technically complex. Further information can be found from the references provided in this handbook or by contacting your electricity network operator.

This Handbook is applicable to exposures from 50 Hz sources owned or operated by the Australian electricity distribution and transmission industry.

The Handbook applies to both public and occupational exposure situations associated with electricity networks and covers:

- electric and magnetic field basic information,
- the science of EMF and health,
- EMF exposure guidelines,
- methods for assessing compliance against exposure guidelines,
- measuring and calculating EMF,
- methods to reduce magnetic fields,
- prudent avoidance / precaution,
- process for evaluating precautionary measures,
- medical implants,
- signage, and
- EMF communication.

The Handbook does not cover:

- direct current (DC) fields,
- radio frequency (RF) fields,
- smart meters[3], and
- EMF management for electrical wiring in industrial, commercial and residential premises and from electrical appliances or metering[4].

The guidance in this Handbook may be modified and adopted as required by individual businesses.

3 More information about smart meters can be found at www.arpansa.gov.au,www.ena.asn.au or your metering provider. ARPANSA's advice is "*The scientific evidence suggests that the low level exposures to the radio waves produced by smart meters do not pose a risk to health. The combination of the relatively low power of the smart meter transmitters, their location on the outside of buildings and the very short time spent transmitting means that the overall exposure from smart meters is very low.*"

4 Some background information about magnetic field sources within the home is provided in section 3. This may be a useful reference for those wishing to reduce their personal exposure.

3. ELECTRIC AND MAGNETIC FIELDS

EMF IS PART OF THE NATURAL ENVIRONMENT AND ELECTRIC FIELDS ARE PRESENT IN THE ATMOSPHERE AND STATIC MAGNETIC FIELDS ARE CREATED BY THE EARTH'S CORE.

EMF is also produced wherever electricity or electrical equipment is in use. Powerlines, electrical wiring, household appliances and electrical equipment all produce power frequency EMF.

It is not uncommon for EMF to be confused with electromagnetic radiation (EMR).

EMR is a term used to describe the movement of electromagnetic energy through the propagation of a wave. This wave, which moves at the speed of light in a vacuum, is composed of electric and magnetic waves which oscillate (vibrate) in phase with, and perpendicular to, each other. This is in contrast to EMF, where the electric and magnetic components are essentially independent of one another.

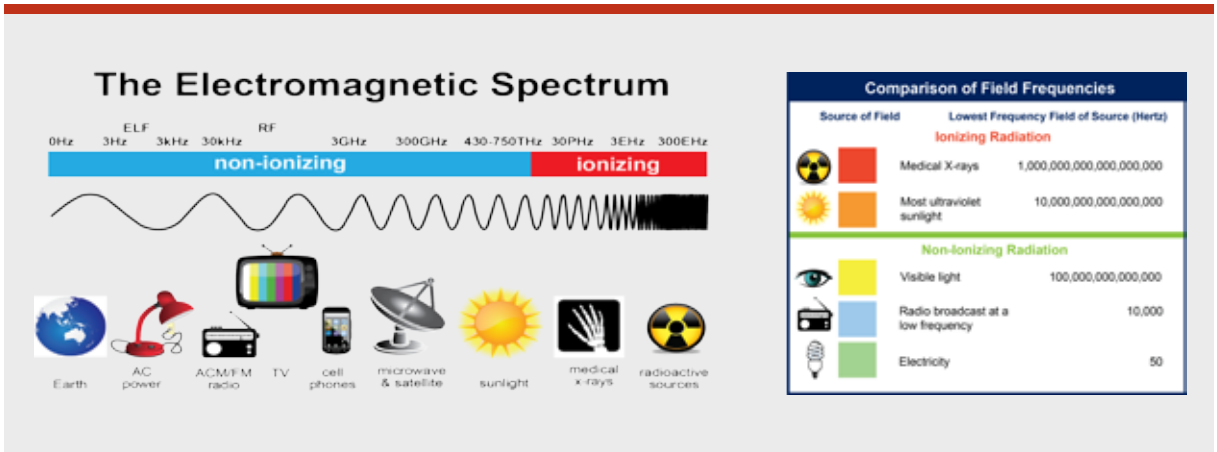
EMR is classified into several types according to the frequency of its wave; these types include (in order of increasing frequency): radio waves, microwaves, teraherz radiation, infra-red radiation, visible light, ultraviolet radiation, X-rays and gamma rays. X-rays and gamma rays are in the ionising part of the spectrum and have enough energy to damage DNA[5].

Whereas EMR causes energy to be radiated outwards from its source e.g. light from the sun or radio-frequency signals from a television transmitter, EMFs cause energy to be transferred along electric wires.

The distinction between EMF and EMR is addressed by the New Zealand Ministry of Health in its public information booklet "Electric and Magnetic Fields and Your Health"[6] as follows:

> "The electric and magnetic fields around power lines and electrical appliances are not a form of radiation. The word "radiation" is a very broad term, but generally refers to the propagation of energy away from some source. For example, light is a form of radiation, emitted by the sun and light bulbs. ELF fields do not travel away from their source, but are fixed in place around it. They do not propagate energy away from their source. They bear no relationship, in their physical nature or effects on the body, to true forms of radiation such as x-rays or microwaves."

FIGURE 3.1 THE ELECTROMAGNETIC SPECTRUM



5 The capability to damage DNA is determined by the "frequency" of the source. Frequency is measured in Hz representing the number of cycles per second. For a source to produce enough energy to damage DNA, it must be at a frequency of approximately 10,000,000,000,000,000Hz. By comparison, EMF from the use of electricity is at a frequency of only 50 Hz.

6 Electric and Magnetic Fields and Your Health: National Radiation Laboratory, New Zealand Ministry of Health, 2008

3.1 ELECTRIC FIELDS

Electrical energy involves 'voltage', which is the pressure behind the flow of electricity and produces an electric field, and 'current', which is the quantity of electricity flowing and produces a magnetic field. An electric field is proportional to the voltage, which remains constant[7] as long as the equipment is energised. The higher the voltage is, the higher the electric field. Even if the appliance is 'off' and the power point is 'on' an electric field will be present as the cord remains energised.

Electric fields are shielded by most objects, including trees, buildings and human skin. For this reason there are negligible electric fields above underground cables. Like magnetic fields, their strength reduces quickly as you move away from the source (see Section 3.2).

The units commonly used to describe electric field strength are volts per metre (V/m) or kilovolts (1,000 Volts) per metre (kV/m).

3.2 MAGNETIC FIELDS

Whenever an electric charge moves (i.e. whenever an electric current flows) a magnetic field is created that is proportional to the current - the higher the current, the higher the magnetic field.

When a piece of equipment is completely turned off, there is no flow of current and so there is no magnetic field.

Like electric fields, the strength of magnetic fields drops quickly as you move away from the source. Unlike electric fields, magnetic fields cannot easily be shielded and pass through most materials.

Magnetic fields are often described in terms of their flux density which is commonly measured in units of Tesla (T) or the older unit of Gauss (G) where:

- 1 Tesla (T) = 1,000 milliT (mT) = 1,000,000 microT (μT)
- 1 μT = 10 mG
- 1 Gauss (G) = 1,000 milliG (mG)

Figure 3-2 can be used to convert from one magnetic field unit to the other. For example, a magnetic field of 1 mT is the same as 1,000 μT, 10^6 nT, 10 G, and 10^4 mG.

In some cases magnetic field strength is expressed as A/m.

1 T = 7.95775×10^5 A/m which is $1/\mu_0$

(This conversion for A/m is only relevant for air and non-magnetic materials.)

FIGURE 3.2 MAGNETIC FIELD UNITS' CONVERSION TABLE

mT	μT	nT	G	mG
10	10^4	10^7	1000	10^5
1	1000	10^6	10	10^4
0.1	100	10^5	1	1000
0.01	10	10^4	0.1	100
0.001	1	1000	0.01	10
10^{-4}	0.1	100	0.001	1
10^{-5}	0.01	10	10^{-4}	0.1
10^{-6}	0.001	1	10^{-4}	0.01

7 Slight changes in power system voltage may occur as a result of loading conditions

How magnetic field decrease with distance

All magnetic fields decrease with distance from the source. Generally at a distance from the source (n), the fields will decrease as follows:

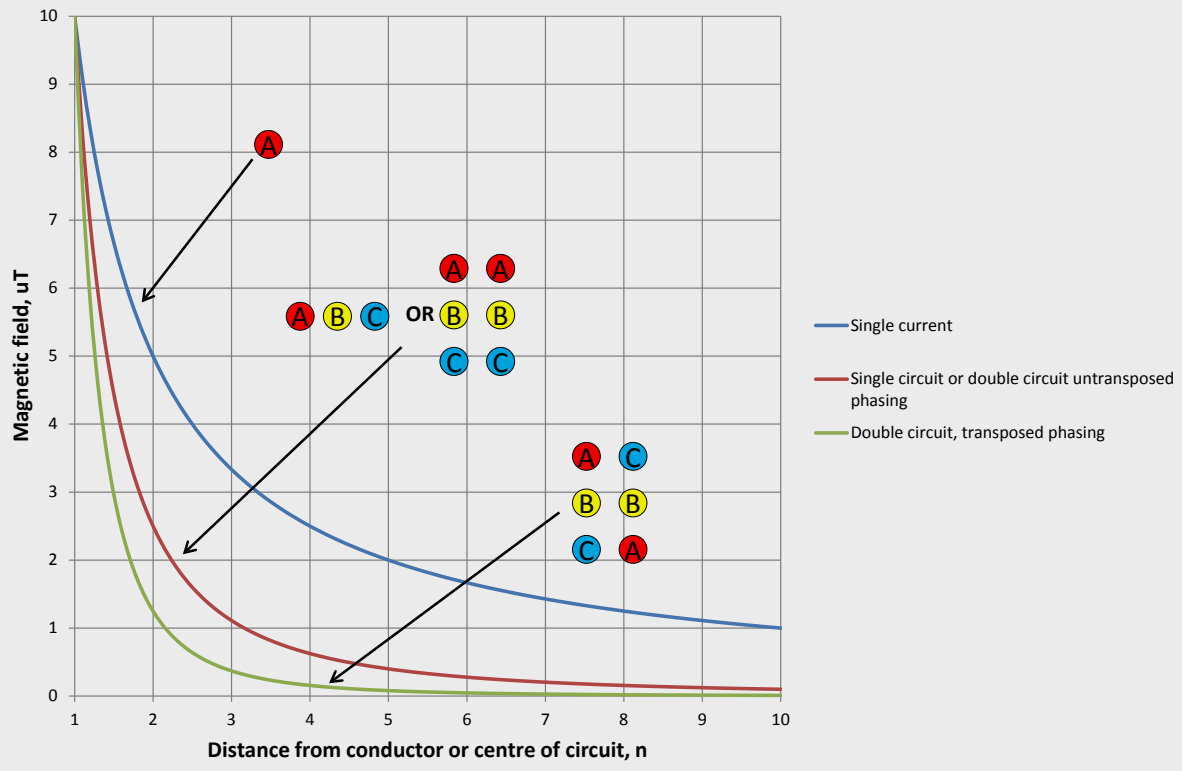
- single current – 1/n.
- single circuit or double circuit un-transposed – $1/n^2$.
- double circuit transposed or coil – $1/n^3$.

Figure 3-3 shows this rate of decrease from different sources. In practice, factors such as unequal currents, zero sequence currents and very close proximity to sources will alter these curves. Further, magnetic field profiles are typically shown horizontally along the ground (at 1m above ground) and perpendicular to the conductor rather than towards the conductors.

3.3 TYPICAL FIELD LEVELS IN THE ENVIRONMENT

While powerlines may create EMF above background levels[8] close to the line, household wiring, appliances and earth return currents tend to be the principal sources of magnetic fields in most homes. A person's exposure is a function of background fields in the home, environment and workplace and fields from sources such as, appliances, powerlines, earthing systems, substations, transport systems and anything that uses electricity.

FIGURE 3.3 RATE OF DECREASE OF MAGNETIC FIELDS FROM DIFFERENT SOURCES



* Note: Hypothetical examples where magnetic fields are 10μT at 1m from the source.

8 Typical values measured in areas away from electrical appliances are of the order of 0.01 – 0.2 uT (ARPANSA fact Sheet – Measuring Magnetic Fields).

Appliances

Magnetic field measurements associated with various appliances are shown in Table 3-1.

TABLE 3.1 MAGNETIC FIELD MEASUREMENTS RANGES THAT ARE ASSOCIATED WITH VARIOUS APPLIANCES.

Magnetic Field Source	Range of Measurement (in µT) (normal user distance)
Electric stove	0.2 – 3
Refrigerator	0.2 – 0.5
Electric kettle	0.2 – 1
Toaster	0.2 – 1
Television	0.02 – 0.2
Personal computer	0.2 – 2
Electric blanket	0.5 – 3
Hair dryer	1 – 7
Pedestal fan	0.02 – 0.2

* Note: Levels of magnetic fields may vary from the range of measurements shown.

Source: ARPANSA, Measuring magnetic fields.

Powerlines

Magnetic field measurements associated with overhead powerlines are shown in Table 3-2.

The magnetic field from power lines will vary with configuration, phasing and load. The effect of configuration and phasing is discussed in section 9.1. More information on electrical loading is provided in Appendix 4.

TABLE 3.2 TYPICAL VALUES OF MAGNETIC FIELDS MEASURED NEAR OVERHEAD POWERLINES.

Source[9]	Location of measurement (1m above the ground)	Range of measurements (µT)*
Distribution Line	directly underneath	0.2 – 3
Distribution Line	10m away	0.05 – 1
Transmission line	directly underneath	1 – 20
Transmission line	at edge of easement[10]	0.2 - 5

* Note: Levels of magnetic fields may vary from the range of measurements shown.

Source: *Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Measuring magnetic fields*.

Substations

Large substations such as zone and transmission substations vary greatly in size, configuration and loading. Key sources of magnetic fields within the substation include the transformer secondary terminations, cable runs to the switch room, capacitors, reactors, bus-bars, and incoming and outgoing feeders. In most cases the highest magnetic fields at the boundary come from the incoming and outgoing transmission lines.

For distribution substations, the key sources of magnetic fields within the substation tend to be the low voltage boards, busbars and transformer cables. In most cases the magnetic field has decreased to background levels within a few metres of the substation. For this reason distribution substations are not a significant source of exposure. Exceptions could include chamber type substations which are typically installed in or adjacent to a building. In these cases the magnetic field exposure will be dependent on the configuration and loading of the substation and uses of adjacent areas (including above and below the substation).

Padmount and distribution substations while varying in design and loading are relatively consistent compared to zone, transmission and chamber type substations. A small survey of 6 padmount substations in Sydney showed average levels ranging from 5.3µT (25cms away), 0.2µT (3m away), to 0.06µT (5m away). Readings were taken on the sides parallel to the property line. Given the small sample size and issues discussed above, the readings should be considered indicative only.

3.4 MAGNETIC FIELD SOURCES AROUND THE HOME

As noted above, electrical appliances in the home produce EMF. In most cases, fields from appliances have decreased to background levels within one or two metres from the appliance. Magnetic fields from appliances generally decrease with the inverse cube of distance from the source.

The highest fields tend to come from motors or transformers designed for lightweight appliances. The peak field in very close proximity to some appliances can be an order of magnitude greater than those shown in Table 3-1. Examples of such appliances include electric shavers, hair dryers and fish tank pumps.

9 In Australia, distribution lines have voltage level of up to 33,000 V. Transmission lines have voltage levels above 33,000 V up to 500,000V.

10 Easement widths vary and depend on a number of factors. Typical transmission line easement widths are provided in *AS/NZS7000 - Informative Appendix DD* as 30-40m (110/132kV), 30-50m (220kV), 50-60m (275kV), 60m (330kV), 65m (400kV) and 75m (500kV).

Other sources of elevated exposure could include items such as the meter box or electric blankets. The meter box where all current enters and leaves the house can have an elevated magnetic field to within a few metres of the box. These sources could result in elevated exposure if for example the bed head is near the meter box or the electric blanket is left on while in use.

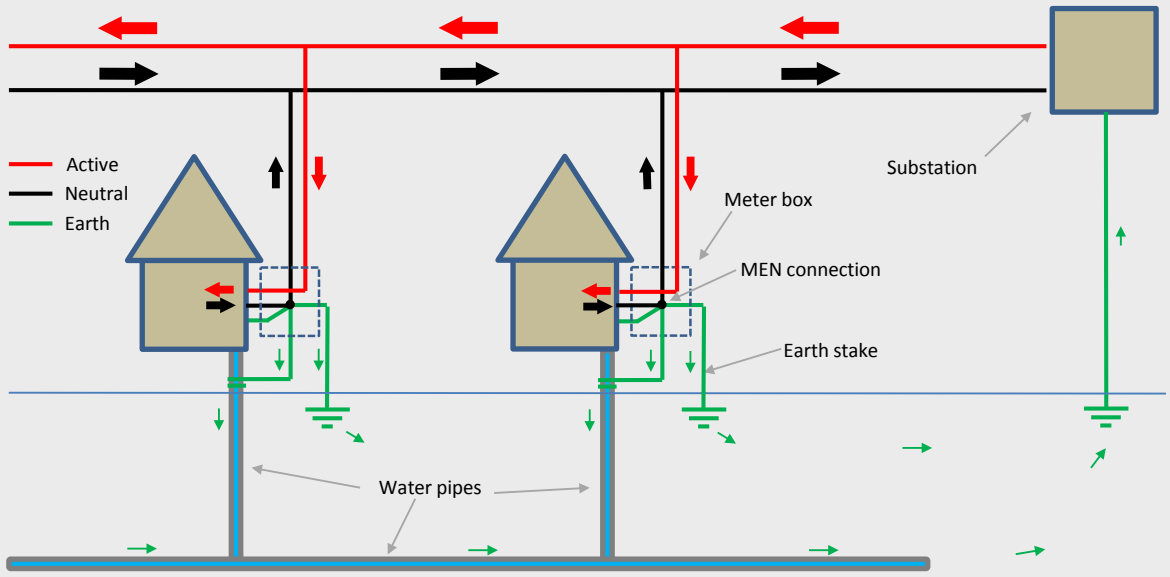
Elevated fields may also occur in proximity to the Multiple Earth Neutral (MEN) system which used in Australia. With MEN systems, the earth and neutral are connected at the meter box and this is required for safety reasons. Some neutral current will return to the substation through the ground. This path could include the earth conductor, the ground and metallic services such as water pipes. As the earth return current is away from the active and neutral conductors, the fields from these net currents decrease with the inverse of the distance (see Figure 3-3) and can sometimes be a significant source. The earth return current can increase if the service line neutral connection becomes loose or broken (see Figure 3-4).

General household wiring typically produces low magnetic fields as the active and neutral wires are run together and the fields largely cancel out. However, there are exceptions:

- circuits that are wired so that the current flows in cables that are not close together.
- some older types of underfloor heating (most new systems are designed with the active and neutral together).
- two-way switching of lights where the cables are not installed together (see Figure 3-5).
- accidental connections between the neutral and earth within the home. This could be because of unauthorised wiring, corrosion, incorrect wiring of an appliance or damage to the neutral insulation.

While not strictly sources around the home, electrical transport systems and mobile phones can also be other sources of elevated fields. While mobile phones transmit radiofrequency energy, their batteries produce pulses of current to power the transmission. These pulses of current produce magnetic fields at similar frequencies to 50Hz.

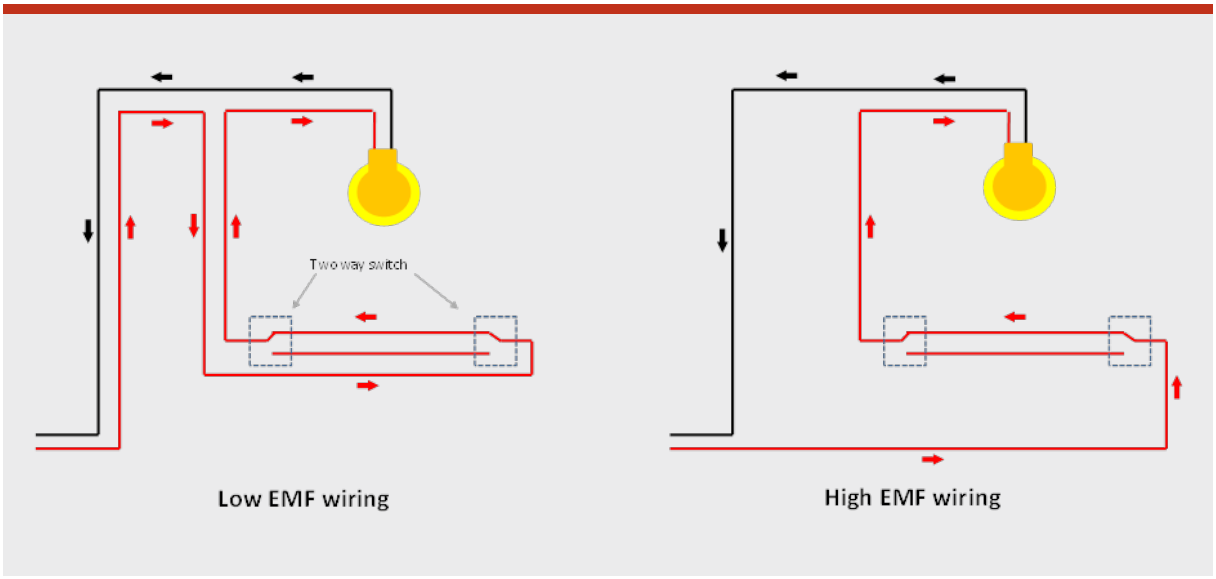
FIGURE 3.4 EXAMPLE OF MEN SYSTEM WITH EARTH RETURN CURRENT



* Earth currents are typically a very small fraction of the active and neutral currents

IMPORTANT NOTE: The MEN system performs a critical safety function. Unauthorised modifications to any aspect of the earthing system in an attempt to reduce magnetic fields could create a potentially fatal electrical hazard. All electrical work must be performed by a licenced electrician in accordance with specific rules and regulations. Further, if the neutral conductor becomes loose or broken, 'tingles' or electric shocks may be felt when touching appliances, taps or water pipes and if this is the case these should be reported immediately and the appliances/pipes not touched until checked by the network operator or a licenced electrician.

FIGURE 3.5 LOW EMF AND HIGH EMF WIRING OF TWO WAY SWITCHES



3.5 OCCUPATIONAL EMF ENVIRONMENTS

The magnitude of EMF produced by electrical equipment is dependent of the size of the source, its configuration, the voltage and current, and proximity.

Examples of situations where elevated magnetic fields could be encountered include close proximity to:

- air cored reactors (substation workers),
- busbars, low voltage boards, transformer secondary terminations, motors (substation),
- cables carrying large currents especially in pits and tunnels (substation workers, jointers),
- conductors carrying large currents (line workers and electric furnace workers),
- appliances with transformers and motors,
- high current testing (testers), and
- earthing conductors carrying large currents (substation workers),

Examples of situations where elevated electric fields could be encountered include:

- directly under 220kV and greater overhead power transmission lines,
- directly under substation busbars (substation workers), and
- close proximity to high voltage conductors (live line workers).

FURTHER INFORMATION

ARPANSA Fact Sheet - Measuring magnetic fields. See more at **www.arpansa.gov.au**

WHO What are electromagnetic fields. See more at **www.who.int**

UK National Grid EMF Information website. See more **www.emfs.info**

FIGURE 3.6 EXAMPLES OF ELEVATED MAGNETIC FIELD ENVIRONMENTS

Air cored reactors

Cable tunnels

Transformer secondaries

Live line work (elevated electric fields also)

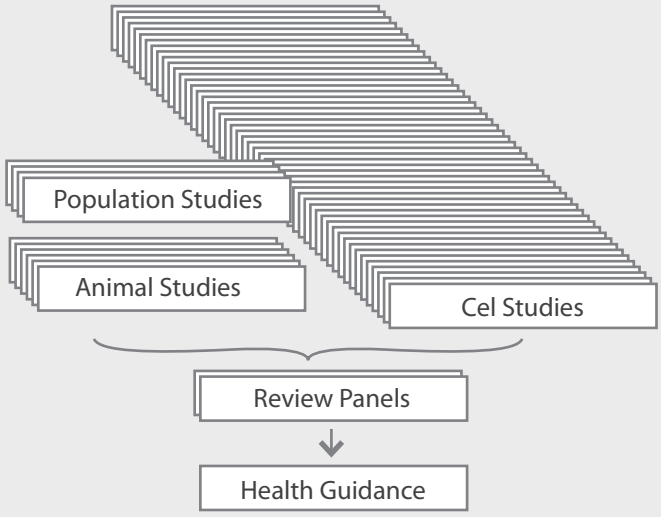
Cable pits and basements

Busbars, LV boards

4. THE SCIENCE OF EMF AND HEALTH

THE QUESTION OF EMF AND HEALTH HAS BEEN THE SUBJECT OF A SIGNIFICANT AMOUNT OF RESEARCH SINCE THE 1970'S. THIS LARGE BODY OF SCIENTIFIC RESEARCH INCLUDES BOTH EPIDEMIOLOGICAL (POPULATION) AND LABORATORY (AT BOTH A CELLULAR AND AN ORGANISM LEVEL) STUDIES.

Research into EMF and health is a complex area involving many disciplines, from biology, physics and chemistry to medicine, biophysics and epidemiology.



EMF at levels well above the recognised international exposure guidelines can cause both synaptic effects perceived as magneto-phosphenes in the sensitive retinal tissue (magnetic fields) and micro-shocks (electric fields). The exposure guidelines are in place to protect against these biological effects (see Section 5).

No single study considered in isolation will provide a meaningful answer to the question of whether or not EMF can cause or contribute to adverse health effects. In order to make an informed conclusion from all of the research, it is necessary to consider the science in its totality. Over the years, governments and regulatory agencies around the world have commissioned many independent scientific review panels to provide such overall assessments.

4.1 CONCLUSIONS FROM PUBLIC HEALTH AUTHORITIES

As part of the Health and Aging Portfolio, Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a Federal Government agency charged with the responsibility for protecting the health and safety of people, and the environment, from EMF.

ARPANSA[11] advises that:

> "The scientific evidence does not establish that exposure to ELF EMF found around the home, the office or near powerlines and other electrical sources is a hazard to human health"

> "There is no established evidence that ELF EMF is associated with long term health effects. There is some epidemiological research indicating an association between prolonged exposure to higher than normal ELF magnetic fields (which can be associated with residential proximity to transmission lines or other electrical supply infrastructure, or by unusual domestic electrical wiring), and increased rates of childhood leukaemia. However, the epidemiological evidence is weakened by various methodological problems such as potential selection bias and confounding. Furthermore this association is not supported by laboratory or animal studies and no credible theoretical mechanism has been proposed."

11 ARPANSA Electricity and Health, ARPANSA Extremely Low Frequency Electric and Magnetic Fields www.arpansa.gov.au

These findings are consistent with the views of other credible public health authorities. For example, the World Health Organization (WHO)[12] advises that:

"Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields."

Similarly, the U.S. National Cancer Institute concludes that

"Currently, researchers conclude that there is little evidence that exposure to ELF-EMFs from power lines causes leukemia, brain tumors, or any other cancers in children."

"No mechanism by which ELF-EMFs could cause cancer has been identified. Unlike high-energy (ionizing) radiation, ELF-EMFs are low energy and non-ionizing and cannot damage DNA or cells directly."

"Studies of animals exposed to ELF-EMFs have not provided any indications that ELF-EMF exposure is associated with cancer, and no mechanism has been identified by which such fields could cause cancer."

Health Canada, the Canadian national public health authority advises that

"There have been many studies on the possible health effects from exposure to EMFs at ELFs. While it is known that EMFs can cause weak electric currents to flow through the human body, the intensity of these currents is too low to cause any known health effects. Some studies have suggested a possible link between exposure to ELF magnetic fields and certain types of childhood cancer, but at present this association is not established."

"The International Agency for Research on Cancer (IARC) has classified ELF magnetic fields as "possibly carcinogenic to humans". The IARC classification of ELF magnetic fields reflects the fact that some limited evidence exists that ELF magnetic fields might be a risk factor for childhood leukemia. However, the vast majority of scientific research to date does not support a link between ELF magnetic field exposure and human cancers. At present, the evidence of a possible link between ELF magnetic field exposure and cancer risk is far from conclusive and more research is needed to clarify this "possible" link."

International Commission On Non-Ionizing Radiation Protection - 2010[13]

"It is the view of ICNIRP that the currently existing scientific evidence that prolonged exposure to low frequency magnetic fields is causally related with an increased risk of childhood leukemia is too weak to form the basis for exposure guidelines. In particular, if the relationship is not causal, then no benefit to health will accrue from reducing exposure."

FURTHER INFORMATION

ARPANSA EMF Fact sheets
Electricity and Health, Extremely Low Frequency Electric and Magnetic Fields. See more at **www.arpansa.gov.au**

ENA, 2014, "Electric and Magnetic Fields – What We Know".

WHO EMF Fact sheets – About electromagnetic fields. See more at **www.who.int**

ICNIRP. See more at **www.icnirp.org**

U.S. National Cancer Institute. See more at **www.cancer.gov**

Health Canada. See more at **healthycanadians.gc.ca**

12 WHO What are electromagnetic fields? www.who.int

13 2010 International Commission on Non Ionizing Radiation Protection, Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz). Health Physics 99(6):818-836

5. EMF GUIDELINES AND EXPOSURE LIMITS

THE TWO INTERNATIONALLY RECOGNISED EXPOSURE GUIDELINES ARE ICNIRP AND IEEE.

- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 2010.
- International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers (IEEE) in the USA 2002.

ARPANSA's advice[14] is *"The ICNIRP ELF guidelines are consistent with ARPANSA's understanding of the scientific basis for the protection of people from exposure to ELF EMF."*

Whilst ARPANSA directly references ICNIRP 2010 as a guideline for exposure, the IEEE guideline provides an alternate set of guideline limits applicable to electric and magnetic field exposure. These provide a technically sound reference which could be applied to specialised exposure environments and different parts of the human body. Such situations could include live line and bare hand maintenance methods on distribution, transmission and substation assets for example.

The WHO (2007) advises:

> "Health effects related to short-term, high-level exposure have been established and form the basis of two international exposure limit guidelines (ICNIRP, 1998; IEEE, 2002). At present, these bodies consider the scientific evidence related to possible health effects from long-term, low-level exposure to ELF fields insufficient to justify lowering these quantitative exposure limits."
>
> "…..it is not recommended that the limit values in exposure guidelines be reduced to some arbitrary level in the name of precaution. Such practice undermines the scientific foundation on which the limits are based and is likely to be an expensive and not necessarily effective way of providing protection."

The above exposure guidelines express limits in terms of Basic Restrictions and Reference Levels for both magnetic field and electric fields under General Public and Occupational exposure conditions. For both Basic Restrictions and Reference Levels the limits are instantaneous and there is no time averaging.

Magnetic field exposure limits are intended to prevent the occurrence of synaptic effects perceived as magneto-phosphenes in the sensitive retinal tissue. While this phenomenon is not itself considered an adverse health effect, it is related to synaptic effects in specialised neural tissue, and since similar effects could possibly occur elsewhere in the central nervous system, particularly the brain, expert groups have advised that exposure involving the head should be below this level.

Electric field exposure limits are intended to protect against synaptic effects (ICNIRP) and micro-shocks (IEEE). Micro-shocks may involve a spark discharge that occurs either immediately before making contact with a grounded conductor, or when a grounded person touches a charged isolated conductor. The public exposure level is similar to that experienced from spark discharges when touching, for example, a door handle after acquiring static from crossing a carpet or getting out of a car seat.

Occupational exposure is defined as follows:

ICNIRP 2010:

> "Occupational exposure in these guidelines refers to adults exposed to time-varying electric, and magnetic fields from 1 Hz to 10 MHz at their workplaces, generally under known conditions, and as a result of performing their regular or assigned job activities. By contrast, the term general population refers to individuals of all ages and of varying health status which might increase the variability of the individual susceptibilities. In many cases, members of the public are unaware of their exposure to EMF. These considerations underlie the adoption of more stringent exposure restrictions for the public than for workers while they are occupationally exposed."

14 ARPANSA, Extremely low frequency electric and magnetic fields www.arpansa.gov.au

IEEE 2002:

> "An area that is accessible to those who are aware of the potential for exposure as a concomitant of employment, to individuals cognizant of exposure and potential adverse effects, or where exposure is the incidental result of passage through areas posted with warnings, or where the environment is not accessible to the general public and those individuals having access are aware of the potential for adverse effects."

Basic restrictions

Basic restrictions are the fundamental limits on exposure and are based on the internal electric currents or fields that cause established biological effects. The basic restrictions are given in terms of the electric fields and currents induced in the body by the external fields. If Basic Restrictions are not exceeded, there will be protection against the established biological effects.

The Basic Restrictions include safety factors to ensure that, even in extreme circumstances, the thresholds for these health effects are not reached. These safety factors also allow for uncertainties as to where these thresholds actually lie. The physical quantity used to specify the Basic Restrictions is the tissue induced electric field. The Basic Restrictions relating to 50Hz are shown in Table 5-1.

Reference Levels

The Basic Restrictions in the ICNIRP and IEEE Guidelines are specified through quantities that are often difficult and, in many cases, impractical to measure. Therefore, Reference Levels of exposure to the external fields, which are simpler to measure, are provided as an alternative means of showing compliance with the Basic Restrictions. The Reference Levels have been conservatively formulated such that compliance with the Reference Levels will ensure compliance with the Basic Restrictions. If measured exposures are higher than Reference Levels then a more detailed analysis would be necessary to demonstrate compliance with the Basic Restrictions.

Table 5-2 and Table 5-3 specify the Reference Levels for exposure to magnetic fields and electric fields respectively at 50 Hz.

5.1 SUMMARY OF BASIC RESTRICTIONS

The following table summaries the basic restrictions for IEEE and ICNIRP.

TABLE 5-1 BASIC RESTRICTIONS AT 50HZ FOR IEEE AND ICNIRP.

	IEEE 2002	ICNIRP2010
GENERAL PUBLIC		
Exposure to head	0.0147 V/m	0.02 V/m
Exposure elsewhere	0.943 V/m (heart) 2.10 V/m (hands, wrists, feet) 0.701 V/m (other tissue)	0.4 V/m (rest of body)
OCCUPATIONAL		
Exposure to head	0.0443 V/m	0.1 V/m
Exposure to rest of body	0.943 V/m (heart) 2.10 V/m (hands, wrists, feet, other tissue)	0.8 V/m (rest of body)

5.2 SUMMARY OF REFERENCE LEVELS

The following tables summarise the magnetic field exposure Reference Levels for IEEE and ICNIRP.

TABLE 5-2 MAGNETIC FIELD REFERENCE LEVELS AT 50HZ FOR IEEE AND ICNIRP.

	IEEE 2002	ICNIRP 2010
GENERAL PUBLIC		
Exposure general	Not specified	200 μT*
Exposure to head and torso	904 μT	Not specified
Exposure to arms and legs	75,800 μT	Not specified
OCCUPATIONAL		
Exposure general	Not specified	1,000 uT*
Exposure to head and torso	2,710 μT	Not specified
Exposure to arms and legs	75,800 μT	Not specified

* ICNIRP advises that it is reasonable in certain circumstances for workers to experience transient effects such as magneto-phosphenes and possible minor changes in some brain functions, since they are not believed to result in long-term or pathological health effects. Exposure of all parts of the body in these circumstances should be limited in order to avoid peripheral and central myelinated nerve stimulation[15]. In this regard the EU Directive 2013/35/EU[16] includes low action levels (ICNIRP levels) and high action levels of 6,000μT and 18,000μT (limbs). Action levels can be exceeded if certain measures are in place such as assessments, action plans and access to information. The measures required depend on the level.

15 ICNIRP 2010 guidelines for limiting exposure to time-varying Electric and magnetic fields (1 hz to 100 khz)

16 The EU Directive 2013 has "exposure limits values" (ELV, the internal quantity, equivalent to ICNIRP's "basic restriction") and "action levels" (the external field, equivalent to ICNIRP's "reference level"). It has two sets of each: the "health" ELV and corresponding "high" action level, and the "sensory" ELV and corresponding "low" action level.

The following table summarises the electric field Reference Levels for relevant Australian and international exposure guidelines.

TABLE 5-3 ELECTRIC FIELD REFERENCE LEVELS AT 50HZ FOR IEEE AND ICNIRP

	IEEE 2002	ICNIRP 2010
GENERAL PUBLIC		
Exposure	5 kV/m 10kV /m (within right of way)	5 kV/m
OCCUPATIONAL		
Exposure	10 kV/m 20kV /m (within right of way)	10 kV/m

FURTHER INFORMATION

ICNIRP Guidelines – 2010 – For Limiting Exposure to Time – Varying Electric and Magnetic Fields
(1 HZ – 100 KHZ).
See more at **www.icnirp.org**

IEEE C95.6™-2002 – Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz - See more at: **www.ices-emfsafety.org/**

Wood, AW, 2008, Extremely low frequency (ELF) Electric and Magnetic Fields Exposure Limits: Rationale for Basic Restrictions used in the Development of an Australian Standard. Bioelectromagnetics 2008, 1-15

6. ASSESSING COMPLIANCE WITH EXPOSURE LIMITS

ENA's policy includes designing and operating electricity generation, transmission and distribution systems in compliance with relevant Australian exposure guidelines and consistent with the concept of Prudent Avoidance. Relevant Australian and international health guidelines are discussed in Section 5.

The concept of prudent avoidance is discussed in Section 7.

In general, electric and magnetic fields from electricity assets will be well below the Reference Levels in these guidelines and specific compliance assessments will not be required. Exceptions could include specific occupational activities in close proximity to assets such as very highly loaded conductors, air cored reactors or air cored transformers. For this reason, the rest of this section focuses on occupational exposure.

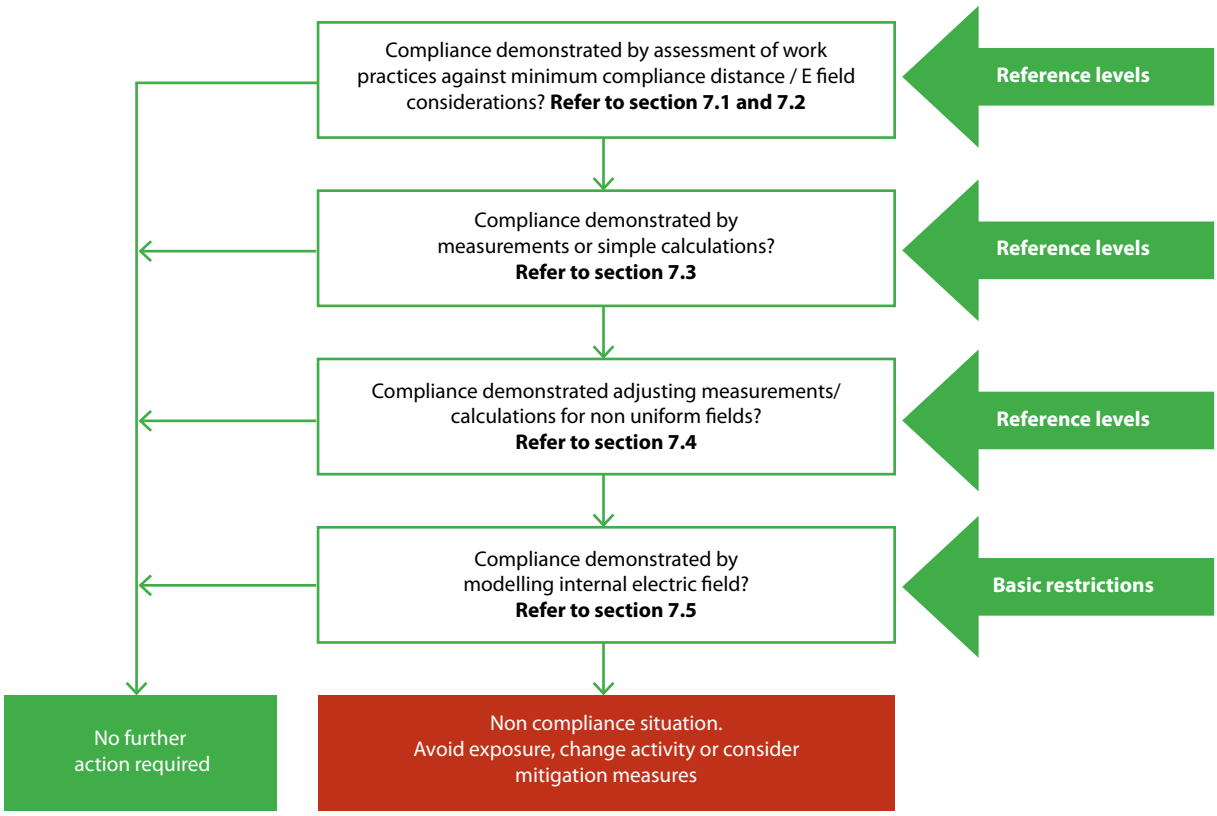
A compliance assessment can be used to demonstrate compliance with relevant Australian and international guidelines and, in particular, the Reference Levels or Basic Restrictions.

Where an assessment is required, it could be in the form of:

- review of work practices against minimum compliance distances,
- measurements or simple calculations or modelling to demonstrate compliance against the Reference Levels, or
- modelling to demonstrate compliance against the Basic Restrictions.

The overall process for a compliance assessment is shown in Figure 6-1.

FIGURE 6.1 PROCESS FOR ASSESSING COMPLIANCE WITH EXPOSURE LIMITS



6.1 MAGNETIC FIELD SOURCES – MINIMUM COMPLIANCE DISTANCES

The methodology in Section 6.1 and Section 6.2 is taken from BS EN 50499:2008 – Procedure for the assessment of the exposure of workers to electromagnetic fields.

Conductors

Compliance with Reference Levels (see Section 5.2) can be demonstrated by showing that people are at a distance larger than the minimum compliance distance as shown in Table 6-1. The minimum distance is calculated by the following equation:

Dmin = 2 I / BLim where D is the distance in metres, I is the current in Amps and BLim is the exposure limit in microtesla.

The above approach can be conservatively applied to three phase circuits, bundled circuits and multiple circuits. Where there are multiple circuits and the separation of conductors is small, an assessment of the net current can be used.

WORKED EXAMPLE:

An assessment is undertaken to determine the compliance distance to a three phase cable in relation to the ICNIRP occupational exposure limit. The exposure limit for occupational exposure is 1,000 μT (ICNIRP 2010).

It can be seen from Table 6-1 that a current of 1,000A corresponds with a minimum compliance distance of 0.2m from the centre of the single conductor for BLim = 1,000 μT. As stated above, this is a conservative calculation for 3 phase cables.

Therefore exposure to any three phase cable (or single conductor) carrying up to 1,000A is intrinsically compliant with the ICNIRP exposure limit of 1,000 μTregardless of distance to the source.

Where the minimum compliance distances in Table 6-1 cannot be maintained, the following could be considered:

1. Apply mitigation measures to reduce exposure (see Section 9),
2. Change work practices to allow for the use of an alternative Reference Level (see Section 5.2) or
3. Undertake further detailed assessment (see Figure 6-1).

TABLE 6-1 MINIMUM COMPLIANCE DISTANCE TO THE CENTRE OF A SINGLE CONDUCTOR (ICNIRP REFERENCE LEVELS).

Current in conductor A	Distance to exposure limit (BLim = 200μT) m	Distance to exposure limit (BLim = 1,000μT) m
100	0.1 (Compliant*)	0.02 (Compliant*)
200	0.2 (Compliant*)	0.04 (Compliant*)
500	0.5	0.1 (Compliant*)
1,000	1.0	0.2 (Compliant*)
1,500	1.5	0.3
2,000	2.0	0.4
2,500	2.5	0.5
5,000	5.0	1.0

* For distances closer than 0.2m, BS EN 50499:2008 (with BLim = 500 μT) states:

Closer to the conductor, considerations relating to the non-uniformity of the field (see EN 62226-1), the diameter of conductor necessary to carry the current and numerical computation of induced current density in the body for uniform field (Dimbylow, 2005), have the consequence that for currents up to 500 A the exposure limit will always be complied with however close together the body and conductor are.

Note: The IEEE 2002 Standard has Reference Levels of 904 μT (public) and 2,710 μT (occupational) and a limit of 75,800 μTfor limbs. Minimum compliance distances for these Reference Levels are not shown in the table above. See Section 5 for more information on exposure limits.

Equipment

Very few pieces of equipment can produce magnetic fields in excess of the Reference Levels at a distance of 0.2m or more. Such items could include air cored transformers or reactors. Items where this is likely to happen will need to be assessed by calculations, measurements or modelling.

Conventional iron-cored devices have low external magnetic field leakage which will not normally be sufficient to exceed the Reference Levels.

6.2 ELECTRIC FIELD SOURCES - CONSIDERATIONS

Overhead bare conductors with a voltage over 200kV, may under some circumstances produce an electric field in excess of the Reference Levels. This is particularly the case for live line workers in close proximity to the very high voltage conductors.

Such situations are typically managed with Faraday suits (occupational exposure) and the provision of information, earthing, and screening (public exposure).

The management of these situations will depend on the construction, geography and nature of exposure and specific rules cannot be prescribed in this Handbook.

FIGURE 6.2 EMF METER

6.3 CALCULATIONS OR MEASUREMENTS OF EXTERNAL FIELDS

Calculations or measurements to demonstrate compliance with guidelines should be made by an appropriately qualified and experienced person or authority.

Calculations are the preferred method of assessment for situations involving simple elements such as powerlines. Calculations have the advantage of enabling the assessor to define and control input variables and to assess a range of loading conditions rather than being limited to the particular conditions at the time.

Measurements can be useful for assessing complex situations such as those associated with live line work, cable pits and LV boards. In these cases, extrapolation may be required to take account of the maximum potential load of the circuits.

For an overhead line the minimum design clearances should be used.

Further information about measuring EMF is contained in Appendix 3.

6.3.1 Loading conditions for exposure assessment calculations

The loading used for calculations in the context of compliance with occupational guideline exposure limits should be the worst case over the foreseeable life of the asset. In most cases this will require use of the short term emergency loading. Measurements should be extrapolated to this loading, although certain assumptions and specialist knowledge may be required where there is complex or multiple sources.

More information on electrical loading is provided in Appendix 4.

6.3.2 Exposure limit reference point

Where the field is considered to be generally uniform, the electric or magnetic field level at the point of interest should be measured at 1 m above the ground. This is a generally accepted practice and is supported by standards such as IEEE, 2010, IEEE Recommended Practice for Measurements and Computations of Electric, Magnetic, and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz to 100 kHz.

Where exposure occurs in very close proximity to high current, non-uniform/complex fields, the reference point should be in those areas reasonably accessible. Such situations may include live-line work, high power testing, or work in cable pits/ basements and tunnels.

In these cases, 'reasonably accessible' should take into account factors such as working procedures, barriers, and any specific factors relevant to the assessment. In most cases a distance of 0.2m from the source within the area of exposure is a conservative approach for performing measurements/calculations (see Section 6.1).

For many occupational activities, placing the meter in the chest or waist pockets is considered a practical, efficient, and reliable means of estimating maximum magnetic-field exposures in electric utility environments.

6.4 ADJUSTMENTS FOR HIGHLY LOCALISED NON-UNIFORM FIELDS

Where the maximum calculated or measured fields exceed the Reference Levels and the fields are highly localised, the following methods could be considered to assess compliance.

1. Monitor using a spatial averaging meter (Section 6.4.1).
2. Applying the magnetic field induction factor (Section 6.4.2).

Where the results of these methods exceed the Reference Levels then modelling of the internal electric field could be considered (Section 6.5).

FIGURE 6.3 HOLADAY HI-3604 SURVEY METER

6.4.1 Spatially averaging meter

The Holaday HI-3604 is one of the commercially available magnetic field meters which has a sensing coil with a diameter of 16.5cm (radius 8.25 cm), which is about the same diameter as the head.

The Holaday HI-3604 has been shown to provide a very good correspondence between its measured magnetic field and the induced electric field from a single phase cable for head exposure. As such the Holaday meter provides a very good surrogate for induced electric field compliance for single cables, but may slightly underestimate compliance distances for cable bundles with balanced current.[17]

Note that the magnetic sensor coil inside the Holaday HI 3604 is a single axis coil and is around 2cm from the nearest edge of the paddle. These factors should be taken into account when making measurements.

6.4.2 Magnetic field induction factor method

Maximum exposure measurements in non-uniform fields are higher than their equivalent uniform field exposures. Where measurements or calculations exceed the Reference Levels, the following approach may be applied.

Note: this method is not suitable when undertaking measurements using the Holaday meter.

However, before adopting this approach, the work environment in question should be surveyed to demonstrate that they can, in fact, be characterized by fields that decrease inversely with the distance or more rapidly. Where there are multiple conductors (such as a cable pit) the environment can generally be categorised by fields that decrease inversely with the distance or faster provided that the cable diameters are greater than 3cm[18].

To determine compliance using this technique, it is necessary to calculate the equivalent uniform magnetic field and compare this against the relevant Reference Level.

The equivalent uniform magnetic field that produces the same peak magnetic field as a non-uniform field with a known maximum field can be derived using induction factors[19].

17 Anderson, V, 2009, B field compliance for 50 Hz live line work, Swinburne University, 2 September 2009

18 Anderson, V, 2009, B field compliance for 50 Hz live line work, Swinburne University, 2 September 2009

19 Bracken, TD, and Dawson, T, 2004, Evaluation of Non-uniform 60 Hz Magnetic-Field Exposures for Compliance with Guidelines, J Occ Envir Hyg, 1, 629 – 638

The derivation requires the following information:

1. maximum measured/calculated exposure (MF),
2. distance from the assumed line source where the maximum exposure occurs (d),
3. relevant normalised induction factor F(d) based on distance from a line source (see Figure 6.4), and
4. relevant Reference Level (RL) (see Section 5.2).

To calculate the Equivalent Uniform Field, multiply the maximum exposure (MF) by the Normalised Induction Factor F(d) (see Figure 6.4). This can then be compared against the relevant Reference Level (RL).

Compliance is achieved if the following holds true:

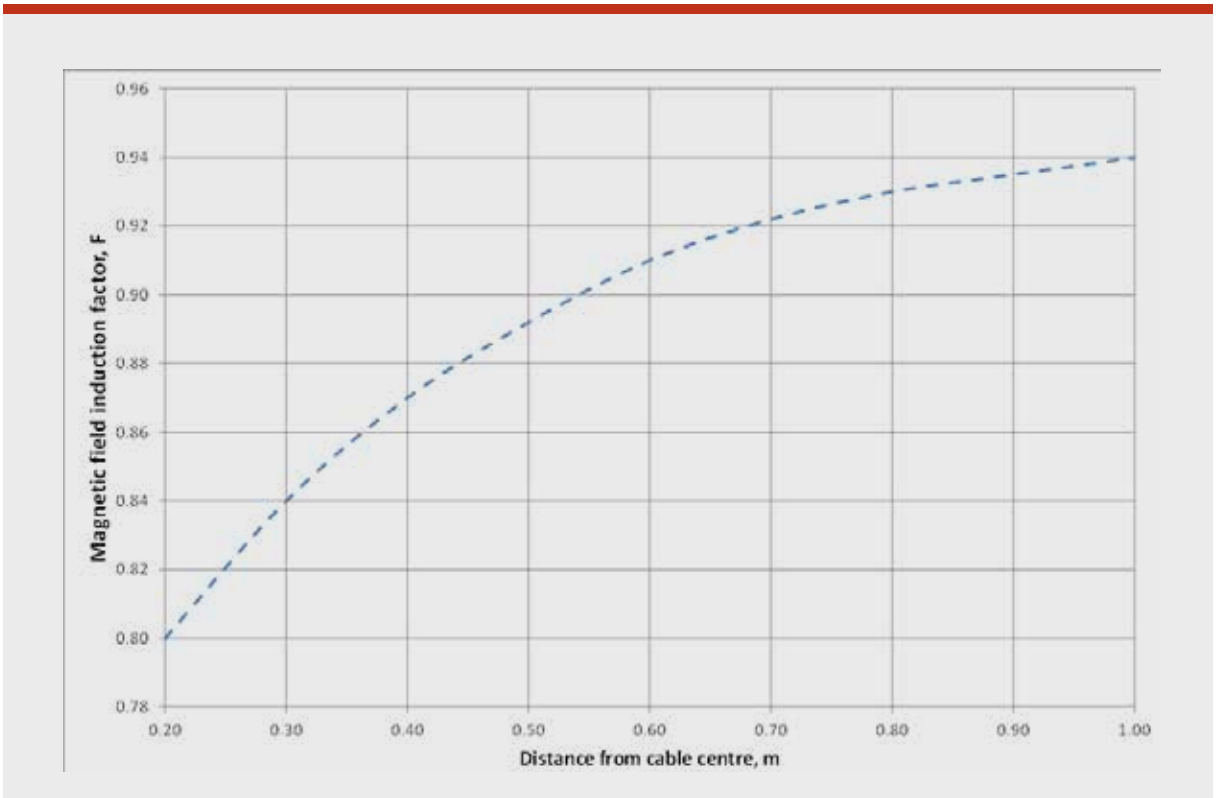
RL > MF x F(d)

As stated by Bracken and Dawson (2004):

> "Normalized induction factors referenced to surface maximum field represent a stable method for comparing non-uniform maximum fields at the surface of the body with field limits for uniform fields. Their use accurately incorporates a comparison of the peak induced electric field with the basic restriction."

The procedures developed here apply to non-uniform field exposures where the magnetic field decreases as the inverse of distance or more rapidly. Under these conditions the maximum fields at the surface of the body that will meet the basic restriction criteria of guidelines are greater than those for uniform field exposures.

FIGURE 6.4 NORMALISED INDUCTION FACTOR TO CALCULATE THE EQUIVALENT UNIFORM FIELD AFTER BRACKEN AND DAWSON (2004)



Ref: Bracken, TD, and Dawson T, 2004, Evaluation of Non-uniform 60 Hz Magnetic-Field Exposures for Compliance with Guidelines, J Occ Envir Hyg, 1, 629 – 638

WORKED EXAMPLE:

An activity requires the head to come within 30cm of a very highly loaded single core cable. Theoretical calculations show that the magnetic field (decreasing at 1/d) is 500 µTat 30cm from the cable. Using the magnetic field induction factor, it can be shown that the equivalent uniform field is 0.84 x 5,000 = 420 µT.

6.5 MODELLING INTERNAL ELECTRIC FIELD

Where measurements or simple calculations have been unable to establish compliance, approaches involving modelling of the internal electric field for comparison with the Basic Restriction could be considered.

If compliance is to be demonstrated by comparison with Basic Restrictions, the combined effect of both electric and magnetic external fields should be taken into account.

6.5.1 Simple modelling

Simple modelling calculations can be undertaken in accordance with appropriate IEC Standards, eg IEC 62226.

A comprehensive study using simple modelling has been performed by Anderson (2009) using the IEC 62226 Model. This has provided calculations of internal electric and magnetic field compliance distances for the configuration of a horizontal wire conductor or two balanced parallel wires and a vertical human body.

These results have been used to determine the compliant conditions and may be useful for determining compliance in other more specific situations.

6.5.2 Complex modelling

Where compliance cannot be demonstrated using measurements, calculations or simple modelling, compliance with the Basic Restrictions may need to be demonstrated via a complex modelling approach. Approaches could include complete numerical (voxel) models of appropriate representative body shapes. Advice from experts in this field should be sought. Papers using this approach have been published from various overseas research centres, for example the work of Peter Dimbylow at the UK Health Protection Agency.

Dosimetry modelling by Dimbylow (2005) has been used to calculate the external electric and magnetic fields required to exceed the ICNIRP 2010 Basic Restrictions (see Table 6-2).

FIGURE 6.5 SIMPLE MODELLING

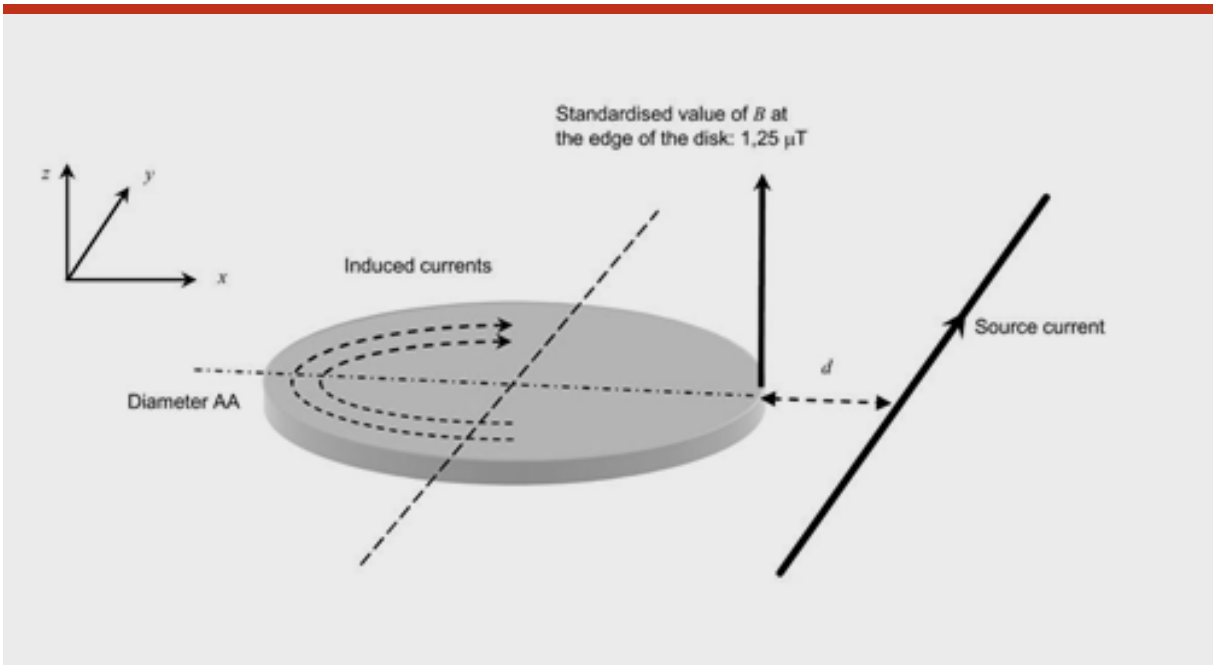


TABLE 6.2 DOSIMETRY FOR ICNIRP 2010 EXPOSURE GUIDELINES.

	ICNIRP Reference Level	Dosimetric modelling	
GENERAL PUBLIC		Dosimetric conversion factor	Calculated external field
Magnetic field	200 µT	33 mV/m / mT	606 µT
Electric field	5 kV/m	2.02 mV/m / kV/m	9.9 kV/m
OCCUPATIONAL			
Magnetic field	1,000 µT	33 mV/m / mT	3,030 µT
Electric field	10 kV/m	33.1 mV/m / kV/m	24.2 kV/m

While the Dimbylow modelling confirms that the INCIRP Reference Levels are indeed conservatively formulated, the first step should always be to demonstrate compliance with the exposure limits by conventional means and where practicable, manage exposure by engineering or administrative controls. When compliance with the exposure limits cannot be demonstrated by conventional calculations and measurements means, then the Dimbylow method could be considered.

FURTHER INFORMATION

Anderson, V, 2009, B field compliance for 50 Hz live line work, Swinburne University, 2 September 2009

ARPANSA EMF Fact sheet - Measuring Magnetic Fields. See more at www.arpansa.gov.au

Bracken, TD, and Dawson, T, 2004, Evaluation of Non-uniform 60 Hz Magnetic-Field Exposures for Compliance with Guidelines, J Occ Envir Hyg, 1, 629 – 638

BS EN 50499:2008 – Procedure for the assessment of the exposure of workers to electromagnetic fields

Dawson, TW, Caputa, K and Stuchley, MA, 1999, Numerical evaluation of 60 Hz magnetic induction in the human body in complex occupational environments. Phys Med Biol, 44, 1025-1040

Dawson, TW, Caputa, K and Stuchley, MA, 2002, Magnetic field exposures for UK live-line workers. Phys Med Biol, 47, 995-1012

Dimbylow, P and Findlay, R, 2009, The effects of body posture, anatomy, age and pregnancy on the calculation of induced current densities at 50 Hz, Rad Prot Dos, advanced access published 23 December 2009

Dimbylow, P, 2005, Development of pregnant female voxel phantom, NAOMI< and its application to calculations of induced current densities and electric fields from applied low frequency magnetic and electric fields, Phys Med Biol 50 1047-1070

Dimbylow, P, 2006, Development of pregnant female, hybrid voxel-mathematical models and their application to the dosimetry of applied magnetic and electric fields at 50Hz. Phys Med Biol 51, 2383-2394

IEEE C95.3.1™-2010 – Measurements & Computations of Electric, Magnetic, and Electromagnetic Fields with Respect to Human Exposure to Such Fields, 0 Hz to 100 kHz - See more at: http://standards.ICES.org/

UK Department of Energy and Climate Change - 2012 - Power Lines: Demonstrating compliance with EMF public exposure guidelines - A voluntary Code of Practice – See more at www.gov.uk

IEC 62226-2-1, Exposure to electric and magnetic fields in the low to intermediate frequency range-Methods for calculating current density and internal electric fields in the human body. Part 2-1 Exposure to magnetic fields - 2D models.

IEC 61786, Measurement of low frequency magnetic and electric fields with regard to exposure to human beings – special requirements for instruments and guidance for measurements.

IEC 62110 Electric and magnetic field levels generated by AC power systems - Measurement procedures with regard to public exposure.

IEC 62311, Assessment of electronic and electrical equipment related to human exposure for electromagnetic fields (0-300Ghz)

7. PRUDENT AVOIDANCE / PRECAUTION

SINCE THE LATE 1980S, MANY REVIEWS OF THE SCIENTIFIC LITERATURE HAVE BEEN PUBLISHED BY AUTHORITATIVE BODIES.

There have also been a number of Inquiries such as those by Sir Harry Gibbs in NSW[20] and Professor Hedley Peach in Victoria[21]. These reviews and inquiries have consistently found that:

- adverse health effects have not been established.
- the possibility cannot be ruled out.
- if there is a risk, it is more likely to be associated with the magnetic field than the electric field.

Both Sir Harry Gibbs and Professor Peach recommended a policy of prudent avoidance, which Sir Harry Gibbs described in the following terms:

> "…. [doing] whatever can be done without undue inconvenience and at modest expense to avert the possible risk …"

Prudent avoidance does not mean there is an established risk that needs to be avoided. It means that if there is uncertainty, then there are certain types of avoidance (no cost / very low cost measures) that could be prudent. These recommendations have been adopted by the ENA and other electricity transmission and distribution businesses.

7.1 ENA POSITION

The Energy Networks Association (ENA) is the peak national body for Australia's energy networks. ENA represents gas and electricity distribution, and electricity transmission businesses in Australia on a range of national energy policy issues.

ENA is committed to taking a leadership role on relevant environmental issues including power frequency EMFs. ENA and its members are committed to the health and safety of the community, including their own employees.

ENA's position is that adverse health effects from EMFs have not been established based on findings of science reviews conducted by credible authorities. ENA recognises that that some members of the public nonetheless continue to have concerns about EMFs and is committed to addressing it by the implementation of appropriate policies and practices.

ENA is committed to a responsible resolution of the issue where government, the community and the electricity supply industry have reached public policy consensus consistent with the science.

Policy statement

1. ENA recommends to its members that they design and operate their electricity generation, transmission and distribution systems in compliance with recognised international EMF exposure guidelines and to continue following an approach consistent with the concept of prudent avoidance.
2. ENA will closely monitor engineering and scientific research, including reviews by scientific panels, policy and exposure guideline developments, and overseas policy development, especially with regard to the precautionary approach.
3. ENA will communicate with all stakeholders including assisting its members in conducting community and employee education programs, distributing information material including newsletters, brochures, booklets and the like, liaising with the media and responding to enquiries from members of the public.
4. ENA will cooperate with any bodies established by governments in Australia to investigate and report about power frequency electric and magnetic fields.

20 Gibbs, Sir Harry (1991). Inquiry into community needs and high voltage transmission line development. Report to the NSW Minister for Minerals and Energy. Sydney, NSW: Department of Minerals and Energy, February 1991.

21 Peach H.G., Bonwick W.J. and Wyse T. (1992). Report of the Panel on Electromagnetic Fields and Health to the Victorian Government (Peach Panel Report). Melbourne, Victoria: September, 1992. 2 volumes: Report; Appendices

7.2 PRECAUTION – WORLD HEALTH ORGANIZATION

In 2007, the WHO published their Extremely Low Frequency [ELF] Fields – Environmental Health Criteria Monograph No. 238. In relation to overall guidance to member states, WHO Organisation has addressed the notion of prudence or precaution on several occasions, including in its 2007 publication Extremely Low Frequency Fields, which states:

> "…..the use of precautionary approaches is warranted. However, it is not recommended that the limit values in exposure guidelines be reduced to some arbitrary level in the name of precaution. Such practice undermines the scientific foundation on which the limits are based and is likely to be an expensive and not necessarily effective way of providing protection."

It also states:

> "[E]lectric power brings obvious health, social and economic benefits, and precautionary approaches should not compromise these benefits. Furthermore, given both the weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukaemia, and the limited impact on public health if there is a link, the benefits of exposure reduction on health are unclear. Thus the costs of precautionary measures should be very low."

The Monograph further emphasises that "Even when allowing for the legitimate desire of society to err on the side of safety, it is likely that it will be difficult to justify more than very low-cost measures to reduce exposure to ELF fields."

In the implementation of precaution, care should be taken not to over-state the risk and unnecessarily raise concern. WHO advise that precaution measures "should not compromise the essential health, social and economic benefits of electric power".

For most practical purposes, very low cost precaution as defined by WHO is consistent with the industry's long standing policy of prudent avoidance.

7.3 SUMMARY OF PRUDENT AVOIDANCE / PRECAUTION PRINCIPLES

In summary, both prudent avoidance and the precautionary approach involve implementing no cost and very low cost measures that reduce exposure while not unduly compromising other issues.

The following key guiding principles can be applied to prudent avoidance / precaution in relation to EMF.

- Prudent avoidance / precaution involves monitoring research; reviewing policies in the light of the most up to date research findings (with particular emphasis on the findings of credible scientific review panels); providing awareness training for electricity supply business employees and keeping them informed and sharing information freely with the community.
- Measures to reduce exposure should be used if they can be implemented at 'no cost' or 'very low cost' and provided they do not unduly compromise other issues.
- Prudent avoidance / precaution does not operate in isolation but rather is one of many issues that need to be given due consideration in the design and operation of the electricity supply system.
- There is no reliable scientific basis for the adoption of arbitrary low exposure limits or setbacks or for a specific exposure level at which precaution should apply.
- Where exposure is consistent with typical background levels[22], the potential for further reductions is limited.
- Due to the large additional cost, undergrounding powerlines for reasons of EMF alone is clearly outside the scope of prudent avoidance / precaution.
- It cannot be said that the above measures will result in a demonstrable health benefit.

FURTHER INFORMATION

WHO What are electromagnetic fields.
See more at **www.who.int**

ENA EMF Policy. See more at
www.ena.asn.au

22 Typical values measured in areas away from electrical appliances are of the order of 0.01 – 0.2 uT (ARPANSA fact Sheet – Measuring Magnetic Fields).

8. IMPLEMENTING PRUDENT AVOIDANCE

ENA'S POLICY INCLUDES DESIGNING AND OPERATING ELECTRICITY GENERATION, TRANSMISSION AND DISTRIBUTION SYSTEMS IN COMPLIANCE WITH RELEVANT AUSTRALIAN GUIDELINES AND IN AN APPROACH CONSISTENT WITH PRUDENT AVOIDANCE.

No cost and very low cost measures that reduce exposure while not unduly compromising other issues should be adopted.

In most cases the application of prudent avoidance can be implemented on a project or incorporated into network standards without the need for a specific assessment. Specific assessments may be undertaken for major projects where a greater range of potential reduction options are available, or where specific investigations or environmental planning approval processes require such an assessment.

Where a specific assessment is required, the following guidance is provided to assist in that assessment.

This section assumes there will be compliance with the exposure limits (see Section 6).

8.1 GENERAL GUIDANCE ON APPLYING PRUDENT AVOIDANCE

The guidance below is provided to assist in evaluating prudent avoidance measures where a specific assessment or further guidance is required.

8.1.1 Potential locations of interest

From a practical perspective, the focus of public attention to EMF issues and therefore areas considered more relevant in a precautionary context would include schools, childcare centres, and other places where children congregate, homes and residential areas.

The specific case of people with medical implants is dealt with in Section 10.

8.1.2 Exposure assessment

Determining actual exposure is complicated as magnetic fields from electrical infrastructure change in accordance with daily and seasonal loading profiles. Further, there may be multiple sources, sources change over time, and people are not stationary. Fortunately such a detailed assessment is not necessary for a prudent avoidance assessment.

Where there are existing magnetic fields of random orientation (such as appliances, ground currents, household wiring etc.) the largest source will dominate the result. This is because fields are vectors and it is not a simple matter of adding the fields. Further the application of prudent avoidance involves assessing exposure from what is proposed. For these reasons it is normal practice for such an assessment to ignore these other sources.

The focus of an exposure assessment in the context of prudent avoidance is on determining magnetic field exposure sufficient to be able to determine whether there are no cost and very low cost measures that reduce exposure while not unduly compromising other issues. This can often be achieved without the need for complex calculations and, in many cases, without calculations at all.

Loading conditions for prudent avoidance calculations

Where specific calculations are required the following guidance is provided.

With prudent avoidance assessments, which address the ability to reduce fields with no cost or very low cost measures, the reduction in exposure arising from potential measures is more relevant than the highest predicted magnetic fields (as would be the case for exposure limit assessments).

According to WHO (Ref 3):

> "In the absence of a known biophysical mechanism, which would yield a known etiologically relevant metric of exposure, the metric of choice used in most epidemiological studies has been the time-weighted average."

While loads of substations and powerlines will generally increase over time after commissioning, a conservative approach which takes into account daily and seasonal variations would be to calculate the time-weighted-average (TWA) over a complete year using loads shortly after commissioning and also in the year representing the maximum foreseeable projected TWA.

Where available loading information does not permit the calculation of TWA, it may be necessary to exercise judgement, based on the best available information to derive a typical load that will occur on a line for the largest portion of a year which represents at least a conservative approximation of TWA. This would not be the maximum possible load or seasonal maximum that would occur for only a small portion of the year.

More information on electrical loading is provided in Appendix 4.

Ground clearance for overhead lines

Where specific calculations are required the following guidance is provided.

A conservative estimate of ground clearance (or average conductor height) for prudent avoidance assessments would be to assume 2/3 of the calculated sag for a typical span under typical ambient conditions for the year representing the maximum foreseeable projected loads. There may be specific circumstances that justify alternative methods.

Prudent avoidance assessment reference points

When undertaking a prudent avoidance assessment, the primary reference points for calculations should be those areas where people, especially children, spend prolonged periods of time. As the epidemiological studies typically use exposure within the home (often a child's bedroom), and in the absence of data suggesting otherwise, a conservative approach for residential areas is to select the reference point as being the nearest part of any habitable room from the source. There may be specific circumstances that justify alternative methods.

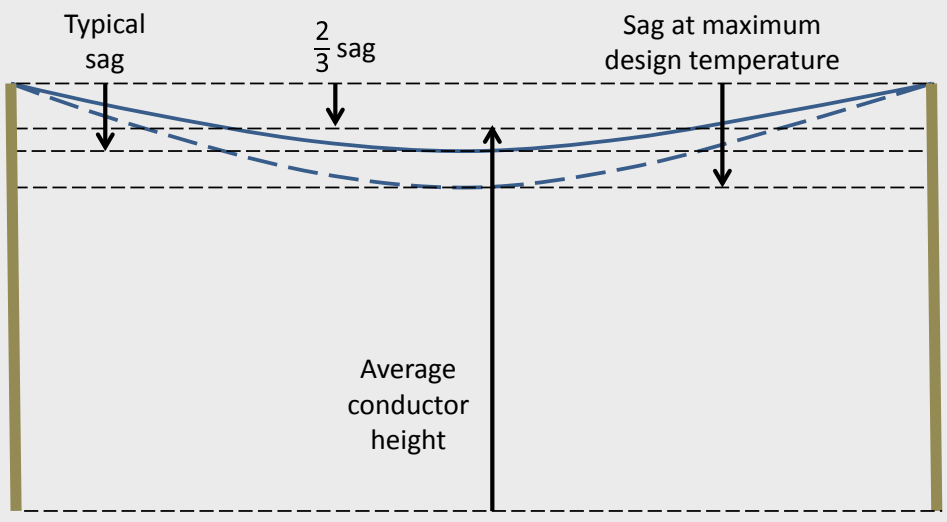
It is important not to over complicate the assessment or lose sight of the purpose – which is to determine no cost and very low cost measures that reduce exposure while not unduly compromising other issues.

The exception to this is non compliance with exposure limits (see Section 6). If the average exposure is less than or equal to typical background magnetic field levels, no further assessment is required.

8.1.3 Possible ways to reduce exposure

Exposure reduction can involve siting measures, which result in increased separation from sources and/or field reduction measures. Methods for mitigating magnetic fields are described in Section 9.

FIGURE 8.1 AVERAGE CONDUCTOR HEIGHT CALCULATIONS



8.1.4 Consideration of other issues

Measures to reduce magnetic field exposure must be considered against numerous other objectives and constraints of the project including:

- worker safety,
- the location of the power source and the load to be supplied,
- availability of suitable sites,
- ease of construction and access,
- reliability,
- cost (prudent avoidance / precautionary measures should be no cost / very low cost),
- conductor heating,
- the nature of the terrain,
- maintenance requirements,
- visual amenity,
- provision for future development,
- legal requirements, and
- environmental impacts.

The goal of any project is to achieve the best balance of all of the project's objectives, taking into account relevant social, technical, financial and environmental considerations.

8.1.5 Cost-benefit analysis

Sir Harry Gibbs and Professor Peach recommended a policy of prudence or prudent avoidance, which Sir Harry Gibbs described in the following terms:

> "…. [doing] whatever can be done without undue inconvenience and at modest expense to avert the possible risk …"

The WHO, in its Environmental Health Criteria monograph on EMF, advises that:

> "Provided that the health, social and economic benefits are not compromised, implementing very low cost precautionary procedures to reduce exposure is reasonable and warranted' [WHO 2007]."

If the available mitigation measures cannot be implemented at no cost or very low cost then no further action is required.

No cost and very low cost measures that reduce exposure while not unduly compromising other issues should be adopted.

Worked examples are shown in Appendix 2.

FURTHER INFORMATION

TNSP Operational Line Ratings - March 2009

UK Department of Energy and Climate Change - 2012 - Optimum Phasing of high voltage double-circuit Power Lines A voluntary Code of Practice – See more at **www.gov.uk**

9. METHODS TO MITIGATE MAGNETIC FIELDS

This section describes options for mitigating magnetic fields from both powerlines and substations. Whether such measures fall within prudent avoidance would depend upon their effectiveness, the project objectives and constraints, the cost to implement and ultimately, the project specific circumstances (see Section 7).

The mitigation measures described in this section are summarised in Appendix 1 to provide an overview of options that may be available for consideration.

There are several approaches that could be considered to mitigate magnetic fields from electrical infrastructure. The following three generic measures are generally the most practicable:

- Increasing the distance from source.
- Modifying the physical arrangement of the source:
- reducing the conductor spacing,
- rearranging equipment layout and equipment orientation, and
- for low voltage, bundling the neutral conductor with other phases
- Modifying the load:
- optimally phasing and balancing circuits,
- optimally configuring downstream loads,
- applying demand management, and
- for low voltage, balancing phases and minimise residual currents.

Additional measures which are less likely to satisfy the cost and convenience criteria which apply to precautionary measures but may be considered include:

- Incorporating a suitable shielding barrier between the source and the receiver.
- Active and Passive compensation.

9.1 OVERHEAD POWERLINES

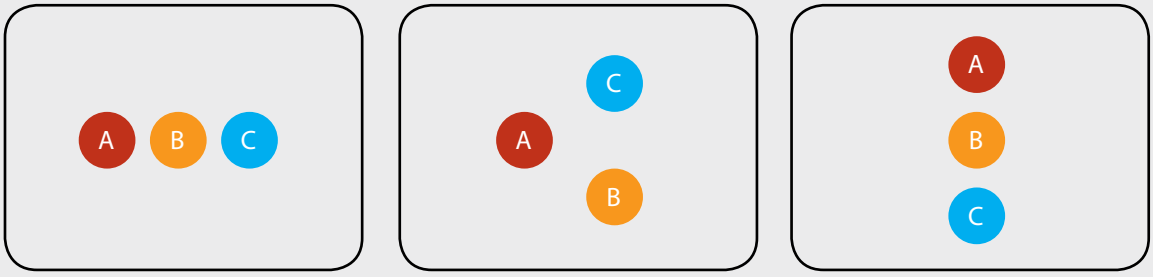
The calculations shown in this section are indicative only and based on 132kV configurations unless specified otherwise. Phase separation, conductor heights and other significant factors such as line load will vary depending on component suppliers and project specifics. The following construction types are referred to in the calculations.

9.1.1 Distance

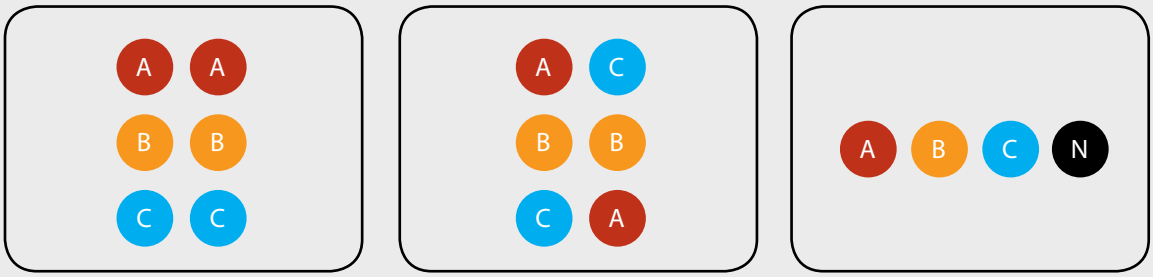
Where the line is to be sited in a road reserve, consideration can be given to selecting sides of the road which are less populated or utilising existing easements. Deviations in the route will need careful consideration of project cost and project constraints and objectives.

Raising the height of supporting structures or towers will generally reduce the magnetic field strength directly under the line as a result of increased distance from the ground. However, the benefit of this measure is reduced with distance from the powerlines. This effect is shown in Figure 10-2. The increased cost, maintenance and visual presence associated with the increased structure height may limit this technique. In some cases, raising the height may increase the field at some locations.

FIGURE 9.1 DIFFERENT OVERHEAD CONSTRUCTION CONFIGURATIONS

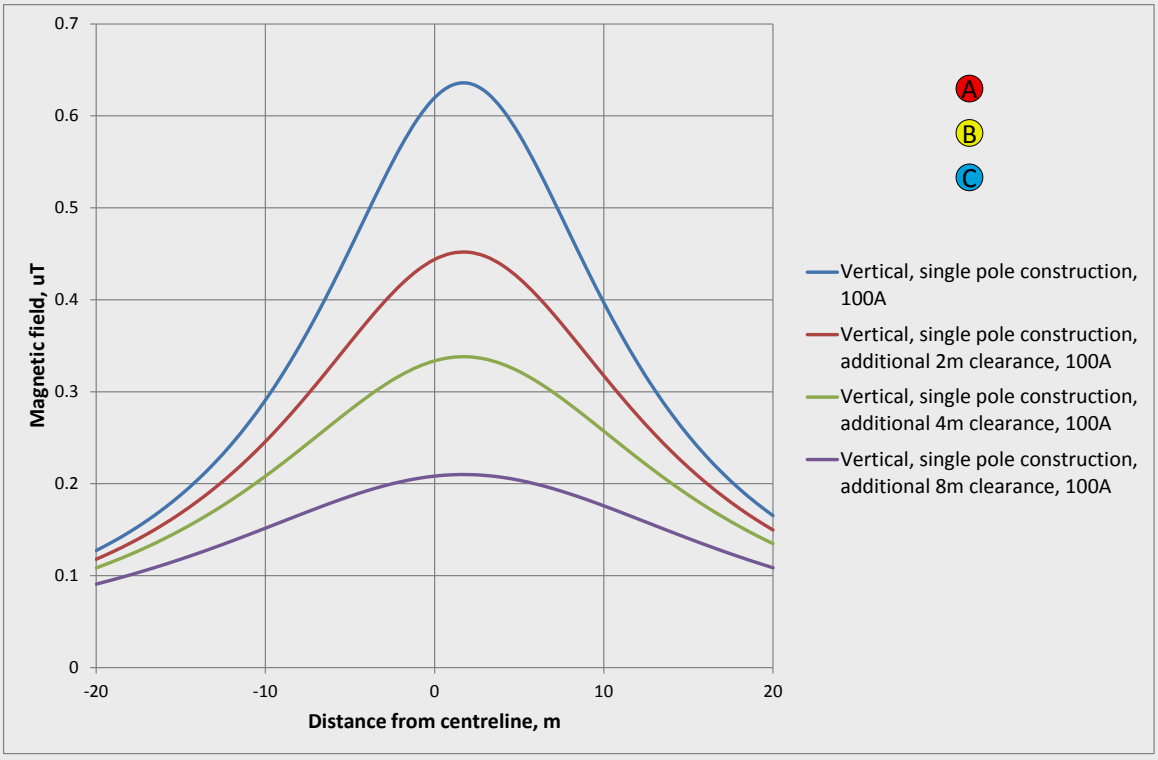


1. H pole dual pole construction
2. Delta single pole construction
3. Vertical, single pole construction



4. Double circuit construction, same phasing
5. Double circuit construction, reverse phasing (transposed) Spilt phasing
6. Low voltage (415V) construction

FIGURE 9.2 EFFECT OF RAISING THE CONDUCTOR HEIGHT



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

9.1.2 Conductor spacing

The magnetic field produced by a 3-phase powerlines is a result of the vector summation of magnetic fields produced by the electric current in the conductors. As the phases of the powerline are moved closer together, there is an increased cancellation effect due to the interaction between the magnetic fields produced by each phase current.

An excellent example of this is Aerial Bundled Conductor (ABC) where the insulated cables are twisted together and strung overhead.

There is a practical limit to the reduction in spacing that can be achieved for open wire or air-insulated construction, due to flashover and reliability considerations, and in some cases, the safe approach distance for live-line maintenance work. Further, for overhead lines above 200 kV, moving phases closer together can cause an increase in the electric field on the conductor surface which could lead to an increase in corona noise and possible noise complaints.

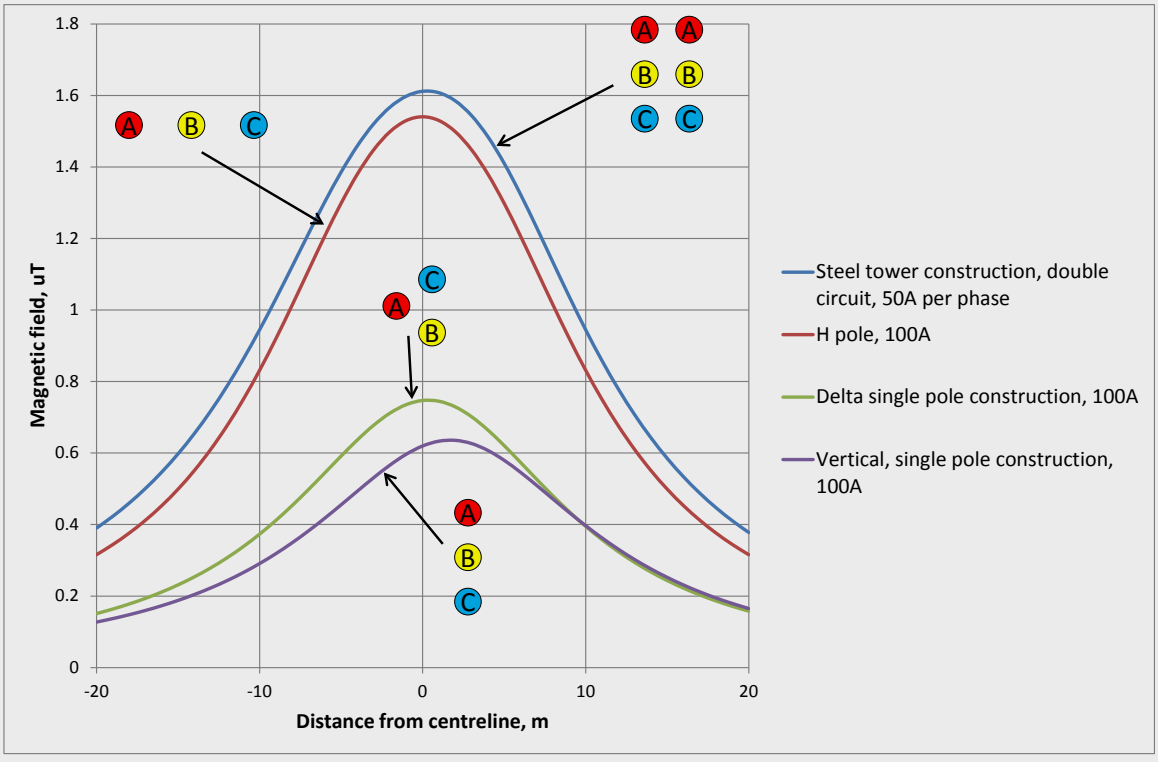
The effect of varying the conductor spacing is shown by comparing the magnetic field profiles from different open wire construction types. Steel tower construction typically has conductors further from the ground, but has large phase separations, resulting in a wider profile. Delta and vertical construction have the smallest phase separation resulting in narrower and smaller profiles (see Figure 9-3).

Delta construction generally produces the lowest fields at a distance from the powerline due to better cancellation effect.

Vertical construction generally produces the lowest fields directly below the powerline as it requires taller poles to maintain the minimum conductor-to-ground clearances.

Vertical construction can involve increased cost and increased visual presence (height) compared to delta construction. However, vertical construction can provide benefits where tree clearing needs to be minimised and in places where the road reserve is too narrow for delta construction.

FIGURE 9.3 MAGNETIC FIELD PROFILES FOR DIFFERENT OVERHEAD LINE CONFIGURATIONS AT 1M ABOVE GROUND LEVEL



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

Horizontal construction (H pole) produces higher fields than vertical or delta configurations due to all conductors being close to the ground.

9.1.3 Phase arrangement

For double circuit lines, it may be possible to arrange the phases to maximise the magnetic field cancellation.

A particular case of arranging the phases is the reverse phasing (low reactance) double circuit vertical configuration (see Figure 9-4).

The maximum effectiveness of this measure depends on the relative magnitude of the load current in each circuit, direction of load flow, and the relative angle shift between the circuit currents.

9.1.4 Split Phasing

Another application of field cancellation through phase configuration is 'split phasing' where a single circuit (three conductors in total) is constructed as two parallel circuits by splitting each phase into two conductors (six conductors in total). For maximum cancellation the conductors of one circuit are arranged in a reverse phased configuration in respect to the other circuit.

Split phasing typically has limited applications as it involves increased cost (larger poles, additional conductors, more components and in some cases wider easements) and increased physical and visual presence (i.e. height, width, potentially greater vegetation clearing, greater bulk of components and additional wires).

The effectiveness of this measure is shown in Figure 9.5.

9.1.5 Voltage, current and power

The magnetic field strength is directly proportional to the magnitude of the current flowing in the conductor. The higher the current is, the higher the magnetic field strength.

Higher voltage powerlines, which are normally used to transfer large amounts of power over large distances, can transfer the same amount of power with less current than a lower voltage powerline. As a result, for a similar power transfer, a powerline operating at a higher voltage will produce a lower magnetic field than a line operating at a lower voltage. It is a common misconception that higher voltage powerlines automatically equate to higher magnetic fields.

The choice of voltage is determined by network and other requirements.

9.1.6 Shielding

Shielding is the erection of a barrier between source and receiver to reduce the field strength at the receiver. Due to costs, it is unlikely that shielding will be consistent with a prudent avoidance / precautionary approach.

For all practical purposes there are no means to shield magnetic fields from overhead lines. In special applications, shielding of areas and individual pieces of equipment is possible using structures or enclosures made from special metals, however, these are expensive and limited in application.

9.1.7 Passive and active compensation

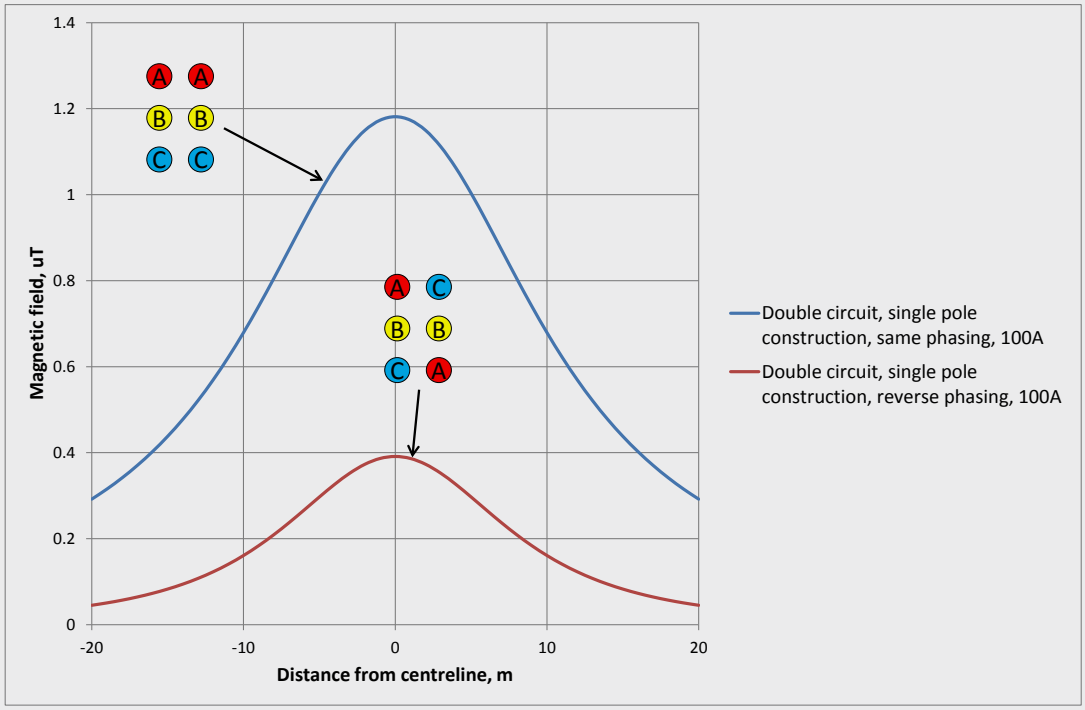
Passive compensation is based on the principle of using induction from a powerline in parallel wires which are either earthed or connected into an elongated loop. Due to the Faraday law of electromagnetic induction, a current is induced in these wires, and flows in the opposite direction to the direction of the current in the powerline. As a result, the magnetic field produced by the induced current opposes the magnetic field produced by the powerline, resulting in a net reduction.

In practice the achievable reduction from passive compensation is limited and restricted to a particular area. It is also possible that the field will be increased elsewhere. Other factors that need consideration include line losses, the possible need for capacitors and ongoing maintenance.

Active compensation is based on the same principle as passive compensation, but its effectiveness is enhanced by boosting the magnitude of the induced current by means of a separate power supply. By controlling the magnitude and phase angle of the current from the power supply, this method of EMF mitigation can provide improved, but more expensive, magnetic field compensation.

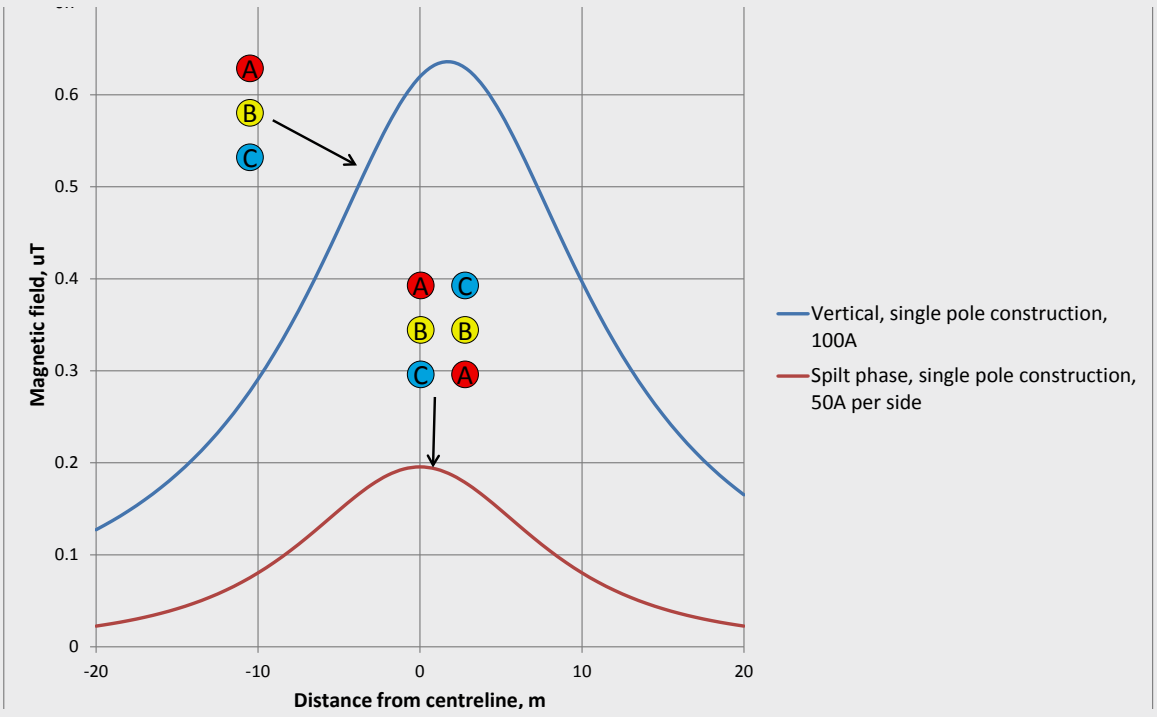
Due to cost, safety, operation, maintenance and visual amenity issues associated with the use of passive or active loops, other than in exceptional circumstances, it is unlikely that either of these two methods of EMF mitigation would satisfy the no cost / very low cost prudent avoidance / precaution criteria.

FIGURE 9.4 EFFECT OF PHASING ON A DOUBLE CIRCUIT LINE



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

FIGURE 9.5 EFFECT OF SPLIT PHASING



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

9.1.8 Undergrounding is not consistent with prudent avoidance

Because undergrounding is usually far more expensive than overhead construction, it is normally outside the scope of prudent avoidance / precaution in the context of an overhead powerline.

On the issue of undergrounding, the Gibbs Report specifically stated that, "because of its additional cost, undergrounding solely for the purpose of avoiding a possible risk to health should not be adopted"[23]. Undergrounding can result in higher magnetic fields directly above the cables.

The application of prudent avoidance / precaution for proposed underground cables is discussed in Section 9.2.

9.1.9 Distribution overhead lines

Generally, the reduction measures outlined above also apply to low voltage lines. In addition the following measures can be considered for low voltage lines to reduce the magnetic fields:

Bundle conductor configuration to significantly reduce the field profile (eg aerial bundled conductors - ABC) ABC can offer a significant reduction in the magnetic field compared to open wire construction. This is especially the case in locations on upper floors of buildings adjacent to the powerlines.

- A twisted bundled conductor will further reduce magnetic field.
- Place the neutral conductor with the phase conductors for insulated lines and cables.
- Minimise stray currents and residual currents by eliminating alternate paths for neutral current (magnetic fields from stray/residual currents decrease less rapidly than the fields from lines). Due to the use of multiple earth neutral (MEN) systems for neutral earthing, it is inevitable that some portion of the neutral current will flow through metallic water pipes and through neutrals of interconnected distributors. This will result in stray or residual current. (see Figure 9-6)
- Balance loads across all phases to reduce neutral currents (magnetic fields from unbalanced currents decreases less rapidly than the fields from lines with balanced currents). Unless harmonic currents are also suppressed, this measure might have limited success as some harmonic currents are returning to the source through the neutral.
- Avoid phase-by-phase grouping of single conductors in parallel circuits.

Predicting magnetic fields from low voltage lines is complicated by the fact that low voltage lines typically have harmonics, unbalanced loads and a residual (earth return) current. The residual current is a portion of the neutral current that is returning to the supply point via alternative paths such as remote earth or through some electrically conductive services including buried metallic pipes, metallic fences, rails, structural steel of buildings and sheaths of communication cables. These alternative return paths for the neutral current are part of the MEN system. Many appliances are also single phase and can have loads which are resistive, inductive or even capacitive. This means that the electrical angles between the three phase currents may not be equal to 120 degrees. Further, load from the low voltage lines decreases towards the end of the distributor as load is tapped off along its length. Noting the complexities above, example profiles for a low voltage line, balanced, unbalanced and unbalanced with a residual current are shown in Figure 9-6.

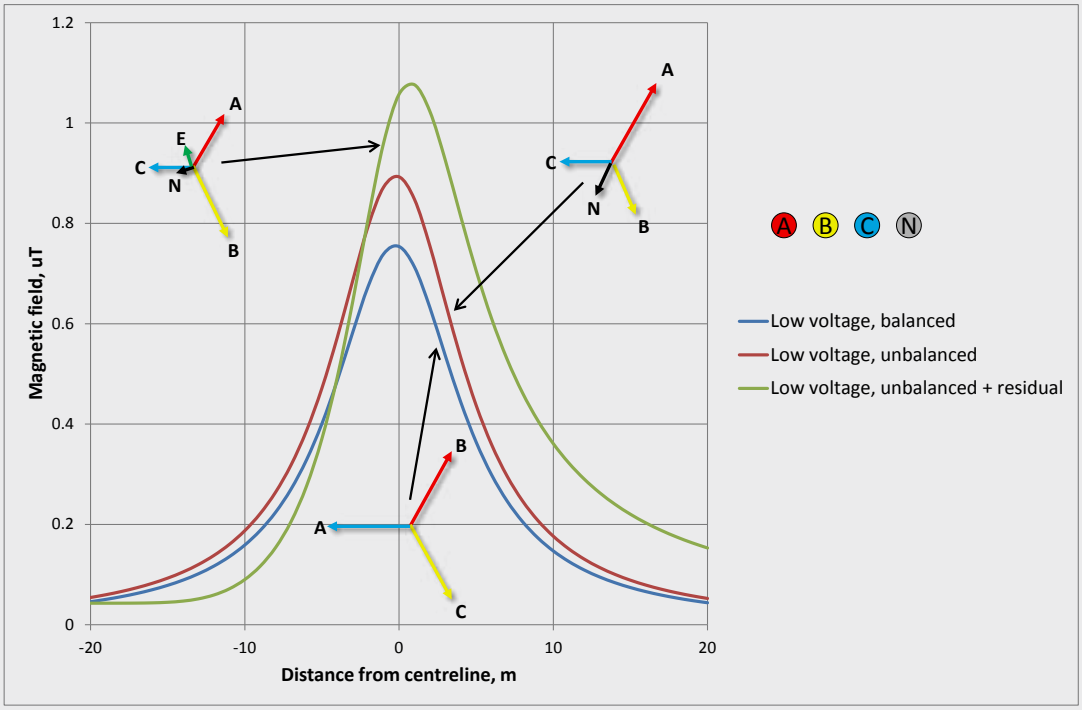
9.2 UNDERGROUND CABLES

The magnetic field directly above an underground cable is comparable to, and sometimes greater, than that from an equivalent overhead line. However, it drops off more rapidly with distance (see Figure 9-3 vs Figure 9-8).

While the magnetic field directly above the cables could be comparable or higher than for the overhead equivalent, due to the fact that cables are frequently located in roadways or footpaths, people's exposure is generally of short duration and transient in nature.

23 Gibbs, Sir Harry (1991). Inquiry into community needs and high voltage transmission line development. Report to the NSW Minister for Minerals and Energy. Sydney, NSW: Department of Minerals and Energy, February 1991

FIGURE 9.6 MAGNETIC FIELD PROFILES ASSOCIATED WITH LOW VOLTAGE CONSTRUCTION



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline, nature of the loading and earthing system. Calculations include only 50Hz currents and assume the electrical angles between the three phases are 120 degrees.

In the context of prudent avoidance / precaution, the options for further material reductions at the point of exposure are generally limited, but there may be some situations where additional measures can be justified.

The calculations shown in this section are indicative only and based on 132kV configurations. Phase separation, cable depths and other factors will vary depending on component suppliers and project specifics. The following construction types are referred to in the calculations.

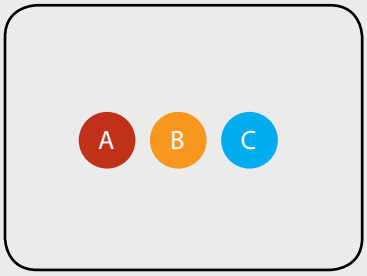
9.2.1 Distance

The extent of magnetic field reduction with distance from underground cables can be seen in all figures within this section. When the cable is to be installed in a roadway, consideration could be given to selecting sides of the road which are less populated, installation within the carriageway, or in some cases, alternative routes. Installing the trench in the centre of the road may maximise distance to all properties, however, consideration should be given to additional cost, reinstatement and traffic impacts.

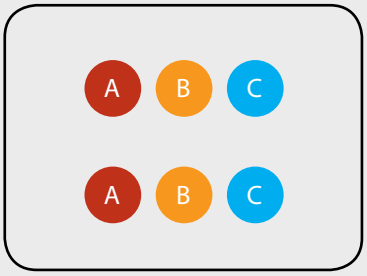
Alternative routes (unless comparable in cost) are rarely justified on EMF grounds alone given the typically low exposures and therefore limited opportunities for further material reductions.

Increasing the depth of cables may result in some field reduction directly above the cables, but generally results in a significant increase in cost, impacts on cable ratings and a negligible difference beyond a few metres away from the cables.

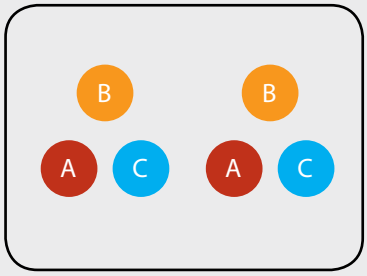
FIGURE 9.7 DIFFERENT UNDERGROUND CONSTRUCTION CONFIGURATIONS



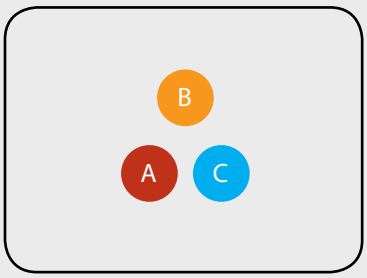
1. Flat



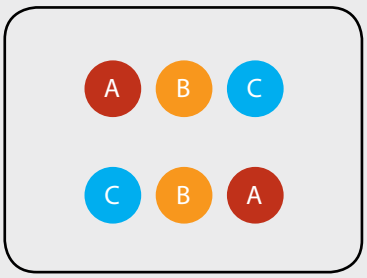
5. Stacked double circuit, flat, same phasing



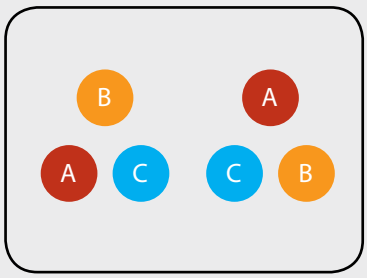
8. Double circuit, trefoil, same phasing



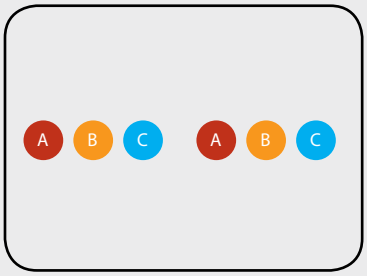
2. Trefoil



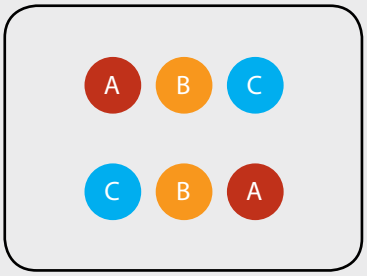
6. Stacked double circuit, flat, reverse phasing



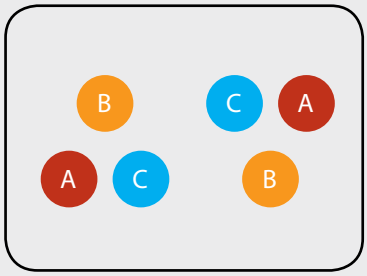
9. Double circuit, trefoil, reverse phasing



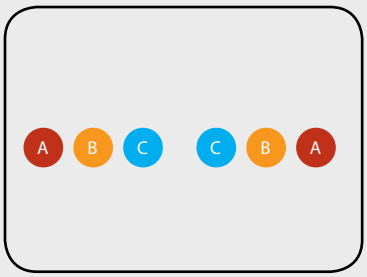
3. Double circuit, flat, same phasing



7. Double circuit, trefoil, reverse phasing – alternate arrangement



10. Double circuit, inverted trefoil, reverse phasing



4. Double circuit, flat, reverse phasing

9.2.2 Voltage

See Section 9.1.5.

9.2.3 Conductor spacing

As for overhead lines, as the phases are moved closer together, there is increased phase-to-phase cancellation of the magnetic field and the total resultant field strength decreases.

This method is particularly effective for underground cables as the conductors are insulated and are therefore not limited by flashover. However, conductor spacing and in some cases application is limited by thermal ratings.

Options include trefoil, multicore cables and triplex (twisted three core cables).

9.2.4 Phase arrangement

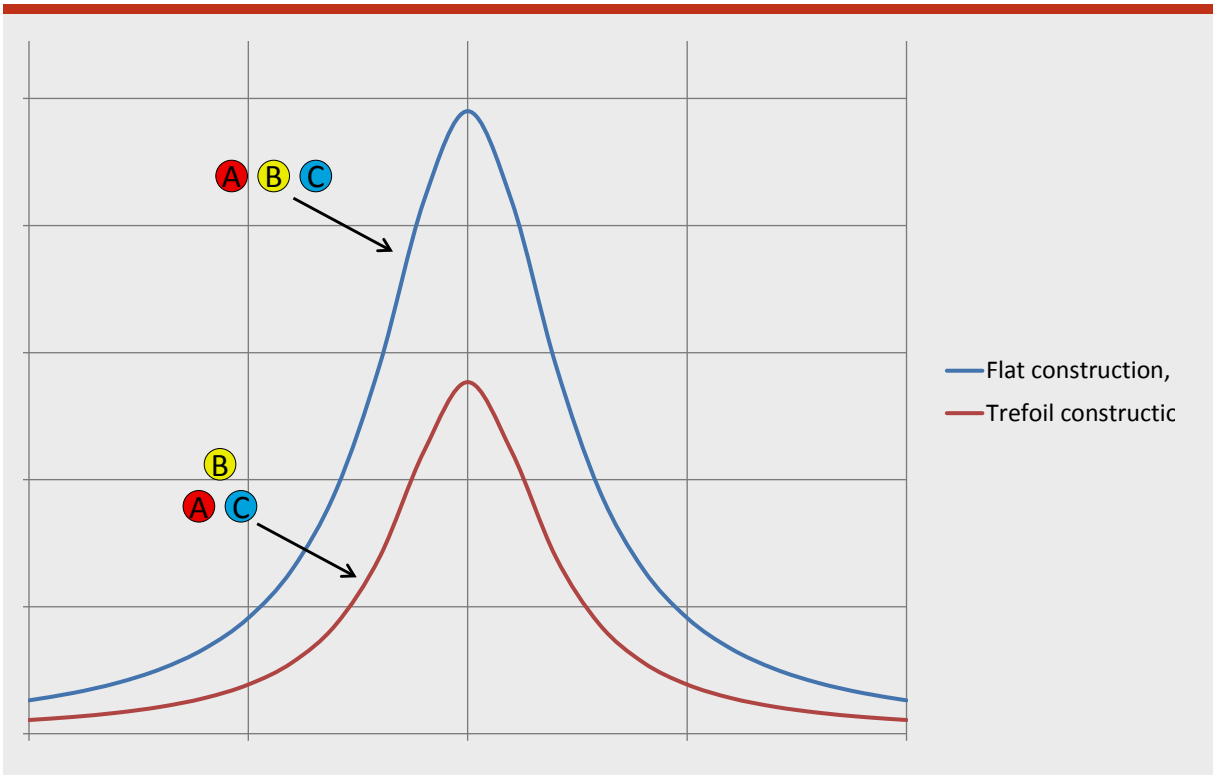
For double circuit lines, it may be possible to arrange the phases to maximise the magnetic field cancellation.

Where undergrounding involves a double circuit flat arrangement consideration could be given to phasing the circuits so that the EMF profile is lowest with both circuits operating and yet still minimal when one circuit is out of service (see Figure 9-9).

A particular case for dual circuits involves arranging the phases such that one circuit is an inverted trefoil with reverse phasing (see Figure 9-10). This arrangement can result in a significant reduction in magnetic field at a distance from the cables. Again, conductor spacing and in some cases application is limited by thermal ratings.

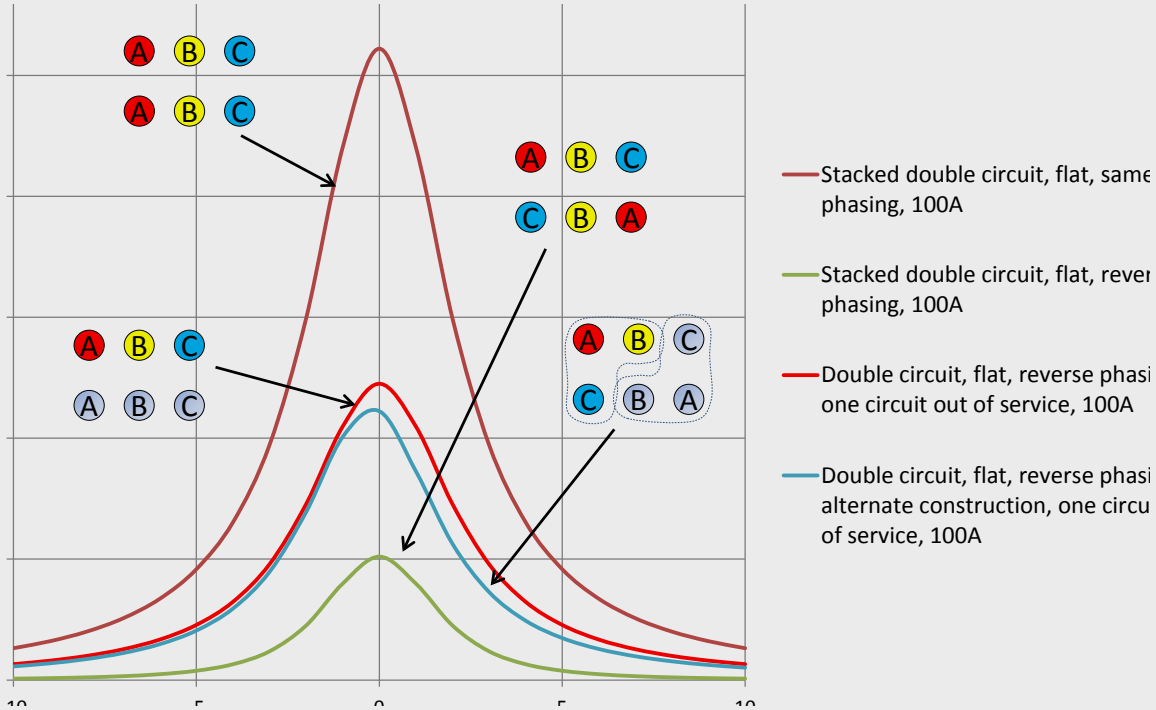
Another particular case involves transitions from trefoil to flat in dual circuits. In these cases it may be possible to change the phasing to maintain optimum phasing.

FIGURE 9.8 FLAT VERSUS TREFOIL CONSTRUCTION



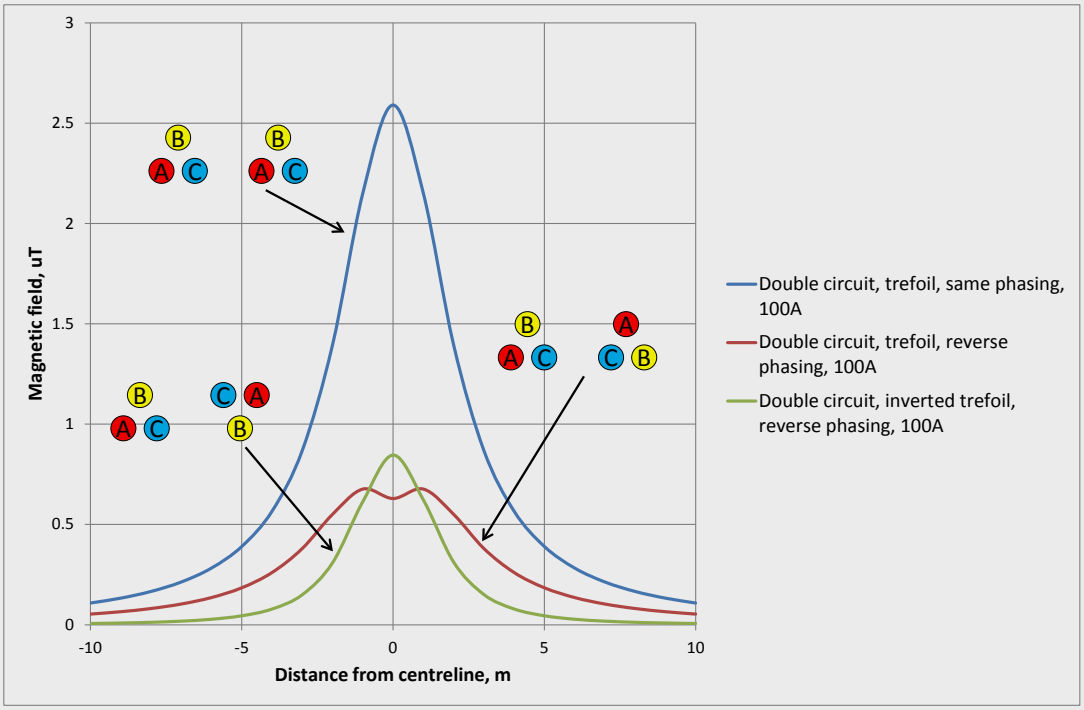
Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

FIGURE 9.9 DOUBLE CIRCUIT, FLAT CONSTRUCTION



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

FIGURE 9.10 DOUBLE CIRCUIT TREFOIL CONSTRUCTION



*Note: Hypothetical examples. Actual field levels will depend on specifics of the powerline.

9.2.5 Shielding

Although shielding of underground cables is theoretically possible, consideration needs to be given to de-rating of cables, access to cables after a fault, corrosion of shielding materials, cost of construction and ultimately the scope for any further field reduction, given the already compact cable arrangement.

In limited cases the installation of a passive shielding loop can be effective in reducing the magnetic field at a particular point. See Section 9.1.7 for additional detail on passive shielding.

In extreme cases consideration could be given to bonding cable sheaths together at each end. However, this method is usually not possible due to de-rating effects and resulting consequences.

9.3 SUBSTATIONS

Predicting magnetic field profiles for substations is a complex exercise given the multitude of time varying sources orientated in multiple directions. As a result, the magnetic field profile is highly dependent on the particular circumstances. The following measures are general in nature and could be further explored as part of a site specific assessment.

9.3.1 Distance

The areas of focus for magnetic field reductions are those areas accessible to the public. For substations, this location is generally the security fence line.

No cost/very low cost magnetic field reduction may be accomplished in a variety of ways, including substation siting, location and orientation of equipment, busbars and cabling, and location of access ways, buildings. Considerations include:

- Substation siting taking into consideration land use, land size, existing easements, proximity to load centre and proximity to powerline routes. While EMF should be a consideration in site selection, land availability, acquisition costs and proximity to feeders are often the dominant factors.
- Locating substations close to the load centre and existing feeders to minimise losses and the need for longer or more powerlines.
- Locating major magnetic field sources within the substation to increase separation distances. Key magnetic field sources include the transformer secondary terminations, cable runs to the switch room, capacitors, reactors, busbars, and incoming and outgoing feeders.
- Minimising fields from incoming and outgoing powerlines as discussed above.
- Locating areas with the lowest magnetic fields closest to the boundaries (eg control rooms, equipment rooms, amenities, fire stairs, lifts, walkways, transformer roadway, oil containment, air vents/ducts and pilot isolation rooms).
- Planning the substation layout with its LV side further away from the location of interest than its HV side. (The HV side currents are substantially smaller than the LV side and, hence the HV equipment generally has a smaller associated magnetic field).
- Orienting equipment so that magnetic fields are minimised.

9.3.2 Conductor spacing and busbar arrangement

The magnetic field strength at ground level is a result of the addition of the magnetic field vectors of the various current carrying conductors. As the phases are moved closer together, there is increased phase-to-phase cancellation of the magnetic field and the total resultant field strength decreases.

Due to flashover and reliability considerations for the circuit, there is a practical limit to the reduction in spacing that can be achieved for exposed conductor construction. A reduction in conductor spacing can also impact on worker safety and could result in the need for extended planned outages to facilitate maintenance work.

For overhead busbars, horizontal or vertical configurations typically have larger phase spacing and hence produce higher fields under the busbar than triangular or delta configurations.

For underground cables/busbars a compact arrangement generally produces a lower magnetic field profile. Example considerations include:

- Avoid direct ceiling/floor mounting of heavy current cables, open type busbars or disconnector switches, depending on adjoin uses.

- Locate cable trays away from walls/ceilings/floors depending on adjoining uses.
- Use triangular or delta bus configurations.
- Use compact arrangement of underground cables/busbars.

The use of compact gas insulated or vacuum switchgear as compared to open or enclosed air insulated switchgear results in significantly lower magnetic fields due to a substantial reduction in phase separation distances. A degree of shielding is also afforded by gas filled enclosures.

9.3.3 Phase configuration

The phasing relationship between all busbars and equipment in the substation will affect the magnetic field strength at any particular location.

Selective use of some phase configurations can be used as a field cancellation technique. Examples can include placing equipment back to back, grouping busbars/cables, and reverse phasing cables.

9.3.4 Voltage

While a higher voltage substation could produce lower magnetic field levels than a lower voltage substation, the choice of voltage is determined by network and other requirements.

9.3.5 Shielding

Shielding is the erection of a barrier between source and subject to reduce the field strength at the subject.

Magnetic fields can be shielded by ferromagnetic or conductive materials. However, the available methods can be complex, costly and can have the opposite effect by concentrating magnetic fields. Due to its high cost, shielding usually falls outside the scope of no cost / very low cost prudent avoidance / precaution.

The use of compact gas insulated or metal clad switchgear offers a degree of shielding.

In limited cases the installation of a passive shielding loop can be effective in reducing the magnetic field at a particular point. See Section 9.1.7 for additional detail on passive shielding.

9.4 LOW VOLTAGE DISTRIBUTION SUBSTATIONS

The measures described above also generally apply to low voltage substations. In addition the following measures could be considered:

- Design busbars to minimise separation between phases and the neutral bus.
- Use multicore or trefoil cables in preference to three single phase cables.
- Minimise stray currents and residual currents by eliminating alternate paths for neutral current (magnetic fields from stray/residual currents decreases less rapidly than the fields from lines) Due to the multiple earth neutral (MEN) systems of the neutral earthing, it is inevitable that some portion of the neutral current will flow through metallic water pipes and through neutrals of interconnected distributors. This will result in stray or residual current.
- Balance loads across all phases to reduce neutral currents (magnetic fields from unbalanced currents decrease less with distance than the fields from lines with balanced currents).
- Avoid phase-by-phase grouping of single core cables in parallel circuits.
- Orientate the LV end of the substation furthest from the receiver.
- Install and appropriately group the LV cables between transformers and switchboard and consumer mains cables.

FURTHER INFORMATION

CIGRE - 2009 - TB 373 Mitigation Techniques Of Power-Frequency Magnetic Fields Originated From Electric Power Systems. See more at **www.e-cigre.org/**

ENA ER G92 Issue 1 - Guidelines for Best Practice in relation to Electric and Magnetic Fields (EMFs) in the Design and Management of Low Voltage Distribution Networks. See more at **www.energynetworks.org**

10. MEDICAL IMPLANTS

There are many types of implanted cardiac pacemakers and other medical implants and in some circumstances these devices may be susceptible to interference from external fields, including radio-frequency fields and power-frequency EMF.

While there are many different manufacturers and models of pacemakers, more recently manufactured devices tend to be designed to shield against external influences. Many pacemakers are designed to 'fail safe' by reverting to fixed-rate operation when they sense the presence of interference above a certain level. The field strengths necessary to induce such behavior vary from one pacemaker model to another.

Generally, standards place an obligation on designers and manufacturers of medical implants to make them immune to interference in up to the public Reference Levels as set by ICNIRP. One such example is CENELEC, the European electrical standards organisation, BS EN 45502 - Active implantable medical devices. As regulations, standards and devices vary depending on the manufacturer and country of origin and distribution, advice should always be sought from the manufacturer or medical professional.

The following are examples of medical implants that may be susceptible to electromagnetic interference:

- cardiac pacemakers and defibrillators,
- leads associated with devices such as pacemakers,
- insulin or other drug infusion pumps,
- continual glucose monitoring,
- spinal cord stimulators (for back pain),
- cochlear implants,
- neuro-stimulators (e.g. for epilepsy, parkinsonism or incontinence), and
- metallic implants.

As the susceptibility of medical implants to EMF interference can differ, there is a need for a case-by-case risk management approach in consultation with the wearer's treating physician.

10.1 MEDICAL IMPLANT RISK MANAGEMENT

For occupational exposure, a risk management approach needs to be adopted, by implementing procedures to identify workers at risk due to fitment of medical implants, and characterising their EMF exposure from the electrical network. Once identified, an assessment can be conducted in consultation with the recipient's doctor to manage the occupational exposure to EMF of workers with medical implants and ensure that exposures are less than those which may interfere with the implant's normal operation.

Control measures can be implemented, advising the worker of any necessary restrictions or changes of their work practices to protect them from unwanted EMF exposure. Risk assessments need to be conducted on a case-by-case basis to determine the likely susceptibility of medical implants whilst performing particular tasks and the severity of the consequences should the medical implants fail or experience interference.

As part of the pre-employment induction process for working on an electrical network, raising awareness of the risk and a confidential check for medical implants should be completed to identify those persons who might have medical implants.

Workers fitted with medical implants should discuss their work and working environment with their doctor and provide the network business with a letter from their doctor describing the circumstances in which the proper functioning of the medical implant or implant may be at risk.

Having involved parties informed will allow for a risk management approach to be adopted that assesses the individual's circumstances so that an effective safety management strategy can be developed.

For general public exposure risk assessment requirements, the recipient should be referred to their treating physician and manufacturer and advice provided on typical exposures.

FURTHER INFORMATION

ARPANSA EMF Fact sheet - Measuring Magnetic Fields. See more at **www.arpansa.gov.au**

Refer to treating physician and medical implant manufacturer.

11. SIGNAGE

Signage although discretionary, may be used as one means of controlling exposure situations where there is risk of micro shocks, interference to medical implants[24] (See Section 10), and areas where levels could exceed the Reference Levels. Signage is only one tool to manage such risks and that many of these risks can be effectively managed by other means such as engineering and administrative controls.

Generally, signage is not considered to be a practical prudent avoidance / precaution measure for utilities, given the ubiquitous nature of electricity distribution and usage.

Where appropriate, signage should generally meet the requirements of Australian Standard AS1319 – 1994 Safety Signs for the Occupational Environment which has a category for "Warning" signs. Some examples of signage wording are shown in Figures 11-1 and 11.2. However, the actual wording chosen needs to have regard to the nature of the area to which the sign applies and the management controls in place.

FIGURE 11.1 EXAMPLE WORDING FOR SIGNAGE WHERE ELECTRIC OR MAGNETIC FIELD LEVELS MAY CAUSE INTERFERENCE TO MEDICAL IMPLANTS (SEE SECTION 10)

WARNING

MEDICAL IMPLANTS

ELECTRIC AND MAGNETIC FIELDS MAY INTERFERE WITH IMPLANTS

SEEK MEDICAL ADVICE BEFORE ENTERING

FIGURE 11.2 EXAMPLE OF SIGNAGE WHERE ELECTRIC OR MAGNETIC FIELD LEVELS MAY EXCEED REFERENCE LEVELS

WARNING

HIGH MAGNETIC FIELD AREA

NO UNAUTHORISED ENTRY

WARNING

ELEVATED ELECTRIC FIELDS IN THIS AREA MAY CAUSE MINOR SHOCKS SIMILAR TO STATIC ELECTRICITY

THIS MAY BE NOTICEABLE FOR SOME PEOPLE

FOR FURTHER INFORMATION CALL …

24 Medical implants may have been manufactured when ICNIRP 1998 guidelines were in force. These guidelines have a public exposure limit of 100μT

12. EMF COMMUNICATION

Communication and sharing of information with the community is a key element of EMF management for utilities. A number of relevant principles and ideas are set out below:

- When EMF issues arise, respond promptly and thoughtfully.
- Have available EMF materials such as a policy position and factsheets:
  - ENA's brochure Electric and Magnetic Fields – What we know
  - ENA EMF Policy Statement
  - ARPANSA Facts Sheets
  - WHO Fact Sheet
- Keep EMF materials accurate, current and consistent.
- Align messages with ARPANSA's public position. This alignment will provide a sound basis for positions and practices.
- Consider an EMF measurement program as a means of responding to customer inquiries. Ensure that the measurements are reported in their context, consistent with advice from ARPANSA. Providers of reading material should be both knowledgeable of the consensus science and approachable. Details of the preferred measurement technique and instrumentation for making measurements are available in a measurement protocol developed by ARPANSA.[25]
- Think about the levels of response in your organisation. Ensure that all staff that interface with the public understand the nature of public concern, have credible EMF materials available, are familiar with them and provide consistent and accurate communications.
- Maintain a role within the company that keeps abreast of the health science, the policy position of regulators and best practices and can support the front line staff when required. The person in this key communication role should be able to address any deeper concerns with credibility and understanding.
- Seek assistance from the ENA EMF Reference Group.

FURTHER INFORMATION

ARPANSA 2002 - Measurement of Residential Power Frequency Fields. See **www.arpansa.gov.au**

WHO – 2002 - Establishing a Dialogue on Risks from Electromagnetic Fields. See more at **www.who.int**

IAP2 Public Participation Spectrum. See more at **www.iap2.org.au**

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IEC 61786, Measurement of low frequency magnetic and electric fields with regard to exposure to human beings – special requirements for instruments and guidance for measurements.

IEC 62110 Electric and magnetic field levels generated by AC power systems - Measurement procedures with regard to public exposure.

IEC 62311, Assessment of electronic and electrical equipment related to human exposure for electromagnetic fields (0-300Ghz)

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14. GLOSSARY

DEFINITIONS

Basic Restrictions

Limitations on the quantities that most closely match all known biophysical interaction mechanisms with tissue (source ICNIRP 2010). (measured in V/m).

Distribution voltages

Voltages less than or equal to 33kV

Electric and Magnetic Fields, (EMF) – (Sometimes referred to as electromagnetic fields)

Power frequency (50Hz) electric and/or magnetic fields in the environment. At this frequency, the electric and magnetic components are independent of one another. EMF should not be confused with 'electromagnetic radiation' (see below). Electric fields are measured in volts/metre (V/m). Magnetic Fields are measured in gauss (G) or tesla (T).

Electromagnetic Radiation

Electromagnetic radiation is a term used to describe the movement of electromagnetic energy through the propagation of a wave. This wave, which moves at the speed of light, is composed of electric and magnetic waves which oscillate (vibrate) in phase with, and perpendicular to, each other. This is in contrast to EMF, where the electric and magnetic components are essentially independent of one another.

ELF or Extremely Low Frequency

A frequency in the range 0 to 3000 Hz.

Exposure

The circumstance of being in the immediate presence of electric or magnetic fields, or having such fields cause electric currents to flow through the body or within the body.

Gauss (G)

A measure of magnetic flux density (also sometimes called magnetic field strength). It may appear on meters to measure magnetic field (gauss or milligauss). One gauss = 10^{-4} tesla (T), the SI unit for magnetic flux density. It is often convenient to use milligauss (mG) for EMF communication as most fields encountered in practice are on a scale of 1 to 1000, thereby obviating the need for small fractions.

Magnetic field

In this document the term 'magnetic field' is equivalent to 'magnetic flux density' (refer below).

Magnetic flux density (B)

A vector quantity that determines the force on a moving charge or charges (that is, on an electric current) within a magnetic field. Magnetic flux density is expressed in teslas (T). One gauss (deprecated unit) equals 10^{-4} T. The quantity commonly referred to in non-technical uses as magnetic field strength.

Magnetophosphenes

The sensation of flashes of light caused by induced electric currents stimulating the retina.

Micro-shock

A micro-shock is a sensation caused by a small electric spark discharge or arc occurring when a person, isolated from ground and exposed to a high electric field, approaches within a few millimetres of an earthed object. Alternatively, a person in contact with ground may experience a micro-shock when approaching an isolated charged conductor. Micro-shocks are due to the transfer of induced charge from the isolated to the grounded object.

Non-uniform field

A field that is not constant in amplitude, direction and relative phase over the dimensions of the body or body part under consideration. In the case of electric fields, the definition applies to an environmental field disturbed by the presence of the body.

Occupational exposure - ICNIRP

See Section 5.2.

Occupational exposure - IEEE

See Section 5.2.

Public exposure (also general public exposure)

Exposure that is not classified as occupational exposure.

Reference Levels

The rms and peak electric or magnetic fields and contact currents to which a person may be exposed without an adverse health effect and with acceptable safety factors. The Reference Levels for electric and magnetic fields in this document may be exceeded if it can be demonstrated that the Basic Restrictions are not exceeded. Thus it is a practical or "surrogate" parameter(s) that may be used for determining compliance with the Basic Restrictions (source ICNIRP 2010).

Safety factor

A factor used in deriving Basic Restrictions and Reference Levels that provides for the protection of exceptionally sensitive individuals, uncertainties concerning threshold effects due to pathological conditions or drug treatment, uncertainties in reaction thresholds, and uncertainties in induction models.

Tesla (T)

SI unit (International System of Unit) of magnetic flux density (also sometimes called magnetic field strength). One gauss = 10^{-4} tesla.

Transmission voltages

Voltages greater than 33kV

Uniform field

A field that is constant in amplitude, direction and relative phase over the dimensions of the body or body part under consideration. In the case of electric fields, the definition applies to an environmental field undisturbed by the presence of a body.

15. ACRONYMS AND ABBREVIATIONS

ABC	Aerial Bundled Conductor
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BS	British Standard
CENELEC	European Committee for Electrotechnical Standardization
CIGRE	Council on Large Electric Systems
DC	Direct Current
ELF	Extremely low frequency
EMF	Electric and Magnetic Fields
EMR	Electromagnetic Radiation
ENA	Energy Networks Association
EU	European Union
G	Gauss
HV	High Voltage
IARC	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronics Engineers (of USA)
kV	kilovolts
LV	Low Voltage
m	Milli ($x10^{-3}$)
MF	Magnetic Field
MEN	Multiple Earth Neutral
RF	Radio Frequency
RL	Reference Level
RMS	Root-mean-square
T	Tesla
TWA	Time Weighted Average
µ	Micro ($x10^{-6}$)
V	Volts
WHO	World Health Organization

APPENDIX 1 - MAGNETIC FIELD MITIGATION – SUMMARY OF OPTIONS

THE FOLLOWING SUMMARISES THE MAGNETIC FIELD REDUCTION MEASURES DISCUSSED IN SECTION 9.

OVERHEAD POWERLINES

The following measures may reduce magnetic field exposure depending on the project. Whether they fall within the meaning of no cost / very low cost prudent avoidance / precaution will depend on the specific circumstances (see Section 8). The measures are not mandatory and will need careful consideration of cost, effectiveness and other project objectives.

- Minimise loads by optimising network configuration.
- Install circuits on sides of the road which are less populated.
- Consider alternate routes.
- Utilise existing easements.
- Raise the height of conductors (eg. Increase height of supporting structures or use vertical construction).
- Minimise phase separation.
- Use a compact phase configuration such delta construction.
- Reverse phase dual circuit lines.
- Consider optimum conductor placements for dual voltage circuits (taking into account phase shift).
- Increase the balancing of loads between dual circuit feeders.
- Split phase sections of single circuit line.
- Use highest practicable voltage.
- Bundle conductors – distribution.
- Twist conductors (eg. ABC) – distribution.
- Minimise stray currents and residual currents – distribution.
- Balance loads across all phases to reduce neutral currents – distribution.
- Avoid phase-by-phase grouping of conductors in parallel circuits – distribution.

For further information see Section 9.1.

UNDERGROUND CABLES

The following measures may reduce magnetic field exposure depending on the project. Whether they fall within the meaning of no cost / very low cost prudent avoidance / precaution will depend on the specific circumstances (see Section 8). The measures are not mandatory and will need careful consideration of cost, effectiveness and other project objectives.

- Minimise loads by optimising network configuration.
- Install cables on sides of the road which are less populated.
- Consider installing cables within the roadway – transmission.
- Utilise existing easements.
- Minimise phase separation.
- Use compact trefoil arrangement of single core cables.
- Optimally arrange and phase of dual circuits (eg reverse phasing and inverted trefoil).
- Where a dual circuit flat arrangement is used, optimally phase dual circuits to allow for compact arrangement when one feeder is out of service.
- Increase the balancing of loads between dual circuit feeders.
- Where there are transitions from trefoil to flat, change phasing to maintain optimum phasing.
- Use highest practicable voltage.

- Use multicore or trefoil cables in preference to three single phase cables – distribution.
- Place neutral conductors with the associated phase conductors – distribution.
- Minimise stray currents and residual currents – distribution.
- Balance loads across all phases to reduce neutral currents – distribution.
- Avoid phase-by-phase grouping of single core cables in parallel circuits – distribution.

For further information see Section 9.2.

SUBSTATIONS

The following measures may reduce magnetic field exposure depending on the project. Whether they fall within the meaning of no cost / very low cost prudent avoidance / precaution will depend on the specific circumstances (see Section 8). The measures are not mandatory and will need careful consideration of cost, effectiveness and other project objectives.

- Minimise loads by optimising network configuration.
- Consider alternate sites for substation (taking into account incoming and outgoing feeders).
- Site substation close to load centre.
- Site substation close to line routes.
- Locate key magnetic field sources within the substation, to increase separation distances. Key magnetic field sources include the transformers and associated connections, cable runs to the switch room, capacitors, reactors, busbars, and incoming and outgoing feeders.
- Minimise fields from incoming and outgoing powerlines (as discussed above).
- Locate areas with the lowest magnetic fields closets to boundaries (eg control rooms, equipment rooms, amenities, fire stairs, lifts, walkways, transformer roadways, oil containment, air vents/ducts and pilot isolation rooms).
- Plan the substation layout with its LV side further away from the location of interest than its HV side.
- Orientate equipment with uneven field patterns so that the highest field side is turned away from the location of interest (the LV side usually has the highest fields).
- Avoid direct ceiling/floor mounting of heavy current cables, open type busbars or disconnector switches, depending on adjoining uses.
- Locate cable trays away from walls/ceilings/floors depending on adjoining uses.
- Consider triangular or delta bus configurations.
- Use compact arrangement of underground cables/busbars and secondary connections.
- Use of compact gas insulated or vacuum switchgear.
- Use selective use of phase configurations as a field cancellation technique (eg back to back, grouping busbars/cables, and reverse phasing cables).
- Use highest practicable voltage.
- Design busbars to minimise separation between phases and the neutral bus – distribution.
- Use multicore or trefoil cables in preference to three single phase cables – distribution.
- Place neutral conductors with the associated phase conductors – distribution.
- Minimise stray currents and residual currents – distribution.
- Balance loads across all phases to reduce neutral currents – distribution.
- Avoid phase-by-phase grouping of single core cables in parallel circuits – distribution.

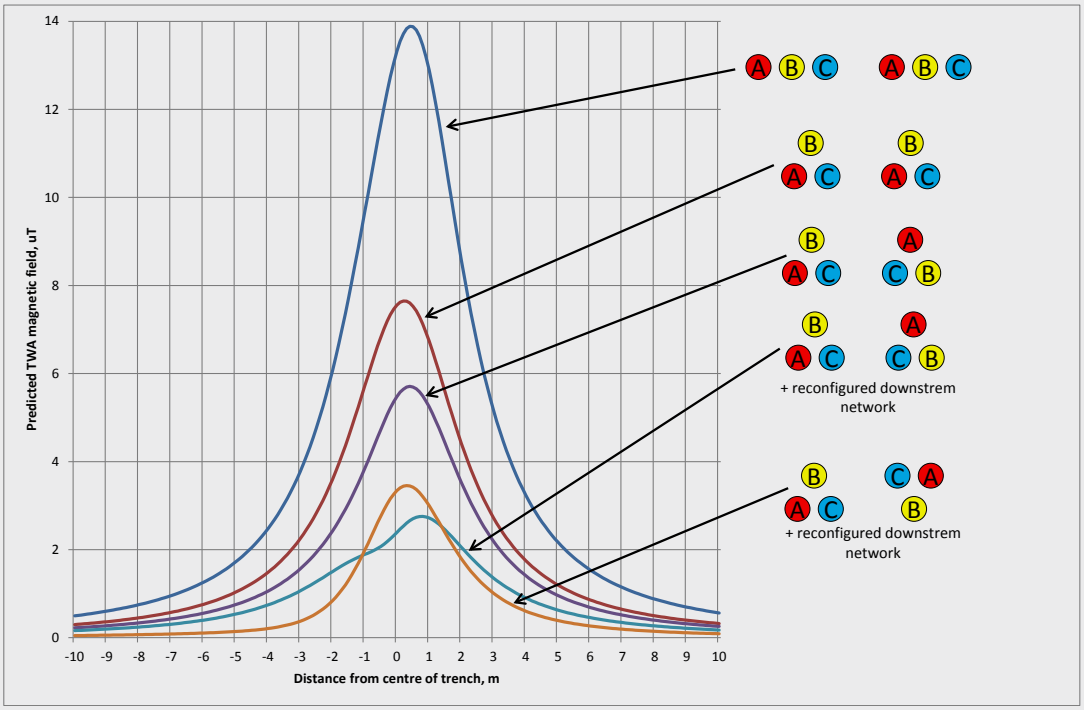
For further information see Sections 9.3 and 9.4.

APPENDIX 2 - WORKED EXAMPLES OF PRUDENT AVOIDANCE

THE FOLLOWING CASE STUDIES ARE PROVIDED AS EXAMPLES ONLY.

In practice the application of prudent avoidance / precaution will depend on the unique set of circumstances and must be considered on a case by case basis.

FIGURE A2.1



Double circuit underground transmission line

A 10km 132kV underground double circuit feeder was proposed to connect two substations. The cables were to be installed within the roadway and run through predominately residential areas.

No cost/very low cost measures such as trefoil and optimising the phasing could be implemented in this case without any material impact on cable rating and were shown to be able to reduce the field levels by around 50% at the nearest habitable rooms from the cables (compared to standard flat formation).

Despite the low magnetic field levels compared to an equivalent overhead line, some members of the community raised concerns and in response to these concerns, measures were investigated to further reduce the magnetic fields.

A further no cost/very low cost measure included changing switching points on the downstream network to improve the balancing of the feeders. This increased the overall reduction to around 70%.

Inverting one of the trefoils was shown to increase the overall reduction to around 85% (see Figure 9-7). This measure was investigated from a ratings and constructability viewpoint and found to be feasible for this project. Implementing this measure would incur an additional cost for a new mould to hold the inverted trefoil.

A number of alternative routes were also evaluated. These were considered to unduly compromise other issues in the context of this project because of environmental impacts, construction risk and cost. All other proposed measures were adopted.

In all, the proposed measures would achieve an overall reduction around 85% at the nearest habitable rooms. The cost for new mould was a very low one off cost and could be used for future projects.

New overhead 132kV powerline

A 10km, 132kV overhead line was proposed to connect two substations, traversing predominately residential areas. A compact delta construction was proposed for the length of the route.

The predicted ultimate TWA magnetic field at the nearest habitable rooms under ultimate loading conditions at the property boundaries in most cases was around 2 μT. This decreased to around 1 μT for most of the 100 residential buildings involved.

Undergrounding would reduce the magnetic field at the nearest residential buildings by around 85%, but the cost to underground was estimated to be an extra $12M (or 600%). This was clearly outside the scope of prudent avoidance / precaution.

A number of magnetic field reduction options such as spilt phasing and raising the height of the conductors with larger poles were put to the community. However, given the additional visual and amenity issues there was a strong community resistance to these measures.

An alternative route through bushland was considered, but it involved additional construction risk, environmental impacts, planning approval risk and an additional cost of $1M. For these reasons this route was considered to be outside the scope of prudent avoidance / precaution.

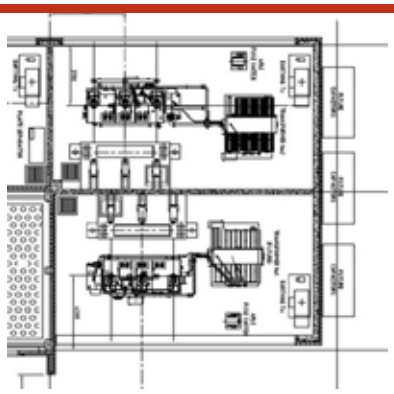
The only very low cost alternative routing for the powerline involved one short section which passed 10 houses. The additional cost for rerouting this section through a disused easement was $20k. Considering the project objectives, a decision was made to reroute this section.

New double circuit overhead 132kV powerline

A double circuit 7km 132kV overhead line was proposed to connect two substations. Initially only one circuit would be required with the second circuit required in 7 years based on current projections. The route was chosen after extensive community consultation and was considered the most appropriate taking into account all project objectives. The circuits would ultimately be reversed phased as a very low cost means of reducing the magnetic field.

The predicted ultimate TWA magnetic field at the nearest habitable rooms was around 0.5 μT. Without the reverse phasing this figure would be around 1.8 μT. With only one circuit operational (as would be the case for the first 7 years), the predicted magnetic field would be around 1.0 μT for the first 7 years.

A decision was made to adopt spilt phasing of the line for the first 7 years of operation (see Section 9.1.4). The cost of this measure was considered low in the context of the project and would result in a magnetic field reduction of around 80% for the first 7 years of operation.



New zone substation

A new zone substation was proposed in a residential area adjoining two residential properties. The key sources of magnetic fields within the substation were the transformers' secondary connections, cable runs, and capacitor banks. The predicted ultimate TWA magnetic field at the nearest habitable rooms ranged from 0.3 to 2.5 μT.

A number of measures were investigated to reduce the magnetic fields from the substation.

Placing the transformers back to back, thereby enabling the fields from the secondary cable risers to in part cancel each other out. The unique nature of the site involving two transformer runways enabled this measure to be undertaken at very low cost.

The cable runs from the transformers to the switch room were redesigned to group the cables in trefoil and use an optimum phasing arrangement.

The site layout was also redesigned to site the capacitor banks further away from habitable areas.

In all the proposed measures would achieve an overall reduction in excess of 50% at the substation boundary and over 60% at the nearest habitable area. The proposed measures were considered to be very low cost in the context of the project, had some technical advantages and took into account the concerns of the neighbouring residents.

Existing distribution line

The conductors from an existing overhead powerline are approximately 3 metres from a residential apartment. The measured fields range from 2-5 μT at the part of the apartment nearest to the powerline, decreasing to 1-3 μT at the centre of the nearest habitable rooms. The family of three has enquired about reducing the fields from the powerline.

To underground the line past the residence would cost around $40,000, given the current network configuration and work required. Bundling of the conductors would cost around $10,000, again given the current network configuration and work required.

Both of these reduction measures are outside the scope of 'very low cost' and hence could not be justified.

However, this case was unusual as it was noted that the fields are generally decreasing from the line at a rate of 1/d as opposed to $1/d^2$. This suggested that there was a high residual current in the line. Further testing revealed a loose neutral connection which was subsequently tightened. Testing showed that the field levels in the nearest habitable rooms had approximately halved.

New distribution substation

A new padmount substation was required in a residential area. There were a number of potential sites available to site the substation.

While not in the initially preferred location, a site was found away from residential buildings within a park. Given the low marginal cost, the negligible impact on technical requirements, and community preferences, a decision was made to site the substation within the park.

No magnetic field calculations were undertaken.

New chamber substation

At the request of a developer, a new chamber substation was proposed for a commercial development. An office area was located directly above the substation.

The predicted ultimate TWA magnetic field levels in the office area were generally in the range of 2-2.5 µT. One workstation had field levels of 8-10 µT as it was directly above the LV board. Being a new substation it was considered prudent to relocate and trefoil the medium voltage and low voltage cables away from the area directly below the office. This resulted in reducing the magnetic fields to 0.5-1 µT for all but one workstation. The developer chose the site for the substation and there were no very low cost alternative sites. It was also not practical to move the location for the LV board. The developer made a decision to rearrange the workstations as far as practical to reduce exposure. Mu metal shielding was considered, however, it was considered by the developer to outside the scope of prudent avoidance / precaution

Proposed development near an existing transmission line

A developer was proposing a new child care centre next to a transmission line. The field levels throughout the property typically ranged from 1.5-2.5 µT throughout the day, decreasing with distance from the line to an average of 0.2-0.6 µT at the furthest point on the property from the line. As the developer was not proposing to encroach onto the easement, the local council was the sole approving authority.

In early discussions, the council advised that they would want to see a consideration of prudent avoidance / precaution measures. They clarified that this meant a consideration of very low cost practical measures that could be implemented to reduce exposure for those who would spend most time at the centre.

As the development was in the early stages of design, a number of alternative layouts were still open for consideration by the developer. A layout was chosen which had the car park located closest to the line followed by the entry, storage areas and toilets. The sleeping and play areas were located furthest from the line.

As the development was in the early stages and given the nature of the site, the overall cost to the developer of these measures were minimal.

The council was satisfied that there was an appropriate application of prudent avoidance / precaution and approved the development.

APPENDIX 3 - EMF MEASUREMENT CONSIDERATIONS

THE FOLLOWING SECTIONS PROVIDE ADDITIONAL GUIDANCE FOR MEASURING ELECTRIC AND MAGNETIC FIELDS.

A3.1 ELECTRIC FIELD MEASUREMENT CONSIDERATIONS

Because electric fields are shielded by most objects, other than in flat open areas, they are rarely uniform. Accordingly, the context of the measurements needs to be understood and care needs to be taken in extrapolating from one situation to another.

Electric field measurement instruments in most cases are single-axis. The electric field adjacent to a conducting surface is normal to the surface, Therefore, the horizontal component of the electric field, particularly where it is generated by overhead lines, can be ignored close to the ground surface. Single-axis measurement (vertical component) is therefore sufficient near the ground.

Particular care must be taken in the presence of conducting objects or when the clearance of the conductor from the ground is small.

To reduce perturbation of a measured electric field as a result of the operator, the distance between the electric field measurement instrument and the operator should be at least 1.5 m and 3 m is recommended.

In order to take electric field level measurements representing the unperturbed field at a given location, the area should be free as far as possible from other powerlines, towers, trees, fences, tall grass, or other irregularities. It is preferred that the location should be relatively flat. It should be noted that the influence of vegetation on the electric field level can be significant. In general, field enhancement occurs above individual items of vegetation and field attenuation occurs near the sides. Field perturbation can depend markedly on the water content in the vegetation.

Electric field measurement may also be perturbed if the relative humidity is more than 70 % due to condensation effect on the probe and support. The ability of the field meter to work correctly under those conditions should be checked before measurement.

Electric field meters should be calibrated in accordance with manufacturer's recommendations.

A3.2 MAGNETIC FIELD MEASUREMENT CONSIDERATIONS

When taking magnetic field measurements, it must be remembered that they represent a point in time. At other times, the magnetic field in a particular area could be higher or lower than recorded in a single set of measurements. When measuring the fields associated with a utility asset, knowledge of the source(s), phasing and currents at the time of the measurements will assist in understanding the fields under other conditions.

In most cases it is preferable to undertake magnetic field measurements with a three-axis meter which calculates the resultant field. If a single-axis instrument is used, the following equation can be used to determine the resultant field (provided that the field level remains stable during the time taken to perform the measurements).

Resultant field = $(X^2+Y^2+Z^2)^{1/2}$

A single-axis instrument can be used to determine the direction of the field or undertake more detailed investigations as may be required for hidden sources. A single axis meter could also be used where the direction of the field is known and value of the semi-minor axis of the field ellipse is significantly smaller than that of the semi-major axis (such as a single current source or a 3-phase line where the line to ground distance is much larger than the phase-to-phase distance).

The following principles may be helpful when undertaking investigations and using a magnetic single axis meter or meter that measures X, Y and Z components.

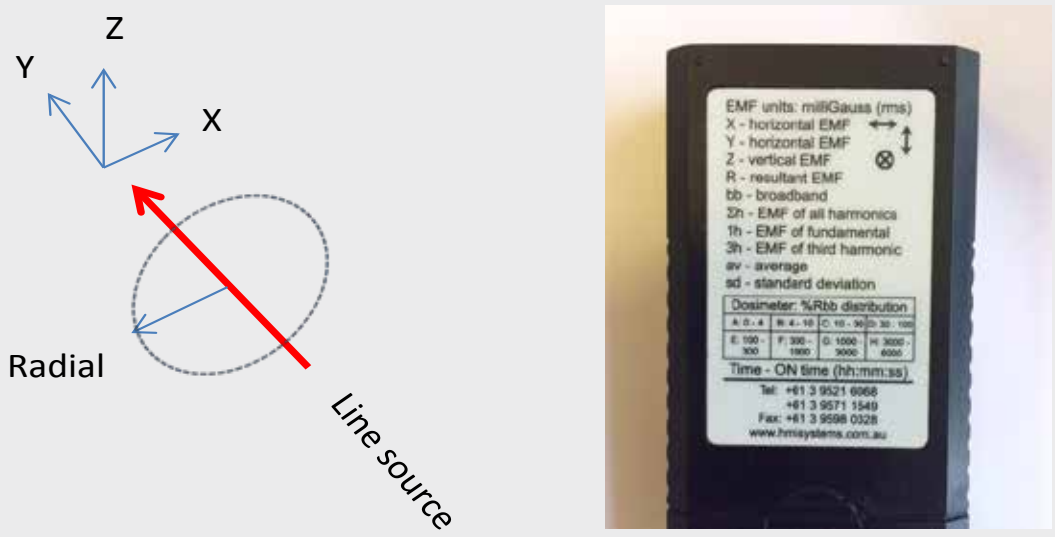
The magnetic field lines for straight line sources will always lie in a vertical plane (X Z plane) perpendicular to the source (Y axis). There will be no Y component.

- The magnetic field direction for a single phase line source will be perpendicular to the radial and therefore horizontal (X component) under the line.
- The magnetic field direction for a horizontal 3ph line will be predominantly vertical (larger Z component) under the line approaching perpendicular to the radial at a distance from the source.
- The magnetic field direction for a vertical 3ph line will be predominantly horizontal (larger X component) under the line and approaching the radial at a distance from the source.
- The magnetic field direction for a delta 3ph line will be highly elliptical (both X and Z components) under the line and approach circular polarisation (similar X and Z components) at a distance from the source.
- The magnetic field direction for a vertical double circuit line (same phasing) will be predominantly horizontal (larger X component) under the line.
- The magnetic field direction for a vertical double circuit line (transposed phasing) will be predominantly vertical (larger Z component) under the line.
- The magnetic field from a single conductor will decrease with the inverse of the distance from source.
- The magnetic field from a three phase line and balanced double circuit (same phasing) will generally decrease with the square of the distance from the source.
- The magnetic field from a balanced double circuit (transposed phasing) will generally decrease with the cubed of the distance from the source.
- The magnetic field from a three phase line with residual current (i.e. three phases and neutral net balance is not zero) will, at a distance from the source, decrease with the inverse of the distance from source.

Magnetic fields from powerlines are typically measured horizontally along the ground. The distance to the source referred to above is the distance to the conductors.

When undertaking measurements the meter should be within calibration as recommended by the meter manufacturer. Further, where fields are highly non-uniform, have high harmonics or are changing rapidly, there should be an understanding of the meters sampling frequency, frequency response, sensor size and sensor location.

FIGURE A3.1 MAGNETIC SINGLE AXIS METER



APPENDIX 4 - ELECTRICAL LOADING

The electrical load and therefore the magnetic field on any powerline or substation (and some appliances) vary continually with time.

Figure A4-1 shows a sample of average residential electricity load profiles for different times of the day and year. An example of an annual load duration curve for a feeder is shown in Figure A4-2.

The situation is further complicated for distribution lines as load is usually progressively tapped off along the line, the loads are typically not balanced between phases and there is often a residual earth return current (see Section 9.1.9)

In addition, changes in load growth patterns or system requirements may alter future load flows on any line in the network. An example of load forecasts for a feeder is shown in Figure A4-3.

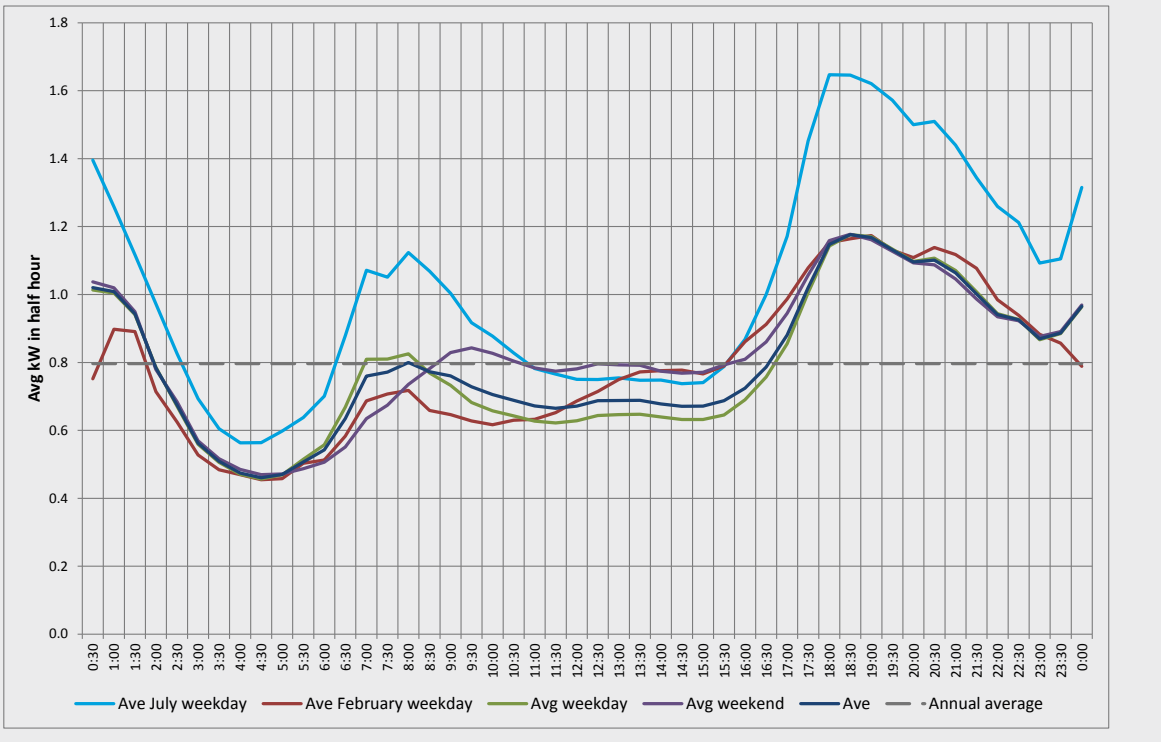
This means that any reference to a magnetic field level needs to make some assumptions regarding the conditions under which this value occurs.

Figure A4-4 shows different loading conditions for a powerline.

For compliance assessments against the exposure limits, the load of interest is typically the short term emergency rating (see Section 6.3).

For prudent avoidance / precaution assessments, the most relevant load is the TWA (see Section 8.1).

FIGURE A4.1 TYPICAL RESIDENTIAL DAILY DISTRIBUTION LOAD PROFILES



* Sourced from Ausgrid's Solar home electricity data - 1 July 2010 to 30 June 2011 (300 households)

FIGURE A4.2 EXAMPLE ANNUAL LOAD DURATION CURVE FOR A 132KV FEEDER

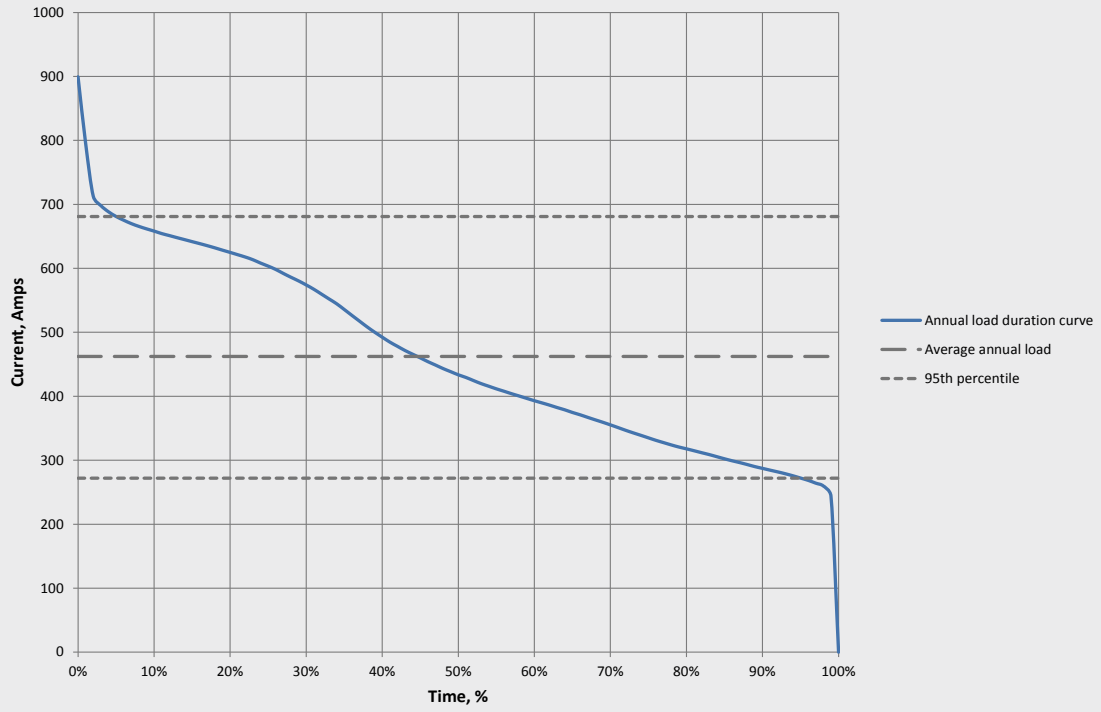


FIGURE A4.3 EXAMPLE LOAD FORECAST FOR A NEW OVERHEAD 33KV FEEDER

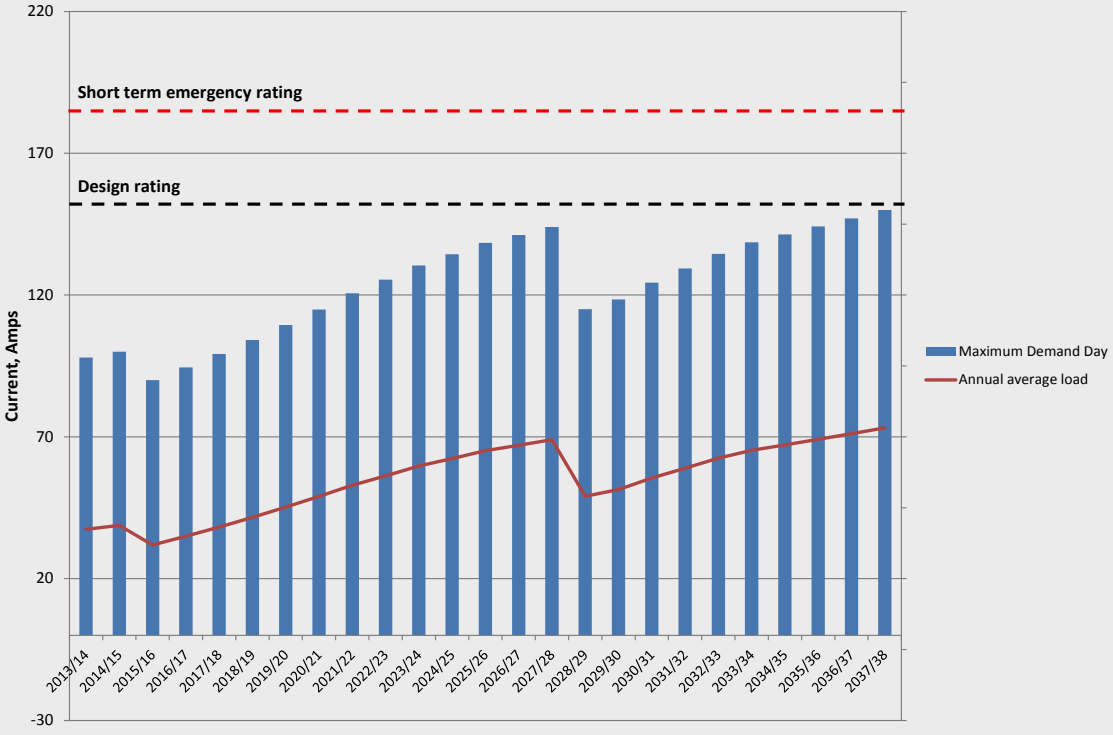
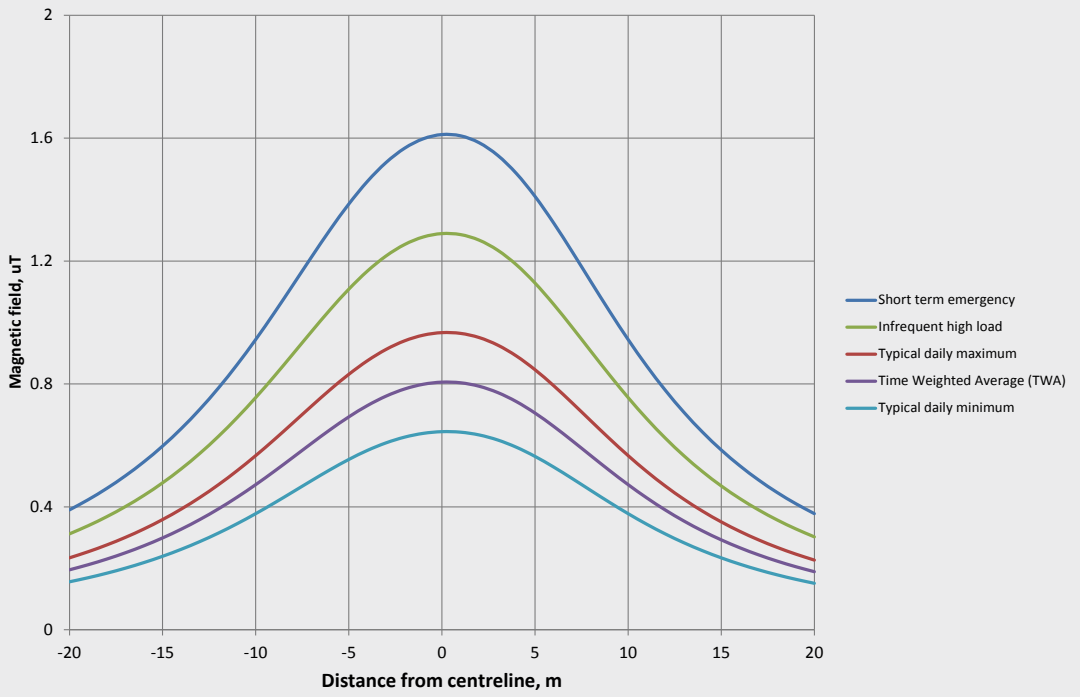


FIGURE A4.4 EXAMPLE MAGNETIC FIELD PROFILES FOR A POWERLINE UNDER DIFFERENT LOADING CONDITIONS



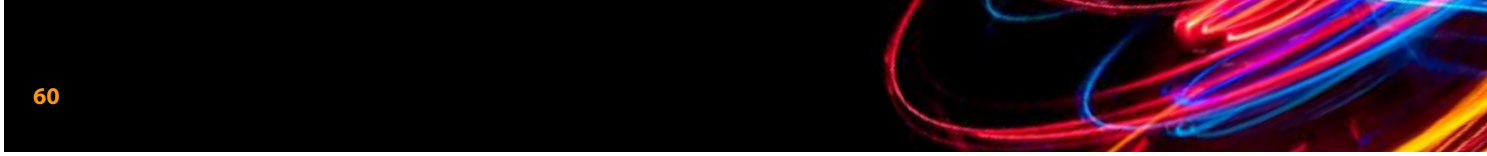
Short Time Emergency Load – Typically used when assessment compliance against the guidelines (see Section 6). This load could be the short time thermal limit and may in practice never be reached on a line.

Infrequent High Load – The yearly peak with the system substantially normal.

Typical Daily Maximum - The peak value reached for the line on a typical day

Time Weighted Average (TWA) Load – Typically used when assessing the application of prudent avoidance / precaution (see Section 7).

Typical Daily Minimum - The minimum value reached for the line on a typical day



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