LAKE VERMONT MEADOWBROOK PROJECT

TERRESTRIAL ECOLOGY ASSESSMENT

PREPARED FOR
BOWEN BASIN COAL PTY LTD

January 2023

ENVIRONMENTAL SOLUTIONS

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1 Introduction

1.1 Background

AARC Environmental Solutions Pty Ltd (AARC) has been commissioned by Bowen Basin Coal Pty Ltd (Bowen Basin Coal) to conduct a Terrestrial Ecology Assessment for the Lake Vermont Meadowbrook Project (the Project) Environmental Impact Statement (EIS).

The Project is located approximately 160 km south-west of Mackay and approximately 25 km north-east of Dysart in the Bowen Basin region of central Queensland (Figure 1.1).

The Project represents an extension of mining activities at the existing Lake Vermont Mine and involves underground longwall mining and open cut mining activities and the development of supporting infrastructure. The existing Lake Vermont Mine operates within Mining Lease (ML) 70331, ML 70477 and ML 70528 (Figure 1.2) in accordance with Environmental Authority (EA) Permit No. EPML00659513.

The Project maximises the use of land owned by Bowen Basin Coal and infrastructure at the Lake Vermont Mine to minimise the environmental impacts from additional infrastructure and provide Project efficiencies. The proposed Project extension footprint lies within Mineral Development Licence (MDL) 303 and MDL 429 held by the proponent. Bowen Basin Coal intends to submit a future Mining Lease Application (MLA) over MDL 303 and MDL 429.

Key components of the Project include:

- underground longwall mining of the Leichhardt Lower Seam and Vermont Lower Seam; the depth and thickness of the coal seams in the Project area means the coal resource can be extracted using underground mining methods;
- an open cut satellite pit to mine the Leichhardt Lower Seam, Vermont Seam and Vermont Lower Seam;
- development of a new infrastructure corridor linking the new mining area to the existing infrastructure of the Lake Vermont Mine;
- development of a mine infrastructure area (MIA);
- construction of drifts and a portal to provide access to underground operations; and
- development of other supporting infrastructure and associated activities.

The conceptual layout of the Project is shown in Figure 1.3.

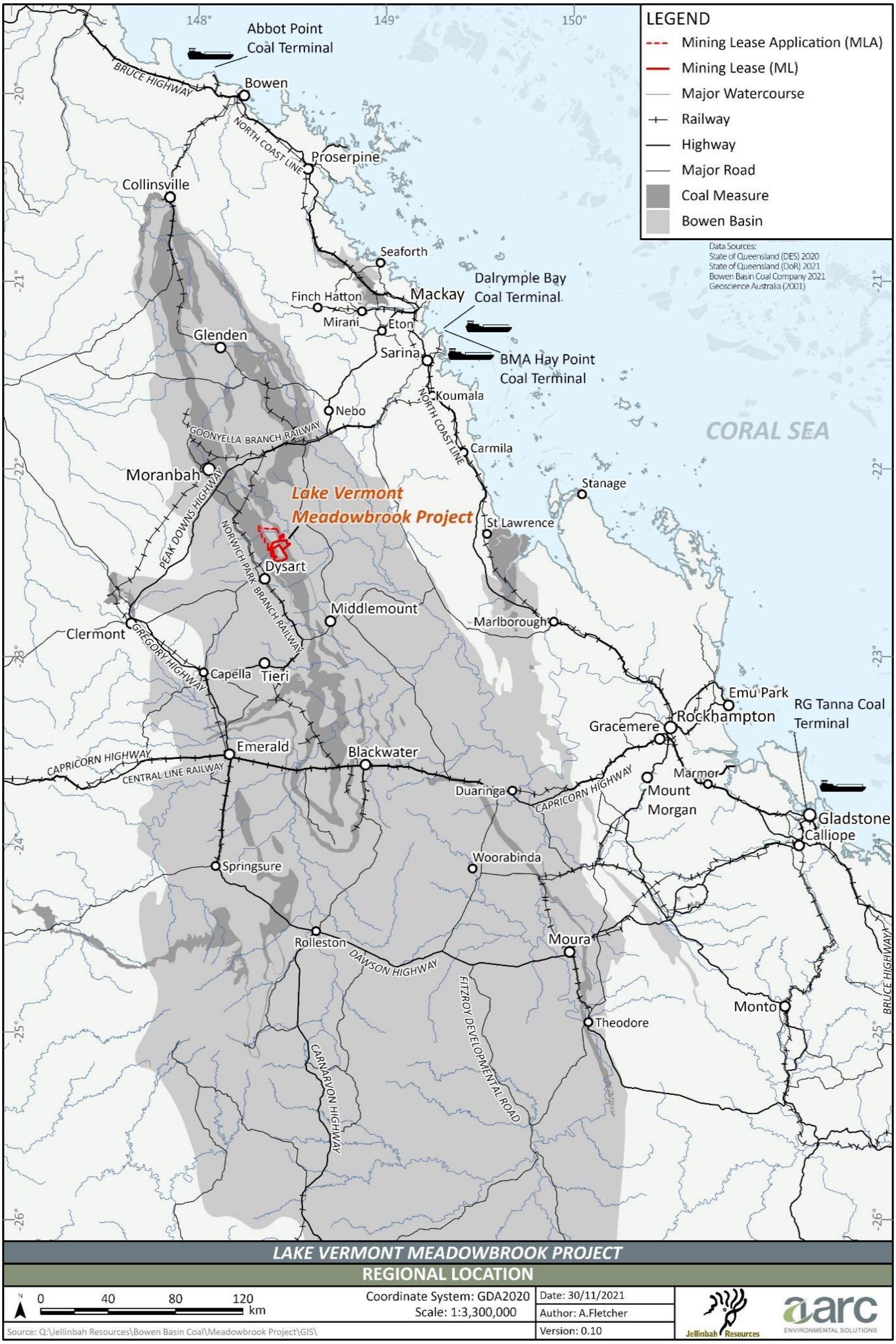


Figure 1.1: Regional location

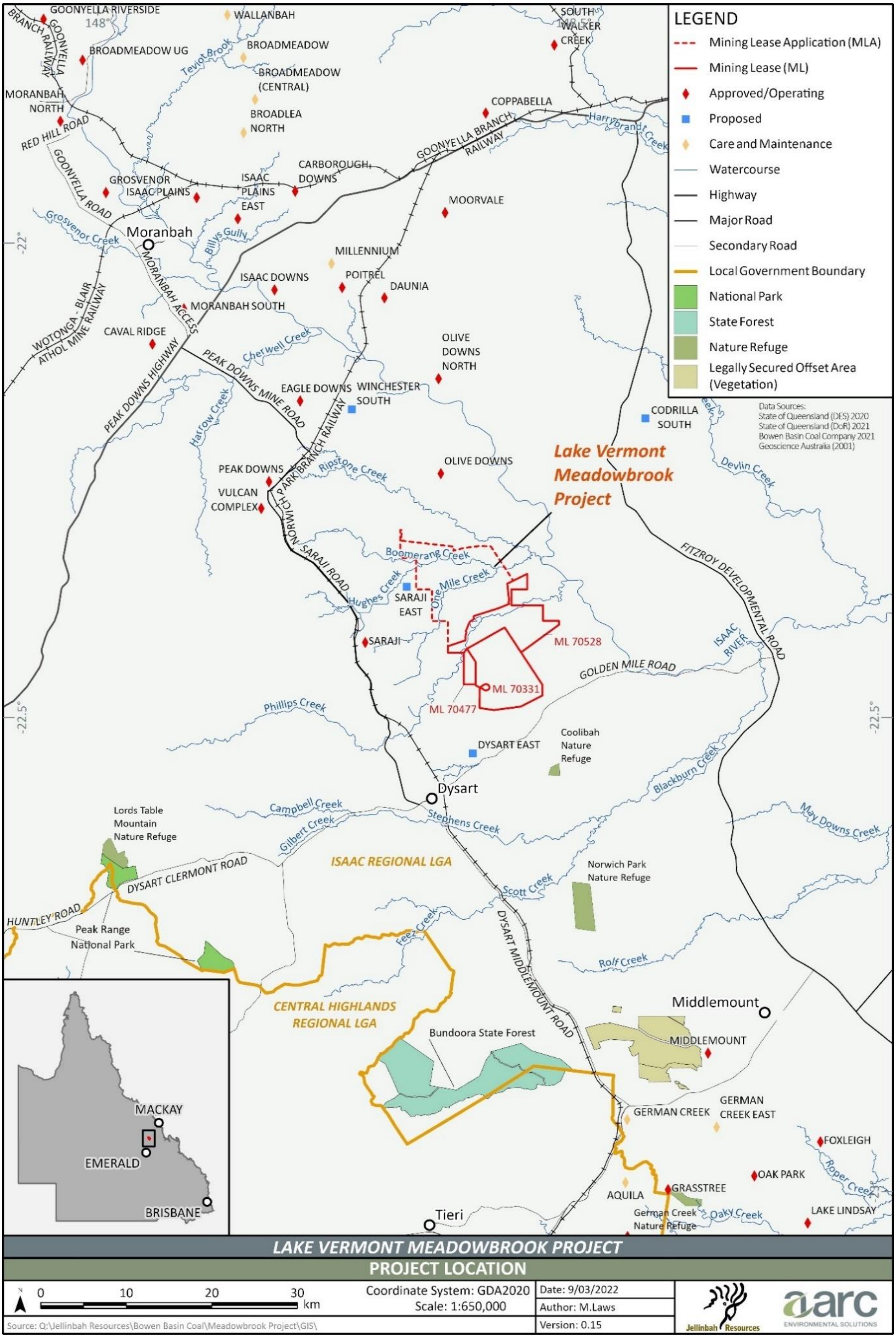


Figure 1.2: Project location

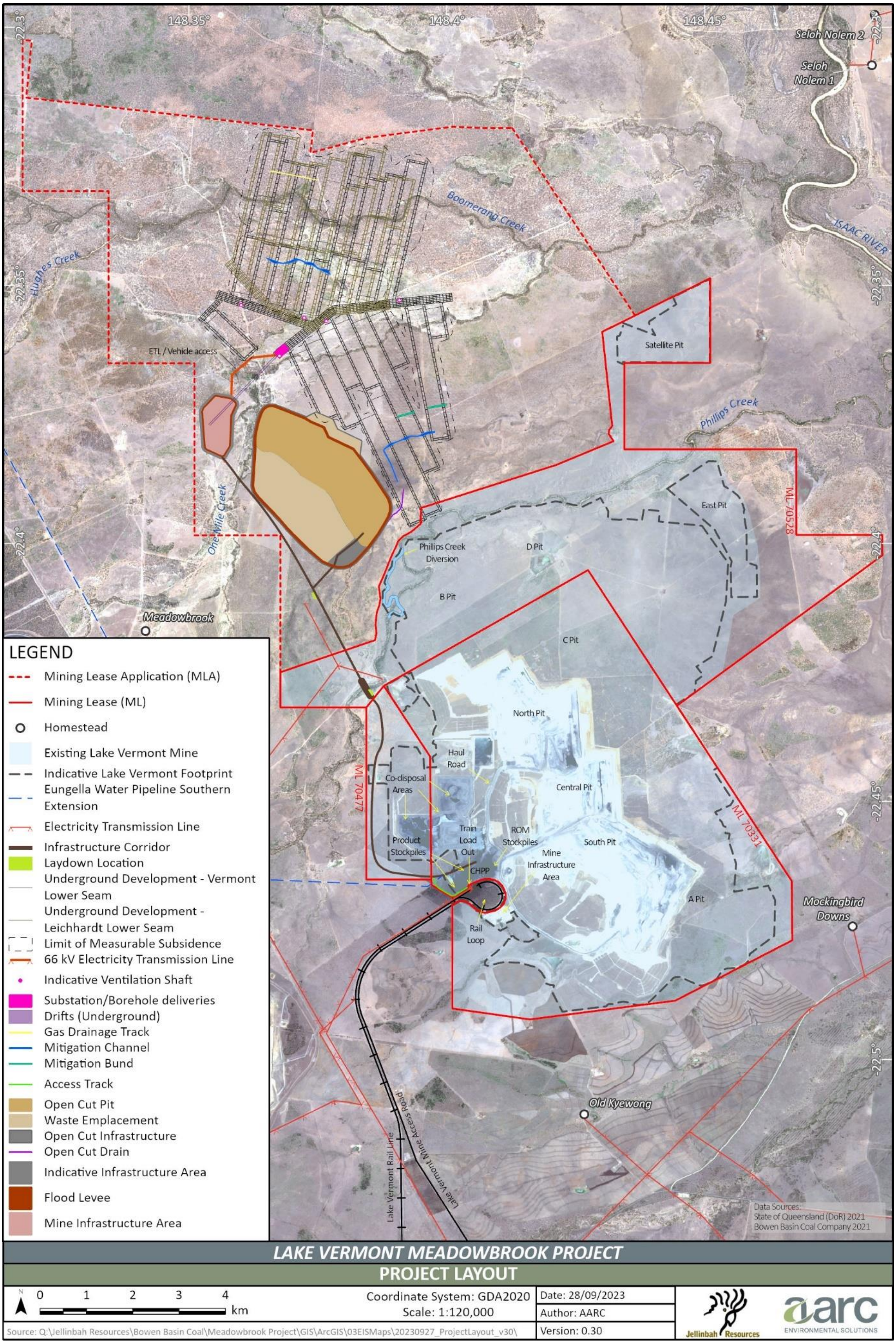


Figure 1.3: Conceptual Project layout

1.2 Study objectives

This report assesses the terrestrial ecological values of the Project and surrounds and the potential impacts of the Project on these values. Specifically, this report:

- identifies legislation and policies relevant to the Project and terrestrial flora and fauna;
- describes the desktop assessments conducted on the Project to identify conservation significant species and ecological communities that have potential to occur within the study area;
- describes the seasonal and targeted terrestrial flora and fauna surveys conducted on the Project and the results of the surveys;
- provides comprehensive flora and fauna species lists for the study area;
- provides Regional Ecosystem (RE) mapping in accordance with the 'Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland' (Neldner *et al.* 2019);
- identifies the presence of Matters of State Environmental Significance (MSES), Matters of National Environmental Significance (MNES) and their habitats;
- assesses the potential direct, indirect and cumulative impacts of the Project on terrestrial species and ecosystems and proposes measures to avoid, minimise or mitigate the impacts; and
- identifies the likely requirements for any offsets under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act) and/or the Queensland *Environmental Offsets Act 2014* (EO Act).

2 Regional setting

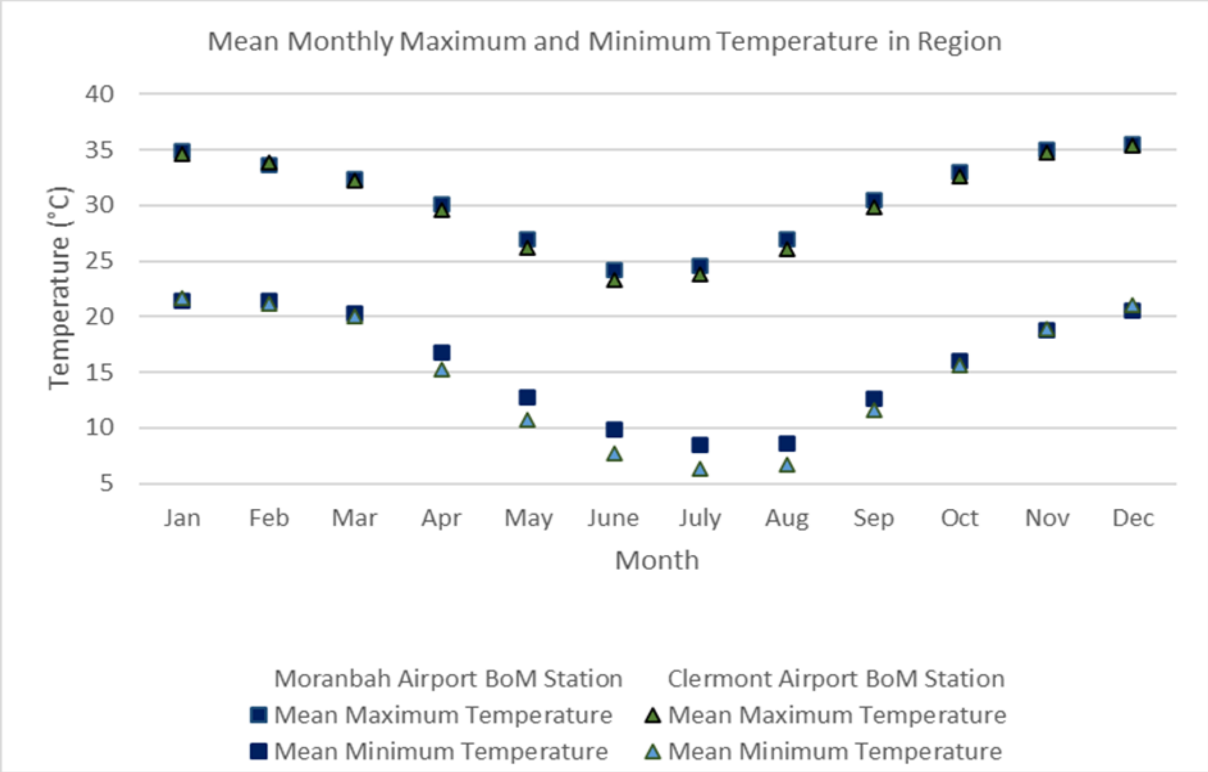
The Project is within the Brigalow Belt Bioregion (Figure 2.1), which occupies over a fifth of Queensland, extending from Townsville in the north to a region close to the border of New South Wales in the south. The Brigalow Belt Bioregion encompasses a broad climatic gradient and a diversity of soils and topography and is host to a high diversity of flora and fauna (DES 2018). The Brigalow Belt Bioregion is divided into two regions by the Great Dividing Range—the Brigalow Belt South Bioregion and the Brigalow Belt North Bioregion. The Project is within the Brigalow Belt North Bioregion (DoEE 2016a) (Figure 2.1) and is characterised by woodlands of Ironbark's (*Eucalyptus melanophloia, E. crebra*), Poplar Box (*E. populnea*), Browns Box (*E. brownii*), Brigalow (*Acacia harpophylla*), Blackwood (*A. argyrodendron*) and Gidgee (*A. cambagei*) (NRS 2000).

The Project is also located within the Fitzroy River Basin, which encompasses an area of 142,545 km^2 and contains the Comet, Dawson, Fitzroy, Isaac, Nogoa, and Mackenzie River sub-catchment areas (BoM 2020a). The Project lies within the Isaac River sub-catchment, which covers a total area of 22,364 km^2 and comprises the catchments of the Isaac and Connors Rivers. The Isaac River is approximately 4.2 km to the east of the study area. The Isaac River flows south from north of Moranbah and converges with the Mackenzie River approximately 150 km south-east of the study area. The Mackenzie River converges with the Dawson River to form the Fitzroy River, which eventually discharges into the Coral Sea south-east of Rockhampton.

The region is described as subhumid, semi-tropical to semi-arid with predominantly summer rainfall (DEWHA 2008a, DoEE 2016a). Based on data sourced from the Bureau of Meteorology (BoM) Weather Station at the Moranbah Airport spanning 2012 to 2022 (BoM 2020b), mean maximum monthly temperatures range between 24.1°C in June and 35.4°C in December and mean minimum monthly temperatures range between 8.5°C in July and 21.5°C in January (Figure 2.2). Mean maximum and minimum monthly temperatures recorded at the Clermont Airport spanning 2010 to 2022 (BoM 2020c) show a similar trend in temperature (Figure 2.2).

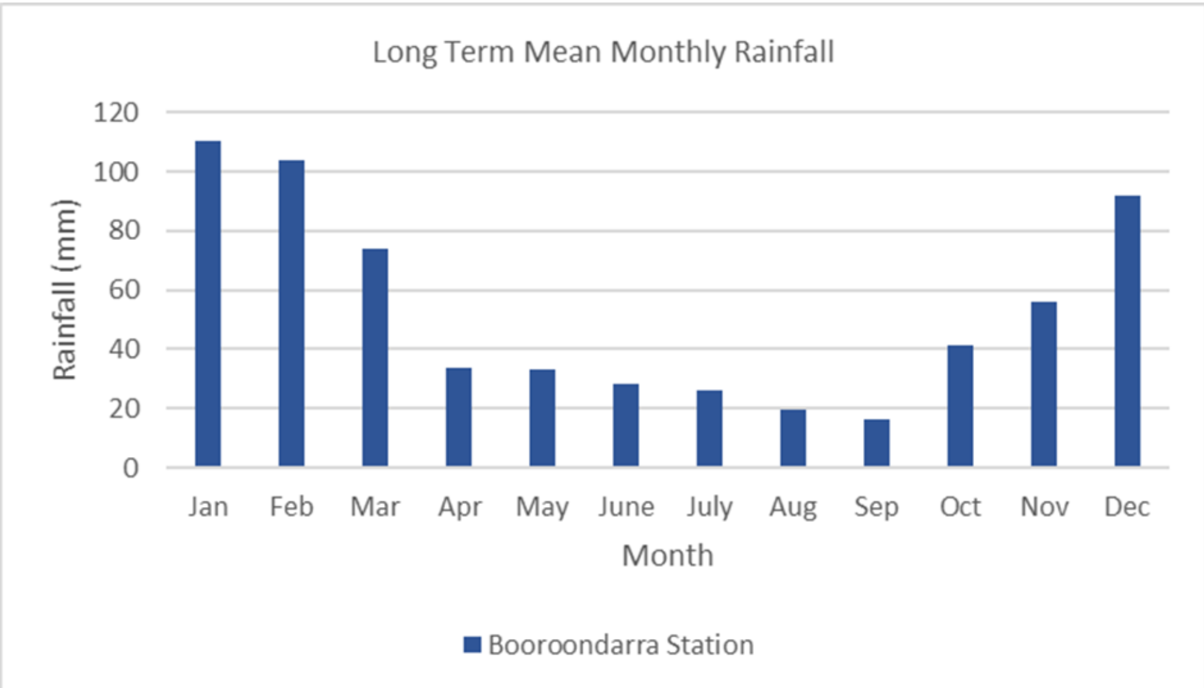
The Booroondarra BoM Weather Station (BoM 2020d) is approximately 30 km south of Dysart and approximately 45 km south of the study area. Mean monthly rainfall recorded at the Booroondarra station indicates that April to September are typically drier months, with mean monthly rainfall ranging from 16.1 mm to 33.8 mm (Figure 2.3).

Figure 2.1: Brigalow Belt Bioregion



Source: (BoM 2020b, BoM 2020c)

Figure 2.2: Regional mean monthly maximum and minimum temperatures



Source: (BoM 2020d)

Figure 2.3: Regional mean monthly rainfall

October through to March signifies the wet season, with mean monthly rainfall ranging from 41.3 mm to 73.7 mm recorded at Booroondarra station. Rainfall is considered a major trigger for increased activity in many species within the Brigalow Belt Bioregion (Eyre *et al.* 2018).

Land use within the Brigalow Belt North Bioregion is primarily beef cattle grazing on pastoral leases; however, coal mining is a major regional economic driver (DEWHA 2008a). Resource developments (approved and proposed) that occur within 50 km of the Project are provided in Table 2.1. Nearby mining developments are also shown in Figure 1.2.

Arrow Energy's Bowen Gas Project involves the development of coal seam gas (CSG) resources in an area approximately 8,000 km^2 that extends from approximately 30 km north of Glenden to 10 km south of Blackwater. The Bowen Gas Project is not shown on Figure 1.2; however, it includes Authority to Prospect (ATP) tenements that overlie the Project.

Table 2.1: Nearby developments

Mine/Project	Proponent	Approximate distance/direction from study area
Bowen Gas Project	Arrow Energy	Authority to Prospect (ATP) 1031 and ATP 1031 overly the Project
Saraji	BHP Mitsubishi Alliance (BMA)	5 km west
Saraji East Project (proposed)	BMA	Borders the western boundary of the study area and Lake Vermont Mine
Olive Downs/Olive Downs North	Pembroke Olive Downs Pty Ltd	2 km to 40 km north
Winchester South Project (proposed)	Whitehaven Coal Pty Ltd	8 km north north-west
Eagle Downs	Bowen Central Coal Joint Venture Parties	13 km north-west
Vulcan Complex	Vitrinite	20 km north-west
Dysart East	Bengal Coal Pty Ltd	20 km south
Peak Downs	BM Alliance Coal Operations Pty Ltd	25 km north-west
Dauhnia	BMA	35 km north
Caval Ridge	BMA	45 km north-west
Poitrel	BHP Mitsui and Co (BMC)	35 km north
Millennium	MetRes	40 km north
Isaac Downs	Stanmore IP South Pty Ltd	40 km north-west
Moorvale	Peabody Energy	45 km north
Moranbah South	Anglo Coal (Grosvenor) Pty Ltd and Exxaro Australia Pty Ltd	45 km north-west
Isaac Plains East	Stanmore IP Coal Pty Ltd	50 km north-west

Protected areas in Queensland include national parks and nature refuges and other areas established under the Queensland *Nature Conservation Act 1992*. The Coolibah Nature Refuge, Norwich Park Nature Refuge, Lords Table Mountain Nature Refuge and Peak Range National Park are approximately 13 km to the south, 25 km to the south, 45 km to the south-west and 45 km to the south-west, respectively (Figure 1.2). There are no World Heritage areas within the Project area or surrounds.

3 Description of the study area and surrounds

The terrestrial ecology study area for the Project is shown on Figure 3.1 and covers an area of approximately 8,919 ha. The study area includes the extent of the Project footprint and adjoining areas. Sections 3.1 to 3.3 provide an overview of the study area and surrounds.

3.1 Hydrology

A number of tributaries of the Isaac River traverse the study area in an easterly direction. These tributaries include Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek (Figure 3.1).

Boomerang Creek is an ephemeral fifth order stream that traverses the northern portion of the study area (Figure 3.1). Hughes Creek flows into Boomerang Creek near the western boundary of MDL 429. The headwaters of Boomerang Creek and Hughes Creek occur to the west of the study area and traverse the tenure of the Saraji Mine.

One Mile Creek, a third order stream, traverses the study area from the south-west until its confluence with Boomerang Creek towards the north-eastern boundary of the study area.

Phillips Creek is a fourth order stream that traverses the proposed Project infrastructure corridor within ML 70528 (Figure 1.3 and Figure 3.1). It continues to meander in an easterly direction to the south of the study area before converging with the Isaac River (Figure 3.1).

Boomerang Creek, Hughes Creek, One Mile Creek, Phillips Creek and the Isaac River are defined watercourses under the Queensland *Water Act 2000.*

Ripstone Creek, also a third order stream, occurs to the north of the study area and flows eastward before flowing into Boomerang Creek to the east of the study area (Figure 3.1). The Olive Downs Coking Coal Project has approval to divert a section of Ripstone Creek to the north of the study area.

3.2 Land use

Land within the study area is currently used for cattle grazing of native pastures and for resource exploration activities. Queensland Land Use Mapping classifies the study area as ‘Grazing Native Vegetation’. Other dominant land uses in the vicinity of the study area include ‘Mining’ and ‘Cropping’.

The existing Lake Vermont Mine (to which the Project is an extension) primarily produces hard coking coal and low volatile Pulverised Coal Injection (PCI) coal. Product coal is railed along the Lake Vermont spur line to the RG Tanna Coal Terminal in Gladstone or Abbot Point Coal Terminal in Bowen for export (Figure 1.1). The mine also has the capability of railing coal to the Dalrymple Bay Coal Terminal in Mackay when opportunities permit.

The Vermont Coal Project EIS (for the existing Lake Vermont Mine) was submitted in 2004 (Minserve 2004), with approval granted in 2005. The Lake Vermont Mine has undergone two extensions since its original approval:

1) the Western Infrastructure Extension (2012); and
2) the Lake Vermont Northern Extension Project (2015).

The Western Infrastructure Extension provided for the construction of new supporting infrastructure for the Lake Vermont Mine within ML 70477. The Lake Vermont Northern Extension Project provided for open cut mining of coal resources located within ML 70528.

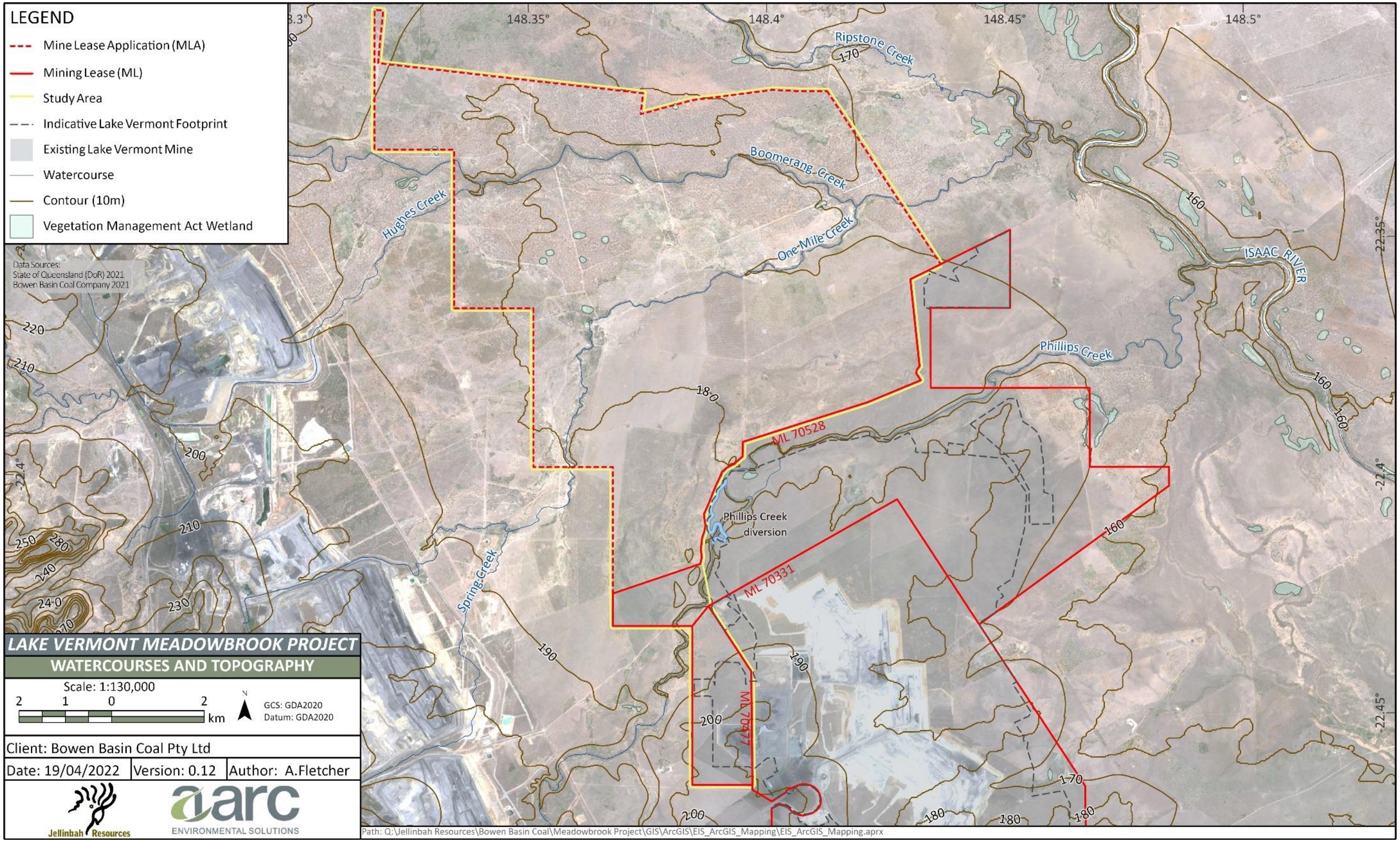


Figure 3.1: Waterways and topography

The Saraji Mine and the proposed Saraji East Project border the Project tenure to the west, whilst the Olive Downs Coking Coal Project is approximately two kilometres to the north. The Winchester South Project is approximately 8 km to the north-northwest. The study area overlaps with existing petroleum tenements, specifically those for Arrow Energy's Bowen Gas Project.

3.3 Topography, land zones and soils

The topography of the study area is generally flat to gently undulating, with elevations ranging between 160 m and 190 m Australian Height Datum (AHD) (Figure 3.1). This is representative of the surrounding region.

The following land zones (and associated soil types) occur within the study area:

- **Land Zone 3: Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence, inland lakes and associated wave-built lunettes (Wilson and Taylor 2012)**. Land Zone 3 excludes colluvial deposits such as talus slopes and pediments. This Land Zone includes a diverse range of soils predominantly Vertosols and Sodosols (Wilson and Taylor 2012). Land Zone 3 also occurs with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols and Organosols in high rainfall areas (Wilson and Taylor 2012).
- **Land Zone 4: Tertiary–early Quaternary clay deposits, usually forming level to gently undulating plains not related to recent Quaternary alluvial systems (Wilson and Taylor 2012)**. This Land Zone mainly occurs with Vertosols with gilgai microrelief. Land Zone 4 also includes thin sandy or loamy surfaced Sodosols and Chromosols with the same paleo-clay subsoil deposits (Wilson and Taylor 2012).
- **Land Zone 5: Tertiary–early Quaternary loamy and sandy plains and plateaus (Wilson and Taylor 2012)**. Land Zone 5 consists of extensive, uniform near level or gently undulating plains with sandy or loamy soils and includes dissected remnants of these surfaces. Soils are usually Tenosols and Kandosols, also minor deep sandy surfaced Sodosols and Chromosols (Wilson and Taylor 2012).

4 Previous terrestrial ecology surveys

The terrestrial ecological values of the existing Lake Vermont Mine have been assessed in studies conducted for the Vermont Coal Project EIS (WBM 2003), the Western Infrastructure Extension (Australasian Resource Consultants 2012) and Lake Vermont Northern Extension Project (Australasian Resource Consultants 2014).

As described in Section 2, a number of existing and proposed resource developments are within the wider surrounds. In particular, extensive ecological surveys and field-validated mapping of vegetation and threatened species habitat have been conducted for the Olive Downs Coking Coal Project to the north and east of the Project, for the Saraji East Project to the west of the Project, and for the Winchester South Project to the north-west of the Project. The results of prior surveys for these developments have been considered in this assessment and are referred to where appropriate. AARC acknowledges and appreciates Pembroke Resources and Whitehaven Coal sharing data from these surveys.

Species of conservation significance recorded by surveys in the wider surrounds, as described in publicly available reports and database searches, are outlined in Appendix A (flora) and Appendix B (fauna).

5 Relevant legislation and policy

5.1 Commonwealth

5.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth EPBC Act provides a framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as MNES. The EPBC Act applies to nine MNES:

1) world heritage properties;
2) national heritage places;
3) wetlands of international importance (Ramsar wetlands);
4) nationally listed threatened species and ecological communities;
5) migratory species;
6) Commonwealth marine areas;
7) the Great Barrier Reef Marine Park;
8) nuclear actions (including uranium mines); and
9) a water resource in relation to coal seam gas development and large coal mining development.

The EPBC Act requires assessment and approval for any activity that has or is likely to have a significant impact on an MNES. The Project was determined to be a controlled action (EPBC Referral 2019/8485) under the EPBC Act on 22 November 2019 (DoEE 2019ca). The relevant controlling provisions for the Project under the Act are:

- listed threatened species and communities (sections 18 and 18A);
- listed migratory species (sections 20 and 20A); and
- a water resource in relation to coal seam gas development and large coal mining development (sections 24D and 24E).

5.1.2 Agreements for migratory species and international conventions

Australia has signed or ratified nearly one hundred environmental treaties which serve as sources of environmental legal obligations (PCA 1999). Providing critical habitat for millions of migratory birds each year, Australia is party to international conventions and agreements to protect migratory species. These include the:

- China–Australia Migratory Bird Agreement (CAMBA);
- Japan–Australia Migratory Bird Agreement (JAMBA);
- Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Each of these agreements provides for the protection and conservation of migratory birds and their important habitats, protection from 'take or trade' except under limited circumstances, the exchange of information and building cooperative relationships (DAWE 2020). Bird species listed within the appendices/annexes of these agreements/conventions are subsequently listed as migratory species under the EPBC Act.

Other international biodiversity conventions to which Australia is party to include the:

- Convention on Biological Diversity (CBD), which is a multilateral treaty with 193 parties, including Australia. The three objectives of the convention are: the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of the benefits arising from the use of genetic resources. The CBD provides an important framework for Australia's integration of natural resources and environment and biodiversity management policies (DAWE 2021). Under the CBD, all parties are required to have a national biodiversity strategy and action plan to guide national implementation of the CBD's Strategic Plan and its Aichi Targets. Australia has reformed its national biodiversity strategy and action plan, which is outlined in 'Australia's Strategy for Nature 2019–2030' (Commonwealth of Australia 2019). The strategy has three priority goals underpinned by 12 objectives:
    - Goal 1: Connect all Australians with Nature.
    - Goal 2: Care for nature in all its diversity.
    - Goal 3: Share and build knowledge.

  Australia's actions for nature includes the implementation of the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), which prioritises action and investment and sets the direction for efforts to recover Australia's threatened plants, animals and ecological communities over the next ten years. Other relevant strategies include (but are not limited to) the 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017-2027' (Commonwealth of Australia 2017b). Australia's obligations under this convention are implemented in accordance with the EPBC Act.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which is an international agreement between governments that aims to ensure that the international trade in wildlife does not threaten wild populations of plants and animals. Australia's obligations under this convention are implemented through the EPBC Act.
- Convention on Conservation of Nature in the South Pacific (Apia Convention) is a multilateral environmental agreement for which the main objective is to take action for the conservation, utilisation and development of the natural resources of the South Pacific region through careful planning and management for the benefit of present and future generations. Many of the commitments made under this Convention have been superseded by the Parties' commitments under the CBD.
- The Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention) aims to promote cooperation among nations to protect heritage of outstanding value around the world and is ratified in Australian law. Australia's obligations under this convention related to the identification, protection, conservation and presentation of World Heritage properties.

5.1.3 Environmental offsets policy

The 'Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy' (DSEWPaC 2012b) outlines the Australian Government's position on the use of environmental offsets. Environmental offsets can be used under the EPBC Act to maintain or enhance the health, diversity and productivity of the environment as it relates to matters protected by the EPBC Act.

Offsets under the EPBC Act are required if residual impacts to MNES are significant (DSEWPaC 2012b). The 'Matters of National Significance Significant Impact Guidelines 1.1' provides overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance protected by the EPBC Act (DoE 2013a).

The 'Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy' provides guidance on the role of offsets in environmental impact assessments and how the Department of Agriculture, Water and the Environment (DAWE) considers the suitability of a proposed offset package (DSEWPaC 2012b).

5.2 Queensland

5.2.1 *Environmental Protection Act 1994*

The objective of the *Environmental Protection Act 1994* (Queensland) (EP Act) and its associated Regulations and Policies are to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. This is commonly referred to as ecologically sustainable development. The EP Act addresses the following areas that are relevant to the Project:

- notifiable activities that are listed in Schedule 3 of the EP Act;
- environmental protection policies for water and wetland biodiversity, noise and air which are intended to enhance or protect Queensland's environment and list relevant environmental outcomes and performance criteria;
- Environmental Regulated Activities defined within the EP Act and listed in schedule 2 of the Environmental Protection Regulation 2019;
- EAs which are required to carry out an ERA, including a resource activity, which will include conditions that will regulate the Project activities; and
- duties of care associated with environmental harm.

The EP Act also prescribes the EIS process which is managed by the Queensland Department of Environment and Science (DES), which will decide the EA application for the Project.

5.2.2 *Vegetation Management Act 1999*

The *Vegetation Management Act 1999* (Queensland) (VM Act) is part of the framework for the management of native vegetation across Queensland.

The purpose of the VM Act is to regulate the clearing of vegetation in a way that:

- conserves remnant vegetation that is an Endangered, Of Concern or Least Concern Regional Ecosystem (RE);
- conserves vegetation in declared areas;
- ensures the clearing does not cause land degradation;
- prevents the loss of biodiversity;
- maintains ecological processes;
- manages the environmental effects of the clearing to achieve the matters mentioned in the above bullet points;
- reduces greenhouse gas emissions; and
- allows for sustainable land use.

Remnant vegetation means vegetation that is either an Endangered, Of Concern or Least Concern RE, and the predominant canopy of the vegetation:

- covers more than 50% of the undisturbed predominant canopy;
- averages more than 70% of the vegetation's undisturbed height; and
- is composed of species characteristic of the vegetation's undisturbed dominant canopy.

The Vegetation Management Regulation 2012 prescribes the status of each RE identified within Queensland as described in the Regional Ecosystem Description Database (DES 2021a).

The regional ecosystem framework provides a systematic means of describing biodiversity across the variable environments of Queensland (Neldner *et al.* 2017). In the classification of Queensland's REs, three major attributes are combined in a hierarchical manner:

1) Broad-scale landscape patterns as described by bioregion.
2) Geology, soils, and landforms which are described as Land Zones.
3) Vegetation, which is described in terms of structure and floristics (Neldner *et al.* 2017).

An RE is defined as a vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil (Neldner *et al.* 2017). Under the VM Act, each RE is classed as either Endangered, Of Concern or Least Concern.

The VM Act does not apply to mining activities undertaken on MLs, as the consideration of impacts on native vegetation is addressed in the EIS process and regulated by the conditions of the EA. Although the VM Act does not apply to clearing vegetation within the ML, the scientific basis for biodiversity conservation under the VM Act is still valid (including the conservation status categories of each RE) and used to assess the conservation significance of the vegetation communities.

The biodiversity status is an additional classification assigned to REs by the Queensland Government. The biodiversity status assigned to each RE is based on an assessment of the condition of remnant vegetation in addition to the criteria used to determine the class under the VM Act. This includes other threatening processes, such as reduction in biodiversity, weed invasion, grazing pressures, inappropriate fire management, fragmentation and infrastructure development. While the biodiversity status is not applicable under the VM Act, it is used for a range of planning and management applications. REs are classified as either Endangered, Of Concern or as No Concern at Present under the biodiversity status.

5.2.3 *Nature Conservation Act 1992*

The Queensland *Nature Conservation Act 1992* (NC Act) and its associated Regulations provide frameworks for the creation and management of protected areas (such as National Parks) and for the protection of native and threatened species. The Regulations include the Nature Conservation (Animals) Regulation 2020 and the Nature Conservation (Plants) Regulation 2020.

The Nature Conservation (Animals) Regulation 2020 and the Nature Conservation (Plants) Regulation 2020 prescribe the following classes of protected wildlife[1]:

- Extinct;
- Extinct in the wild;
- Critically Endangered;
- Endangered;
- Vulnerable;
- Near Threatened; and
- Least Concern.

[1] Under the NC Act, the term wildlife refers to any native taxon or species of an animal, plant, protista, procaryote or virus.

The Nature Conservation (Animals) Regulation 2020 prescribes the following species of Least Concern wildlife as a Special Least Concern wildlife:

- Short-beaked Echidna (*Tachyglossus aculeatus*).
- Platypus (Ornithorhynchus anatinus).
- A Least Concern bird to which any of the following agreements apply:
  - China–Australia Migratory Bird Agreement;
  - Japan–Australia Migratory Bird Agreement;
  - Republic of Korea–Australia Migratory Bird Agreement; or
  - the Convention on the Conservation of Migratory Species of Wild Animals.

Under the NC Act, a Regulation may prescribe a Least Concern plant as a Special Least Concern plant if the taking or use of the plant is at risk of not being ecologically sustainable.

Permits and licences may be required to authorise impacts to native flora and fauna or the handling of them. For example, if there is a requirement for the clearing of Endangered, Vulnerable or Near Threatened plants protected under the NC Act, a Protected Plant Clearing Permit would be required.

5.2.4 *Biosecurity Act 2014*

The Queensland *Biosecurity Act 2014* (Biosecurity Act [Qld]) provides comprehensive biosecurity measures to safeguard the economy, agricultural and tourism industries, environment and way of life from pests, diseases and contaminants.

Biosecurity matters are separated into two broad categories:

1) A 'prohibited matter' is a biosecurity matter that is not found in Queensland but would have a significant adverse impact on our health, way of life, the economy or the environment if it entered the state. Prohibited matters must be reported to Biosecurity Queensland within 24 hours, and all reasonable steps must be taken to minimise the risks of the prohibited matter and not make the situation worse.
2) A 'restricted matter' is a biosecurity matter found in Queensland that has a significant impact on human health, social amenity, the economy or the environment. There are seven categories whereby specific actions are required to limit the spread and impact of the matter by reducing, controlling or containing it. Several categories can apply to the one restricted matter. In such cases, the requirements of all the relevant restriction categories would apply.

Everyone is obligated to take all reasonable and practical steps to minimise the risks associated with other biosecurity matters under their control. The Biosecurity Act (Qld) is relevant to the Project in regard to control and management of invasive plant and animal species.

5.2.5 *Environmental Offsets Act 2014*

The Queensland environmental offsets framework consists of the EO Act, Environmental Offsets Regulation 2014, and the 'Queensland Environmental Offsets Policy (Version 1.12)' (DES 2022). The offsets framework requires environmental offsets to be delivered when an activity is likely to result in a significant residual impact on a prescribed environmental matter. The 'Significant Residual Impact Guideline' (DEHP 2014) is used to assess whether the Project will result in a significant residual impact.

Prescribed environmental matters are outlined in the Environmental Offsets Regulation 2014 and include:

- matters of national environmental significance (MNES);
- matters of state environmental significance (MSES); and
- matters of local environmental significance (MLES).

MNES are matters that are protected and regulated under the EPBC Act, which are listed in section 5 of the Environmental Offsets Regulation. MSES are matters protected and regulated under Queensland legislation and are listed in schedule 2 of the Environmental Offsets Regulation. An MLES cannot replicate an MNES or MSES and is a matter that is prescribed under a local planning instrument as a prescribed environmental matter.

MSES comprise:

- regulated vegetation including:
    - Endangered and Of Concern REs;
    - REs that intersect areas shown as wetlands on the Vegetation Management Wetlands map;
    - REs located within a defined distance from the defining banks of a relevant watercourse or relevant drainage feature; and
    - REs mapped as essential habitat for Endangered and Vulnerable flora and fauna;
- areas that provide connectivity and maintain ecosystem functioning;
- mapped wetlands and watercourses;
- designated precincts in a strategic environmental area under the Regional Planning Interests Regulation 2014;
- protected wildlife habitat;
- protected areas and highly protected zones of State marine parks;
- fish habitat areas;
- waterways providing for fish passage;
- marine plants; and
- legally secured offsets.

6 Desktop assessment

6.1 Government mapping, database searches and literature review

Desktop assessments have been conducted to collate information on the terrestrial ecological values within the study area and surrounds. A review of Government mapping, database searches and available literature has been conducted to update the terrestrial ecology assessment and field survey techniques to be used to target conservation of significant flora and fauna known from the region:

- **The DES Environmental Report:** Matters of State Environmental Significance to identify known MSES within the study area and surrounds (DES 2018–2021a) (Appendix C).
- **The DES Environmental Report:** Regional Ecosystems Biodiversity Status to identify remnant Regional Ecosystems within the study area and surrounds (DES 2018–2021b) (Appendix A3).
- **The Department of Resources** (DoR, previously the Department of Natural Resources Mines and Energy, DNRME) **Vegetation Management Report** to identify areas of regulated vegetation, Vegetation Management Regional Ecosystems mapping (VM Act) and essential habitat for protected wildlife (NC Act) within the study area and surrounds (DoR 2018–2021a).
- **The Queensland Government's Wetlands Maps Report** to identify wetland waterbodies and protected areas within the study area and surrounds (Queensland Wetlands Program 2019–2021).
- **The DES Protected Plants Flora Survey Trigger Map** to identify any high risk areas where the NC Act protected plants that are present or are likely to be present (searches based on the study area) (DES 2018–2021c) (Appendix A3).
- **The DES Modelled Potential Habitat Mapping** to identify threatened flora and fauna species that have been modelled to have pre-clear potential habitat within the study area and surrounds (DES 2018–2021d).
- **The Queensland Government's Environmentally Sensitive Area mapping** to identify areas mapped as environmentally sensitive within the study area and surrounds (Queensland Government 2018–2021a).
- **The DES Environmental Report:** Biodiversity and Conservation Values to identify known Biodiversity Planning Assessment areas and Aquatic Conservation Assessment areas within the study area and surrounds (DES 2018–2021e) (Appendix C).
- **The BoM and DoR mapping of GDEs** study area and surrounds (BoM 2018-2021, DoR 2018-2021b).

The EPBC Act Protected Matters Search Tool has been used to identify MNES with the potential to occur in the study area or surrounds (searches based on a central coordinate [-22.3503, 148.3908] with 10 km and 50 km buffers) (DAWE 2018-2021). The results of the 50 km search are provided in Appendix C.

Searches of databases have also been conducted to identify known records. These searches included:

- **The DES Wildlife Online search and WildNet Wildlife Records results** to identify Endangered, Vulnerable, Near Threatened (EVNT) and Special Least Concern (SLC) species records (searches based on central coordinate [-22.3503, 148.3908] with a 50 km buffer) (Queensland Government 2018–2021b, DES 2018–2021f). The most recent results of the 50 km search are provided in Appendix A3.
- **The Atlas of Living Australia Occurrence Records** to identify EVNT and SLC species records (searches based on central coordinate [-22.3503, 148.3908] with a 50 km buffer) (ALA 2018–2021).
- **The Queensland Museum Zoology Data Search records** to identify EVNT and SLC species (searches based on central coordinate [-22.3503, 148.3908] with a 50 km buffer) (Queensland Museum 2018–2020).

As described in Sections 2 and 4, a number of recent ecological surveys and assessments have been conducted for resource developments within 50 km of the study area. When publicly available, these ecological surveys and assessments have been reviewed to identify conservation significant flora and fauna, including studies for the:

- Existing Lake Vermont Mine, for which the Project is an extension (WBM Oceanics Australia 2003; Australasian Resource Consultants 2012; Australasian Resource Consultants 2014).
- Olive Downs Coking Coal Project located less than 2 km north of the study area (DPM Envirosciences 2018a, 2018b).
- Saraji East Coal Mine Project (SKM 2011) and the Saraji East Mining Lease Project (Aecom 2021) that borders the western boundary of the study area and the Lake Vermont Mine.
- Winchester South Project (e2m 2021) located approximately 8 km north-northwest of the study area.
- Caval Ridge Coal Mine Project (BAAM 2009) located approximately 45 km north-west of the study area.
- Isaac Downs Project located approximately 40 km north-west of the study area (Ecological Survey & Management 2020a) and the Isaac Plains East Extension approximately 50 km north-west of the study area (Ecological Survey & Management 2020b).

The results of the desktop assessment are described in Section 6.2. Species of conservation significance recorded by surveys in the wider surrounds as described in publicly available reports and database searches are tabulated in Appendix A1 (flora) and Appendix A2 (fauna).

6.2 Desktop assessment results

6.2.1 Matters of national environmental significance

6.2.1.1 Threatened ecological communities

In Australia, three categories exist for the listing of Threatened Ecological Communities (TECs) under the EPBC Act; they are:

- Critically Endangered;
- Endangered; and
- Vulnerable.

Five communities listed as Endangered under the EPBC Act have been identified as potentially occurring within the study area or surrounds, namely:

1) Brigalow (*Acacia harpophylla* dominant and co-dominant) Endangered Ecological Community (EEC);
2) Poplar Box Grassy Woodland on Alluvial Plains EEC;
3) Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin EEC;
4) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions EEC; and
5) Weeping Myall Woodlands EEC.

No TECs listed as Critically Endangered or Vulnerable have been identified within the study area or surrounds.

A number of REs mapped by the Queensland Government within the study area potentially represent TECs. RE 11.3.1, RE 11.4.8 and RE 11.4.9 have the potential to represent the Brigalow EEC while RE 11.3.2 has the potential to represent the Poplar Box EEC or the Weeping Myall Woodlands EEC.

The following REs are known to be associated with the Natural Grasslands EEC: RE 11.3.21, RE 11.4.4, RE 11.4.11, RE 11.8.11, RE 11.9.3, RE 11.9.12 and RE 11.11.17 (TSSC 2009). While none of these REs are mapped by the Queensland Government within the study area, the TEC has been mapped as occurring at the Winchester South Project to the north and within the Saraji East study area to the west.

The following REs are known to be associated with the Semi-evergreen Vine Thickets EEC: RE 11.2.3, RE 11.3.11, RE 11.4.1, RE 11.5.15, RE 11.8.3, RE 11.8.6, RE 11.8.13, RE 11.9.4, RE 11.9.8 and RE 11.11.18 (DAWE 2021). None of these REs are mapped by the Queensland Government within the study area, and the ecological studies reviewed by the desktop assessment have not recorded this TEC as being present.

As described in Section 7, field surveys have been conducted to ground-truth and assess the vegetation of the study area to determine the presence and extent of any TECs.

6.2.1.2 Threatened flora and fauna species

Four flora and 12 fauna species listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act have been identified by the desktop assessment as having known records within the region (50 km search area) (Table 6.1, Figure 6.1 and Figure 6.2).

While not known to be recorded within 50 km of the study area, the Project Terms of Reference for MNES (Appendix 3 of the Terms of Reference) identified a number of additional threatened flora and fauna species requiring consideration and assessment. A description of each threatened flora and fauna species' distribution, habitat, ecology and an assessment of their likelihood of occurrence is provided in Appendix D (flora) and Appendix E (fauna).

6.2.1.3 Migratory species

Eighteen species listed as migratory under the EPBC Act have been identified by the desktop assessment as having known records within the wider region (50 km search area) (Table 6.2 and Figure 6.3).

While not known to be recorded within 50 km of the study area, the Project Terms of Reference for MNES (Appendix 3 of the Terms of Reference) identified four additional migratory species requiring consideration and assessment, namely the:

- Oriental Cuckoo;
- Yellow Wagtail;
- Curlew Sandpiper; and
- Pectoral Sandpiper.

A description of each migratory species' distribution, habitat, ecology and an assessment of their likelihood of occurrence is provided in Appendix E.

Table 6.1: EPBC Act listed Threatened flora and fauna species known records

Family	Scientific Name	Common Name	EPBC Act Status[1,2]
Flora			
Myrtaceae	*Eucalyptus raveretiana*	Black Ironbox	V
Poaceae	*Aristida annua*	Annual Wiregrass	V
Poaceae	*Dichanthium queenslandicum*	King Bluegrass	E
Poaceae	*Dichanthium setosum*	Bluegrass	V
Fauna			
Reptiles			
Elapidae	*Denisonia maculata*	Ornamental Snake	V
Scincidae	*Lerista allanae*	Allan's Lerista	E
Birds			
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	V
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	V, Mi
Columbidae	*Geophaps scripta scripta*	Squatter Pigeon (Southern)	V
Falconidae	*Falco hypoleucos*	Grey Falcon	V^
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E
Mammals			
Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	E
Phascolarctidae	*Phascolarctos cinereus*	Koala	V
Pseudocheiridae	*Petauroides volans*	Greater Glider	V
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V
Vombatidae	*Lasiorhinus krefftii*	Northern Hairy-nosed Wombat	CE

[1] CE = Critically Endangered; E = Endangered; V = Vulnerable; Mi = migratory

[2] Known records within 50 km of the study area (refer Appendix A and Appendix B)

^ The Grey Falcon was listed as threatened under the EPBC Act after the Controlled Action decision for the Project

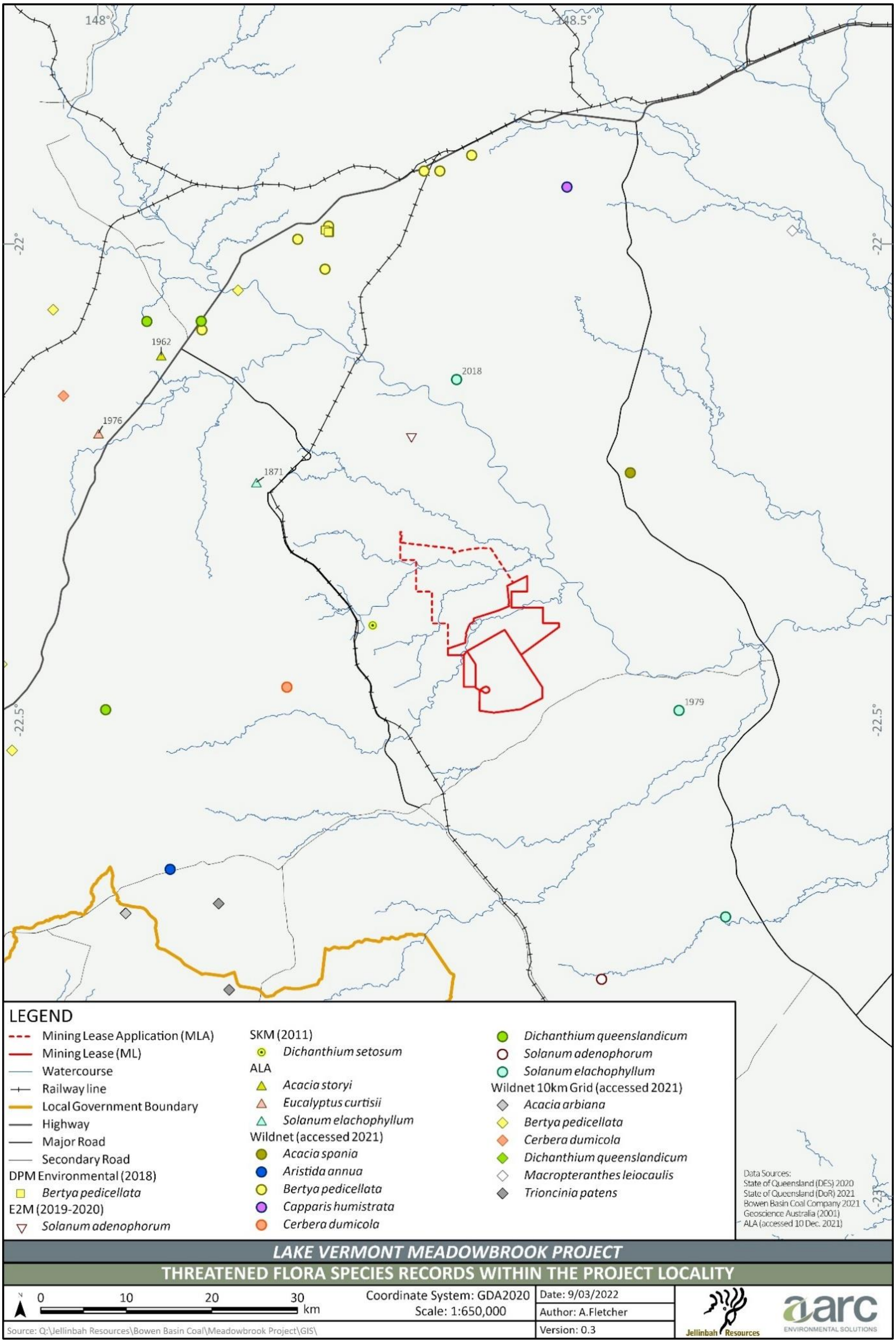


Figure 6.1: Threatened flora species records within the Project locality

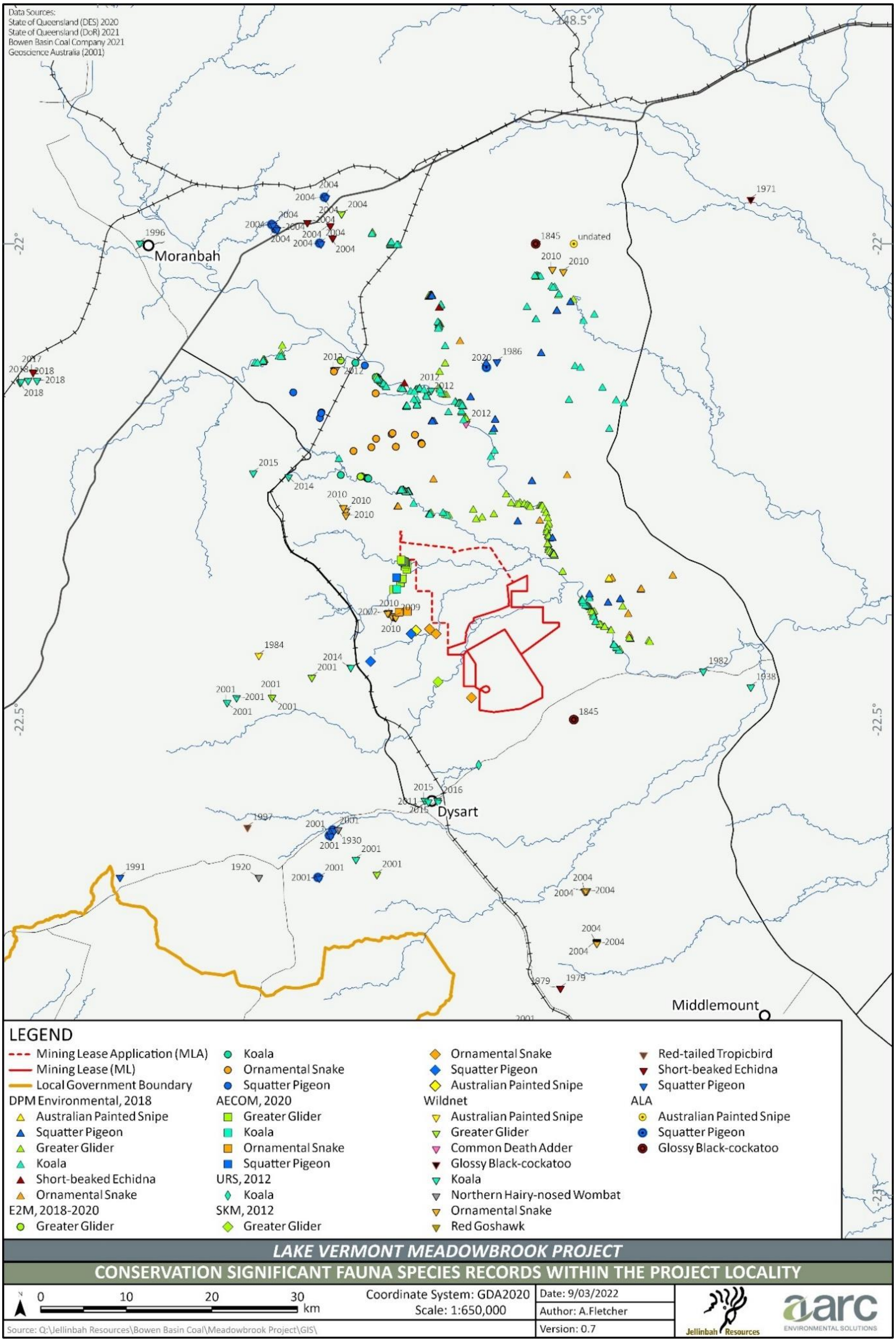


Figure 6.2: Conservation significant fauna species records within the Project locality

Table 6.2: EPBC Act listed migratory species known records

Family	Scientific Name	Common Name	EPBC Act Status[1,2]
Birds			
Accipitridae	*Pandion cristatus*	Eastern Osprey	Mi
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mi
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	V, Mi
Laridae	*Gelochelidon nilotica*	Gull-billed Tern	Mi
Laridae	*Hydroprogne caspia*	Caspian Tern	Mi
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch	Mi
Monarchidae	*Symposiachrus trivirgatus*	Spectacled Monarch	Mi
Muscicapidae	*Myiagra cyanoleuca*	Satin Flycatcher	Mi
Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropicbird	Mi
Rhipiduridae	*Rhipidura rufifrons*	Rufous Fantail	Mi
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E, Mi
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	Mi
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	Mi
Scolopacidae	*Calidris ruficollis*	Red-necked Stint	Mi
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	Mi
Scolopacidae	*Tringa nebularia*	Greenshank	Mi
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	Mi
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	Mi

[1] V = Vulnerable; E = Endangered, Mi = migratory
[2] Known records within 50 km of the study area (refer Appendix A and Appendix B)

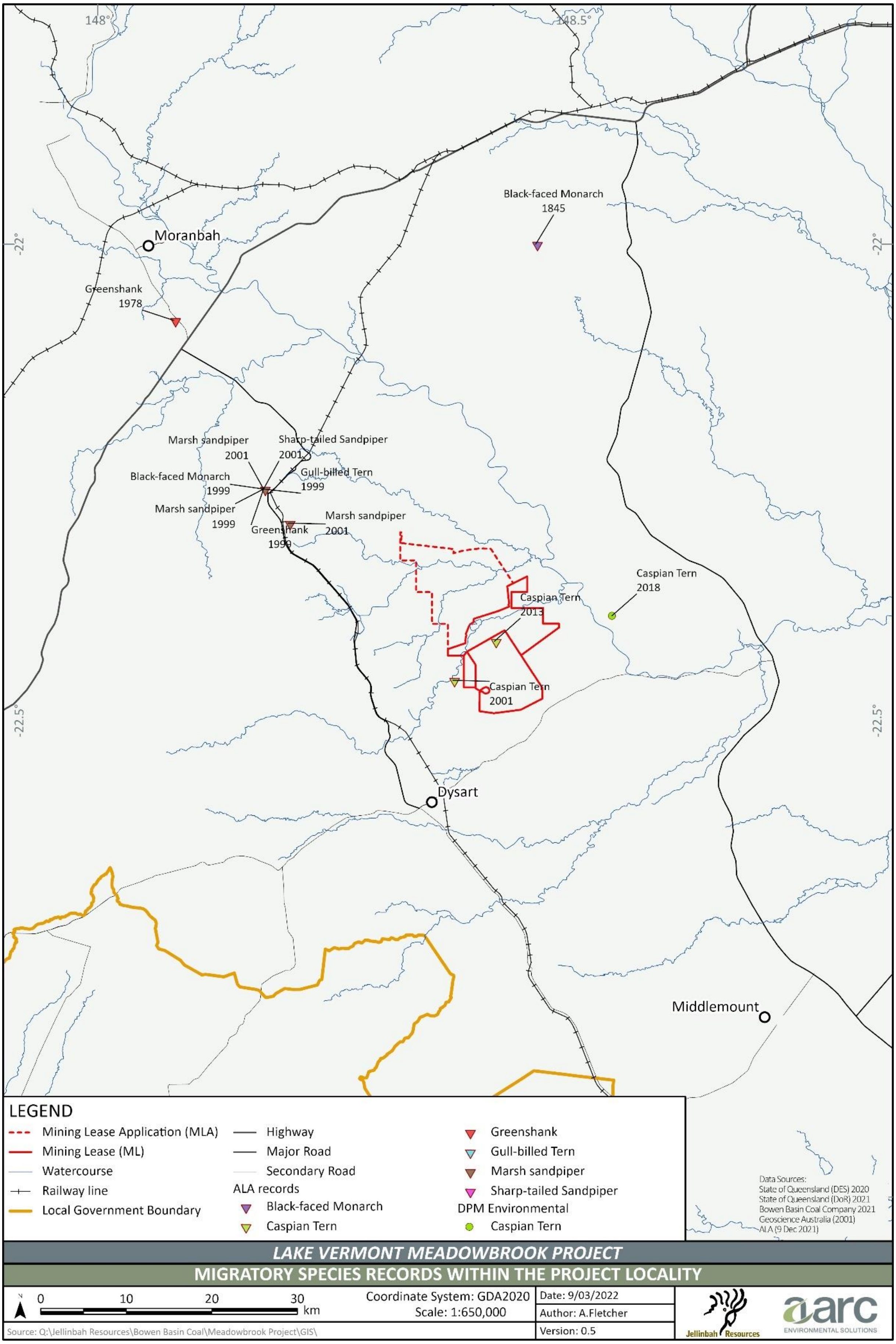


Figure 6.3: Migratory species records within the Project locality

6.2.2 Matters of state environmental significance

6.2.2.1 Regional ecosystems

Within the study area, the Queensland Government regulated vegetation management map identified areas of:

- Category B: Remnant vegetation;
- Category C: High value regrowth vegetation; and
- Category X: Exempt clearing work on Freehold, Indigenous and Leasehold land.

The Category B remnant vegetation mapped within the study area by the Queensland Government and the classified as Endangered, Of Concern or Least Concern REs under the VM Act are listed in Table 6.3. The biodiversity status of each RE is also provided in Table 6.3.

Regional Ecosystems that are Endangered or Of Concern represent regulated vegetation under the VM Act.

Table 6.3: VM Act regional ecosystems mapped within the study area

RE	RE Short Description[1]	VM Act Status[2]	Biodiversity Status[3]
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	Endangered
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	Endangered	Endangered
11.4.9	*Acacia harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains	Endangered	Endangered
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern
11.5.3	*Eucalyptus populnea* +/- *E. melanophloia* +/- *Corymbia clarksoniana* woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	No Concern at Present
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Least Concern	Of Concern
11.3.27	Freshwater wetlands. Vegetation is variable, including open water with or without aquatic species and fringing sedgelands and Eucalypt woodlands.	Least Concern	Of Concern
11.5.17	*Eucalyptus tereticornis* woodland in depressions on Cainozoic sand plains and remnant surfaces	Endangered	Endangered
11.5.9	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains and/or remnant surfaces	Least Concern	No Concern at Present

[1] Regional Ecosystem Description Database (DES 2021a)

[2] Endangered; Of Concern; Least Concern

[3] Endangered; Of Concern; No Concern at Present

6.2.2.2 Vegetation management wetlands and watercourses

Vegetation management wetlands

Under the VM Act, a wetland is defined as an area of land that supports plants or is associated with plants that are adapted to and dependent on living in wet conditions for at least part of their life cycle (DEHP 2014). The vegetation management wetlands map under section 20AA of the VM Act has been developed by the Queensland Government. The mapped vegetation management wetlands within the study area and surrounds are shown on Figure 6.4 as General Ecological Significance (GES) or High Ecological Significance (HES) wetlands.

Vegetation management watercourses

The Queensland Government vegetation management watercourse map shows watercourses defined under the VM Act are used to regulate vegetation clearing in proximity to watercourses (DEHP 2014). Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek are defined watercourses under the VM Act (Figure 6.4).

Referable wetlands

The Map of Queensland wetland environmental values is a state-wide statutory map under the 'Environmental Protection (Water and Wetland Biodiversity) Policy 2019'. The map of referable wetlands includes:

- Wetland Protection Areas comprising:
  - High Ecological Significance (HES) wetlands within the Great Barrier Reef Catchments; and
  - trigger areas that represent the area of hydrological influence of HES wetlands.

Wetland mapping indicates several Wetland Protection Areas associated with HES wetlands occur to the north and east of the Project (Figure 6.4). The closest HES wetlands are approximately 2.4 km east of the Project near the confluence of Boomerang Creek and Ripstone Creek and approximately 4.5 km east of the southern end of Phillips Creek. No HES wetlands or their trigger areas are mapped within the study area.

6.2.2.3 Conservation significant species

Critically Endangered, Endangered and Vulnerable flora and fauna species

Six flora and 13 fauna species listed as Critically Endangered, Endangered or Vulnerable under the NC Act have been identified by the desktop assessment as having known records within the wider region (50 km search area) (Figure 6.4). A number of these results are also listed as Threatened Species under the EPBC Act (refer to Table 6.1). A description of each flora and fauna species' distribution, habitat, ecology and assessment of likelihood of occurrence is provided in Appendix D (flora) and Appendix E (fauna).

Near threatened flora and fauna species

Six flora and one fauna species listed as Near Threatened under the NC Act have been identified by the desktop assessment as having known records within the region (Table 6.5, Figure 6.1 and Figure 6.2). A description of each flora and fauna species' distribution, habitat, ecology and assessment of likelihood of occurrence is provided in Appendix D (flora) and Appendix E (fauna).

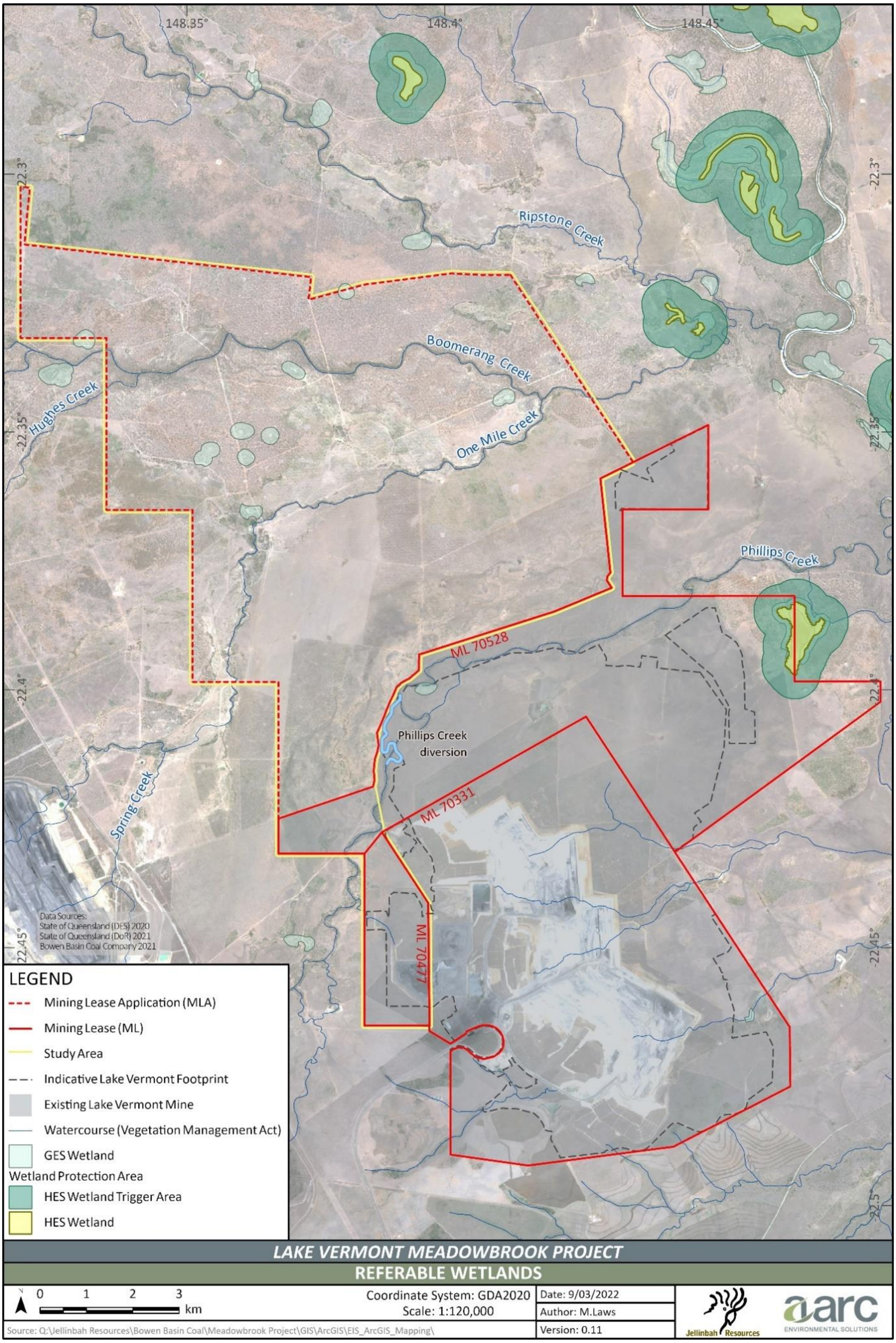


Figure 6.4: Referable wetlands

Table 6.4: NC Act listed Critically Endangered, Endangered or Vulnerable flora and fauna species

Family	Scientific name	Common name	NC Act status[1,2]
Flora			
Asteraceae	*Trioncinia patens*	Peak Downs Daisy	CE
Capparaceae	*Capparis humistrata*	—	E
Poaceae	*Aristida annua*	Annual Wiregrass	V
Poaceae	*Dichanthium queenslandicum*	King Bluegrass	V
Solanaceae	*Solanum adenophorum*	—	E
Solanaceae	*Solanum elachophyllum*	—	E
Fauna			
Reptiles			
Elapidae	*Acanthophis antarcticus*	Common Death Adder	V
Elapidae	*Denisonia maculata*	Ornamental Snake	V
Scincidae	*Lerista allanae*	Allan's Lerista	E
Birds			
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	E
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	V
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	V
Columbidae	*Geophaps scripta scripta*	Squatter Pigeon (Southern)	V
Falconidae	*Falco hypoleucos*	Grey Falcon	V
Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropicbird	V
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	V
Mammals			
Phascolarctidae	*Phascolarctos cinereus*	Koala	V
Pseudocheiridae	*Petauroides volans*	Greater Glider	V
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V
Vombatidae	*Lasiorhinus krefftii*	Northern Hairy-nosed Wombat	CE

[1] CE = Critically Endangered, E = Endangered, V = Vulnerable
[2] Known records within 50 km of the study area (refer Appendix A and Appendix B)

Table 6.5: NC Act listed Near Threatened flora and fauna species

Family	Scientific Name	Common Name	NC Act Status[1,2]
Flora			
Apocynaceae	*Cerbera dumicola*	—	NT
Combretaceae	*Macropteranthes leiocaulis*	—	NT
Euphorbiaceae	*Bertya pedicellata*	—	NT
Mimosaceae	*Acacia arbiana*	Tony's Wattle	NT
Mimosaceae	*Acacia spania*	Western Rosewood	NT
Mimosaceae	*Acacia storyi*	Blackdown Wattle	NT
Fauna			
Mammals			
Emballonuridae	*Taphozous australis*	Coastal Sheathtail Bat	NT

[1] NT = Near Threatened
[2] Known records within 50 km of the study area (refer Appendix A and Appendix B)

Special Least Concern Fauna Species

One Special Least Concern (non-migratory) fauna species has been identified by the desktop assessment as having known records within the wider region: the Short-beaked Echidna (*Tachyglossus aculeatus*).

Special Least Concern (migratory) fauna species identified by the desktop assessment as occurring in the wider region is consistent with the list of migratory species listed under the EPBC Act, which is provided in Figure 6.2

A description of Special Least Concern species distribution, habitat, ecology and assessment of likelihood of occurrence is provided in Appendix E (fauna).

6.2.2.4 Conservation significant species habitat

Essential habitat

Essential habitat is mapped by the Queensland Government and defined as vegetation identified as containing at least three essential habitat factors for a species that is Endangered, Vulnerable or Near Threatened or where a species has been known to occur (DEHP 2014).

Essential habitat for the Ornamental Snake has been mapped within the study area in the form of riparian woodland/open forest and shrub/woodland including Brigalow (Appendix C).

Wildlife habitat

Protected wildlife habitat is defined as an area of habitat for an Endangered, Vulnerable or Special Least Concern (non-migratory) animal (DEHP 2014). Habitat is defined as the area occupied (including periodically and occasionally) by any species, population or ecological community or an area used by species during different stages of their life cycles (DEHP 2014). Within the study area, protected wildlife habitat has been mapped by the Queensland Government, and these areas coincide with the mapping of essential habitat for the Ornamental Snake (Appendix C).

Protected plants flora trigger map

A Protected Plants Flora Survey Trigger Map represents a 2 km buffer around known or potential locations of protected flora species and identifies areas at high risk of supporting protected flora species. No high risk areas are mapped within the study area on the Protected Plants Flora Survey Trigger Map (Appendix C).

High risk areas are mapped within remnant riparian vegetation at the confluence of Boomerang Creek and the Isaac River approximately 3 km to the east of the study area.

6.3 Conservation significant species likelihood of occurrence

Conservation significant species identified by the desktop assessment have been assigned a likelihood of occurrence based on the criteria provided in Table 6.6. The likelihood assessment is based on the knowledge of ecologists, species' distribution, potential habitat suitability, known records and scientific literature and is provided in Appendix D (flora) and Appendix E (fauna).

Table 6.6: Criteria adopted for likelihood of occurrence determination

Likelihood of occurrence	Criteria
Known	There are confirmed species records within the study area*.
Likely	Preferred habitat occurs within the study area. There are confirmed species records in the nearby surrounds; however, the species is not yet confirmed as occurring within the study area.
Potential	Potential habitat may occur within the study area, and the species is known to occur in the wider surrounds.
Unlikely	Due to a lack of suitable habitat within the study area and/or the absence of records from the wider surrounds, the species is considered to have a low likelihood of occurring within the study area.

*Note: The likelihood assessment has been conducted in consideration of the desktop assessment and prior to the field survey.

Conservation significant flora and fauna species identified by the desktop assessment and assessed for likelihood of occurrence informed the design the Project field surveys. Details of the targeted surveys conducted for the conservation significant species are provided in Section 7.

6.4 Groundwater dependent ecosystems

The Commonwealth Bureau of Meteorology (BoM) has developed the National Groundwater Dependent Ecosystems Atlas (GDE Atlas) as an interactive tool to assist in the identification of potential groundwater dependent ecosystems (GDEs). The GDE Atlas provides ecological and hydrogeological information on potential GDEs and ecosystems that could potentially use groundwater. The GDE Atlas supplies information to support the identification of GDEs but does not provide a definitive map of GDEs.

The GDE Atlas mapping identifies potential terrestrial and aquatic GDEs within the study area and surrounds. No potential subterranean GDEs are mapped by the GDE Atlas within the study area or surrounds.

The BoM GDE Atlas maps areas of 'Moderate potential terrestrial GDEs' associated with riparian vegetation of Boomerang Creek, Hughes Creek and the eastern section of One Mile Creek and their associated watercourses. The western section of One Mile Creek is mapped as 'Low potential terrestrial GDEs' (Figure 6.5). Phillips Creek, the lower sections of Ripstone Creek and the Isaac River are mapped as 'high potential terrestrial GDEs', with associated riparian vegetation mapped as either 'low', 'moderate' or 'high' (Figure 6.5).

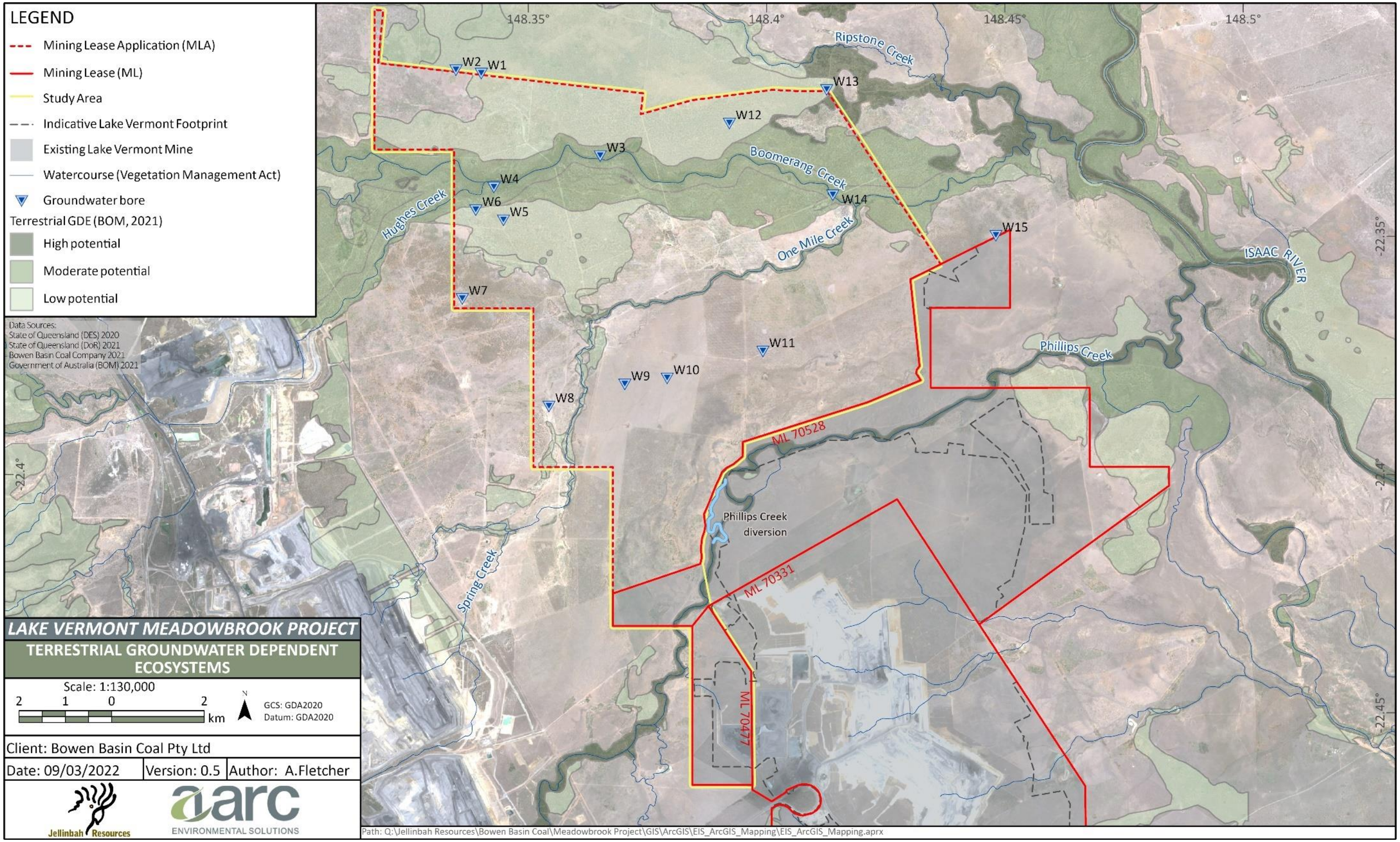


Figure 6.5: Groundwater dependent ecosystem atlas mapping

GES wetlands within the study area are mapped as 'moderate' or 'low' potential terrestrial GDEs while the HES wetland near the confluence of Boomerang Creek and Ripstone Creek is mapped as 'high' potential terrestrial GDE. Other remnant vegetation within the study area is mapped as a 'low potential terrestrial GDE' (Figure 6.5).

The GDE Atlas maps aquatic GDEs in association with the wetlands identified by Wetland*Maps* and with riparian vegetation along Boomerang Creek, Phillips Creek and the Isaac River.

The Queensland Government has also developed mapping of potential GDEs throughout much of Queensland; however, no GDEs have been mapped for this region. A search of the Queensland Springs Database indicates no spring wetlands have been identified within the study area or surrounds.

7 Methodology

This section describes the terrestrial flora and fauna survey methodology, including survey timing and prevailing climatic conditions, the selection of survey sites and survey techniques utilised.

The field surveys have been conducted in accordance with the following guidelines:

Commonwealth Guidelines:

- 'Survey guidelines for Australia's threatened reptiles' (DSEWPaC 2011a);
- 'Survey guidelines for Australia's threatened birds' (DEWHA 2010a);
- 'Survey guidelines for Australia's threatened mammals' (DSEWPaC 2011b);
- 'Survey guidelines for Australia's threatened bats' (DEWHA 2010b);
- 'EPBC Act Referral Guidelines for the Vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)' (DoE 2014a);
- 'Draft Referral guidelines for the nationally listed Brigalow Belt reptiles' (DSEWPaC 2011c); and
- 'Draft referral guideline for 14 migratory birds listed under the EPBC Act' (DoE 2015a).

Field surveys for EPBC Act listed species considered likely to occur or have the potential to occur have also been conducted in consideration of the requirements outlined within the 'Species Profile and Threats Database' (SPRAT Database).

State Guidelines:

- 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.0)' (Neldner *et al.* 2019);
- 'Flora Survey Guidelines–Protected Plants (V2.01)' (DES 2019a);
- 'Management of endangered plants' (Cropper 1993);
- 'Terrestrial Vertebrate Fauna Survey Guidelines for Queensland (V3.0)' (Eyre *et al.* 2018);
- 'Targeted species survey guidelines: Common death adder *Acanthophis antarcticus'* (Rowland and Ferguson 2012); and
- 'Targeted species survey guidelines: Glossy black-cockatoo *Calyptorhynchus lathami'* (Hourigan 2012).

This report uses nationally accepted taxonomy for flora from the Australian Plant Census (APC 2020), and the nomenclature for fauna follows the Australian Biological Resources Study Faunal Directory (ABRS 2020).

7.1 Assessment personnel

The personnel and their contributions to the survey and reporting is presented in Table 7.1. The personnel included suitably qualified ecologists demonstrated by the experience of the team.

Table 7.1: Personnel and experience of survey and reporting team

Role	Personnel	Experience	Contribution
Field and assessment personnel	Caitlin Fleck Jason Raguse Peter Spratt David Toms Lucia Lopez Iain Goodrick Mark Sanders	3 years 11 years 2 years 14 years 11 years 6 years >20 years	Spring 2019, autumn 2020, autumn 2021 surveys Autumn 2019 , spring 2019, autumn 2020 surveys Autumn 2019 survey Autumn 2021 survey Flora mapping and RE amendment submission Spring 2021 habitat assessment EcoSmart Ecology, spring 2021 habitat assessment
Report authors	Caitlin Fleck Iain Goodrick Stacey Gromadzki Mark Sanders	3 years 6 years >20 years >20 years	Initial version Final version Intermediate version EcoSmart Ecology, habitat assessment
Report reviewers	Stacey Gromadzki Aiden Campbell Rod Hailstone	>20 years >10 years >20 years	Initial review of assessment report Technical review of assessment report Principal review of assessment report

7.2 Survey timing and conditions

Terrestrial flora and fauna surveys have been conducted for the Project in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April), autumn 2021 (16–25 April) and spring 2021 (6–10 September 2021).

Desktop assessment of conservation of significant flora species, their known ranges, preferred habitats and ecology Appendix D) indicates autumn and spring surveys were appropriate to detect the flora species to be targeted. The surveys were also conducted in accordance with the recommended survey timing for Brigalow Belt Bioregion terrestrial vertebrate fauna in the 'Terrestrial Vertebrate Fauna Survey Guidelines for Queensland V3.0' (Eyre *et al.* 2018) to account for temporal and seasonal changes in faunal assemblages.

During the autumn 2019 survey, a significant regional rainfall event occurred. On 16 March 2019, the Booroondarra BoM weather station (located approximately 45 km south of the study area) recorded over 110 mm of rainfall within a 24 hr period. This event followed an earlier 12.6 mm of rainfall, recorded in the 24 hrs of 13 March 2019. High rainfall experienced in the study area resulted in localised flooding and restricted vehicle access to portions of the study area for the remainder of the survey. This rainfall event exceeded the average monthly rainfall for March recorded at the Booroondarra Station (73.7 mm). Minimum temperatures recorded during the 2019 autumn survey ranged between 19.4°C and 23.6°C (at the Moranbah BoM Station) with maximum temperatures ranging between 33.5°C and 40.1°C (Moranbah BoM Station).

During the spring 2019 survey, minimum temperatures recorded at the Moranbah Airport or Clermont Airport ranged between 19.4°C and 23.9°C, with maximum temperatures ranging between 31.8°C and 39.5°C (Table 7.2). The spring 2019 survey was conducted during a low rainfall period. No rainfall was recorded at the Booroondarra BoM Station during the preceding two months, which is below the average of 214 mm for January–February as recorded at this station. Light rain (2 mm) fell during the survey on 14 November 2019, with no rain falling for the remainder of the survey period (Table 7.2). Rainfall recorded in the three months prior to the survey (August to October) was 1 mm, which is below the long-term average (77.2 mm) for these months (as recorded at the Booroondarra BoM Station).

During the autumn 2020 survey, minimum temperatures recorded at the Moranbah Airport and Clermont Airport ranged between 14.1°C and 22.0°C (respectively), and maximum temperatures at these stations ranged between 31.0°C and 35.0°C (Table 7.2). No rainfall was recorded on site during the 2020 autumn survey. Rainfall recorded in the three months prior to the survey (December to February) was 326.6 mm, which is marginally above the long-term average rainfall (306mm) for these months (as recorded at the Booroondarra BoM Station).

During the autumn 2021 surveys, minimum temperatures recorded at the Moranbah Airport and Clermont Airport ranged between 11.2°C and 20.6°C (respectively), and maximum temperatures at these stations ranged between 22.0°C and 32.0°C (Table 7.2). Light rainfall was recorded on 23 April and 24 April (6.4 mm and 2.6 mm, respectively), with no rainfall for the remainder of the survey period (Table 7.2). Rainfall recorded in the three months prior to the survey (January to March) was 303.1 mm, which exceeds the long-term average rainfall (287.7 mm) for these months (as recorded at the Booroondarra BoM Station).

Table 7.2: Temperatures and rainfall for the survey periods

Survey Date	Temperature				Rainfall Recorded	
	Minimum		Maximum		Lake Vermont Mine[3]	Booroondarra Station[4]
	Moranbah Airport[1]	Clermont Airport[2]	Moranbah Airport[1]	Clermont Airport[2]		
Autumn 2019						
11 March 2019	19.4°C	21.5°C	38.9°C	39.2°C	NA	0.0 mm
12 March 2019	23.6°C	24.7°C	40.1°C	40.4°C	NA	0.0 mm
13 March 2019	21.5°C	20.6°C	37.5°C	37.9°C	NA	12.6 mm
14 March 2019	23.1°C	22.7°C	37.0°C	35.8°C	NA	0.0 mm
15 March 2019	22.5°C	23.9°C	NA	36.3°C	NA	0.0 mm
16 March 2019	22.4°C	21.0°C	35.1°C	28.5°C	NA	110.0 mm
17 March 2019	20.9°C	20.4°C	33.5°C	32.9°C	NA	0.0 mm
18 March 2019	21.4°C	20.6°C	34.5°C	34.3°C	NA	0.0 mm
19 March 2019	20.2°C	20.5°C	34.8°C	34.6°C	NA	0.0 mm
20 March 2019	21.1°C	21.6°C	36.4°C	35.6°C	NA	0.0 mm
21 March 2019	21.0°C	21.0°C	34.1°C	34.4°C	NA	0.0 mm
Spring 2019						
6 November 2019	17.3°C	15.2°C	33.0°C	31.8°C	0.0 mm	0.0 mm
7 November 2019	13.0°C	10.9°C	35.7°C	35.8°C	0.0 mm	0.0 mm
8 November 2019	16.6°C	16.9°C	38.1°C	37.2°C	0.0 mm	0.0 mm
9 November 2019	16.8°C	15.1°C	36.0°C	34.3°C	0.0 mm	0.0 mm
10 November 2019	17.8°C	16.8°C	34.6°C	33.4°C	0.0 mm	0.0 mm
11 November 2019	13.7°C	11.3°C	36.7°C	36.2°C	0.0 mm	0.0 mm
12 November 2019	14.4°C	19.5°C	36.6°C	36.8°C	0.0 mm	0.0 mm
13 November 2019	19.5°C	20.5°C	38.2°C	38.2°C	0.0 mm	0.0 mm
14 November 2019	21.6°C	22.6°C	37.9°C	37.6°C	2.0 mm	0.0 mm
15 November 2019	20.5°C	18.8°C	37.3°C	37.2°C	0.0 mm	0.0 mm
16 November 2019	21.3°C	21.9°C	38.9°C	38.2°C	0.0 mm	0.0 mm
17 November 2019	19.1°C	22.0°C	38.8°C	39.5°C	0.0 mm	0.0 mm

Survey Date	Temperature				Rainfall Recorded	
	Minimum		Maximum		Lake Vermont Mine[3]	Booroondarra Station[4]
	Moranbah Airport[1]	Clermont Airport[2]	Moranbah Airport[1]	Clermont Airport[2]		
18 November 2019	21.0°C	18.5°C	39.0°C	38.5°C	0.0 mm	0.0 mm
19 November 2019	21.2°C	22.4°C	37.7°C	37.6°C	0.0 mm	0.0 mm
Autumn 2020						
23 March 2020	18.7°C	17.4°C	33.4°C	34.9°C	0.0 mm	0.0 mm
24 March 2020	18.9°C	19.9°C	32.7°C	32.3°C	0.0 mm	0.0 mm
25 March 2020	21.0°C	20.9°C	31.5°C	31°C	0.0 mm	0.0 mm
1 April 2020	18.5°C	17.1°C	32.8°C	33.2°C	0.0 mm	0.0 mm
2 April 2020	17.9°C	16.7°C	33.0°C	32.8°C	0.0 mm	0.0 mm
3 April 2020	18.3°C	18.6°C	32.7°C	33.6°C	0.0 mm	0.0 mm
4 April 2020	18.9°C	21.2°C	34.4°C	35.0°C	0.0 mm	0.0 mm
5 April 2020	21.9°C	22.0°C	33.8°C	33.3°C	0.0 mm	0.0 mm
6 April 2020	21.1°C	18.6°C	32.3°C	31.6°C	0.0 mm	0.0 mm
7 April 2020	15.8°C	14.1°C	32.3°C	32.0°C	0.0 mm	0.0 mm
8 April 2020	15.4°C	14.8°C	32.5°C	32.0°C	0.0 mm	0.0 mm
Autumn 2021						
16 April 2021	16.1°C	11.2°C	32.0°C	31.3°C	0.0 mm	0.0 mm
17 April 2021	15.0°C	13.4°C	31.8°C	30.3°C	0.0 mm	0.0 mm
18 April 2021	18.7°C	16.7°C	30.8°C	28.8°C	0.0 mm	0.0 mm
19 April 2021	17.7°C	15.6°C	31.3°C	29.6°C	0.0 mm	0.0 mm
20 April 2021	17.9°C	13.6°C	31.2°C	29.9°C	0.0 mm	0.0 mm
21 April 2021	19.7°C	20.0°C	NA	29.5°C	0.0 mm	0.0 mm
22 April 2021	20.6°C	20.4°C	23.1°C	NA	0.0 mm	0.0 mm
23 April 2021	17.5°C	16.6°C	23.5°C	23.8°C	0.0 mm	6.4 mm
24 April 2021	17.0°C	15.9°C	22.0°C	24.6°C	0.0 mm	2.6 mm
25 April 2021	16.6°C	17.1°C	22.6°C	28.1°C	0.0 mm	0.0 mm

[1] Moranbah Airport Bureau of Meteorology Station 034035 (BoM 2020b)
[2] Clermont Airport Bureau of Meteorology Station 03512 (BoM 2020c)
[3] Lake Vermont Mine Rainfall Gauge
[4] Booroondarra Bureau of Meteorology Station 035109 (BoM 2020d)
NA = Not available

7.3 Flora surveys

7.3.1 Site selection

Aerial imagery and a review of Government RE mapping (Version 11) have been used to identify suitable sites to survey the vegetation communities present, target threatened flora species and communities and provide a comprehensive flora species list. Sites have been selected to appropriately survey the spatial coverage of each vegetation community. The location and number of flora survey sites have been modified in the field to allow for the identification of REs not mapped by the Government, to modify vegetation community boundaries and sample representative sites of the vegetation communities.

7.3.2 Flora survey methods

7.3.2.1 Vegetation community mapping

Vegetation communities have been mapped and described in accordance with the 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.0)' (Neldner *et al.* 2019). This methodology uses different types of sites to survey, map and validate Government RE mapping. Quaternary and secondary survey sites have been used to determine the vegetation communities and their corresponding REs within the study area. All RE's described in this report are in accordance with the Queensland Regional Ecosystem Description Database (DES 2021a). Vegetation community boundaries have been validated in the field using a Global Positioning System (GPS) and refined using the latest aerial imagery available for the study area. Data from the flora survey has been used in conjunction with topographical and geological maps to produce a ground verified vegetation map.

7.3.2.2 Secondary sites

A total of 54 secondary sites have been surveyed within the study area and surrounds in accordance with the 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.1)' (Neldner *et al.* 2020). The locations of the secondary sites are shown in Figure 7.1.

Secondary level flora assessments have been undertaken to classify and provide detailed descriptions of the vegetation communities (and associated REs) present within the study area. The following information has been collected at each secondary site:

- site identifier information (e.g. GPS location, site name, collector, corresponding photographs);
- site photographs (including start and end transect photos and central orientation photos to the north, east, south and west);
- ground truthed REs;
- remnant status of the vegetation (e.g. non-remnant, remnant, regrowth);
- vegetation structural formation (e.g. woodland, open woodland, forest);
- vegetation stratum details (including list of species present, their dominance and stratum height);
- vegetation structure details (including foliage projection cover percentage, ground cover species percentage composition, stem density counts, basal area of vegetation [Bitterlich Stick methodology2], diameter at breast height assessments);
- identification of ecologically dominant layer;
- land zone descriptions (including landform, slope and aspect and soil characteristics); and
- disturbance notes (e.g. presence of weed species, cattle grazing etc.).

[2] A method for determining the proportional basal area of vegetation. Where the basal area is the area of the cross section of a tree taken at the height of 1.3 m.

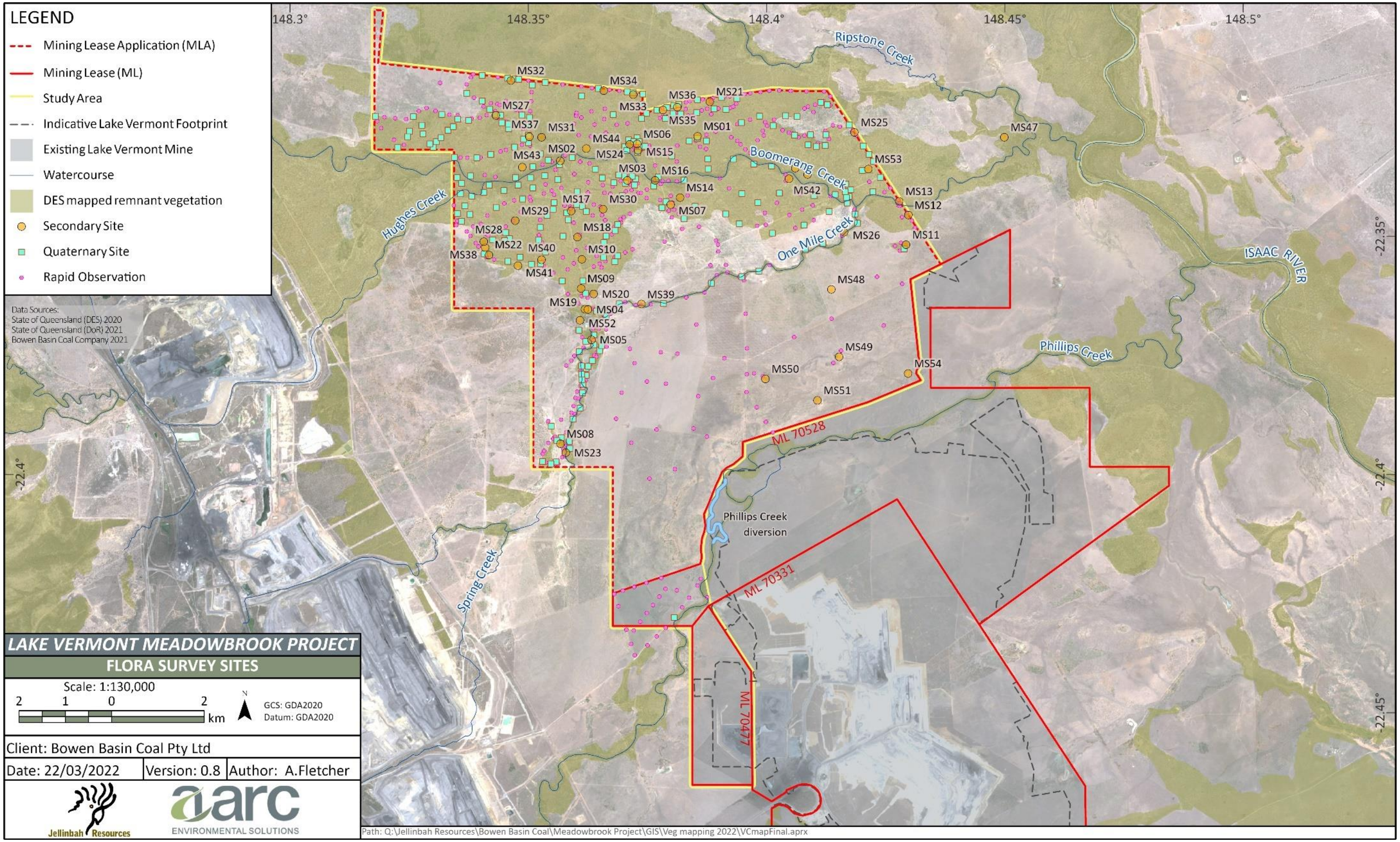


Figure 7.1: Flora survey sites

7.3.2.3 Quaternary sites

A total of 245 quaternary sites have been sampled within the study area in accordance with the methods detailed in Neldner *et al.* (2019). Rapid observations have been undertaken at approximately 500 locations. Quaternary sites and rapid observation points are shown in Figure 7.1.

Quaternary level flora assessments have been undertaken to verify the mapped vegetation communities and associated REs and inform the mapping of vegetation community boundaries.

The following information has been recorded at each quaternary site:

- site identifier information (e.g. GPS location, site name, collector, corresponding photographs);
- site photographs (taken of the vegetation at north, east, south and west orientations);
- remnant status of the vegetation (e.g. non-remnant, remnant, regrowth);
- vegetation structural formation (e.g. woodland, open woodland, forest);
- vegetation stratum details (including list of main species present, their dominance and stratum height);
- identification of ecologically dominant layers;
- land zone descriptions (including landform and soil characteristics); and
- disturbance notes (e.g. presence of weed species, cattle grazing).

7.3.2.4 Targeted surveys for conservation significant species

Conservation significant flora species identified by the desktop assessment (Appendix D) have been targeted during the flora surveys. Traverses (meanders) (Cropper 1993; Goff *et al.* 1982; DES 2019a) of potentially suitable habitat have been undertaken within the study area. Field observations for conservation significant flora have also been conducted along with the flora field survey methods described above. The timing of the autumn and spring surveys was appropriate to record these species if they occurred.

7.3.2.5 Threatened ecological community mapping

As described in Section 6.2.1.1, the desktop assessment has identified five Endangered TECs listed under the EPBC Act with the potential to occur within the study area, namely:

1) Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community;
2) Poplar Box Grassy Woodland on Alluvial Plains ecological community;
3) Natural grasslands of the Queensland Central Highlands and northern Fitzroy Basin ecological community;
4) Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions ecological community; and
5) Weeping Myall Woodlands ecological community.

When the field surveys identified vegetation communities containing vegetation that could represent a TEC, the vegetation has been assessed against the key diagnostic characteristics and condition thresholds described in the relevant Commonwealth listing advice to determine whether the vegetation community meets TEC status. The field-validated vegetation mapping and the assessment conducted to determine TEC status is provided in Section 8.

7.3.2.6 Flora species list

A comprehensive flora species list, including native and introduced species, has been compiled for the study area. The flora species list incorporates all species encountered within the Project area from assessments of secondary sites, quaternary sites, targeted searches and from incidental observations whilst traversing the site. The flora species list is provided in Appendix A.

When a flora species could not be positively identified to a species level, a voucher specimen has been collected for identification by the Queensland Herbarium.

7.3.2.7 Regional Ecosystem mapping amendment

The ground-truthed vegetation map was submitted to the Queensland Herbarium as a RE map amendment request. The submission was accepted by the Queensland Herbarium with minor corrections on 1 March 2022 and the resulting map is to be incorporated into current version RE mapping (Queensland Herbarium reference ABP_MAR_3562). The accepted RE mapping was adopted in this assessment report as the ground-truthed vegetation map.

7.4 Fauna surveys

7.4.1 Site selection

Aerial imagery and a review of Government RE and broad vegetation group mapping (Version 12, DES 2021a) have been used to identify potential habitat types and suitable survey site locations.

The desktop assessment and initial site assessment identified five major habitat types occurring within the study area. These major habitat types have been used to design the initial fauna surveys:

1) Brigalow Woodlands;
2) Eucalypt Dry Woodlands;
3) Eucalypt Open Forest to Woodlands on Floodplains;
4) Freshwater Wetlands; and
5) Cleared Agricultural Areas.

A description of the characteristics of each major habitat type within the study area is provided in Section 9.1.

Subsequent surveys have been designed in consideration of the vegetation communities and habitat features identified on site during the initial surveys.

Fourteen systematic survey sites (MF01 to MF14, Figure 7.1) were established within the major habitat types, with the exception of the cleared agricultural area habitat type. A range of fauna survey methods (as described in Section 7.4.2) were employed at the systematic survey sites, including:

- Elliott trapping;
- pitfall trapping;
- funnel trapping;
- automated camera trapping;
- bird surveys;
- spotlighting surveys;
- call playback surveys;
- habitat searches; and
- echolocation call detection.

Six supplementary bat survey sites (MH01 to MH06) and four other supplementary sites (MSS01 to MSS04) have also been surveyed (Figure 7.2). A range of survey methods were employed at the supplementary survey sites including echolocation, microbat surveys, harp traps, mist netting and spotlighting surveys. A description of each systematic survey site and supplementary survey site is provided in Appendix F.

Additional supplementary and targeted surveys have been conducted throughout the study area, as described in Sections 7.4.2 and 7.4.3.

7.4.2 Fauna survey methods

The fauna survey methods utilised in the study (as described below) are consistent with various Commonwealth and State fauna survey guidelines, including the 'Terrestrial Vertebrate Fauna Survey Guidelines for Queensland' (Eyre *et al.* 2018).

Elliott trapping

Elliott A traps (8 x 10 x 33 cm) were used to target small ground-dwelling mammals. Twenty baited Elliott traps were installed at 10 m intervals at systematic survey sites for a duration of four days. Traps were strategically positioned under shrubs or beside logs to reduce exposure of trapped animals to the sun, wind and rain and maximise trap success. Traps were checked soon after dawn and captured animals were identified and released. They were left open at each systematic survey site for four days and nights.

Pitfall trapping

Pitfall traps were established at systematic survey sites to target small ground-dwelling taxa (e.g. amphibians, reptiles and small terrestrial mammals). Four 20-litre buckets were buried with their rims flush with the soil surface at 7.5 m intervals along a pitfall trap line constructed in a T-shape design with a 45 m drift fence. A small amount of soil, vegetation litter, a damp sponge and a small plastic pipe were placed in the bottom of each bucket to provide shelter and moisture for captured wildlife. Traps were checked soon after dawn, and captured animals were identified and released. The traps were left open for four days and nights.

Funnel trapping

Funnel traps were installed at systematic survey sites to catch amphibians and medium to large reptiles. Six funnel traps were positioned approximately 3 m from the ends of the pitfall trap drift fence. The traps were covered with a hessian bag and contained a damp sponge to provide protection and moisture for captured wildlife. Traps were checked soon after dawn, and captured animals were identified and released. The traps were left open for four days and nights.

Automated camera trapping

Automated camera traps baited with raw chicken were installed at systematic survey sites for four consecutive nights for the purpose of detecting medium and large-sized nocturnal terrestrial species as a less invasive method than cage trapping (Eyre *et al.* 2018). Cameras were attached to trees at systematic survey sites and selected supplementary sites based on habitat suitability.

Diurnal bird surveys

Bird surveys were conducted at each systematic survey site during early mornings during peak avian activity to provide a direct census of diurnal bird species occurrence and abundance. Bird surveys included observations of all bird taxa visible from the survey site, including aerial hunters, feeders and scavengers such as raptors, wood swallows and bee-eaters. Bird surveys were undertaken for a minimum of 30 minutes at each systematic site on two occasions.

Bird surveys were also conducted within the study area where high avian diversity is likely (e.g. vegetated watercourses or dams) or where cryptic species or threatened species are likely at sites additional to those shown on Figure 7.2. The survey effort implemented at each survey and at additional locations within the study area is detailed in Section 7.4.3.

Spotlighting

Spotlighting was carried out in the early evenings and before midnight at the survey sites for the purpose of identifying nocturnal wildlife such as amphibians, reptiles, nocturnal birds and nocturnal arboreal mammals. Spotlight searches were undertaken on two occasions (less than one hour after dusk and more than one hour after dusk) for a minimum of 30 minutes at each systematic site. Additional spotlight searches were undertaken within the study area according to habitat suitability. The survey sites were randomly traversed with spotlights and binoculars consistent with the methodology outlined in the 'Terrestrial Vertebrate Fauna Survey Guidelines for Queensland' (Eyre *et al.* 2018). Where survey site habitat was suitable for species likely to be detected through call playback, spotlighting was undertaken following call playback to maximise the chance of detecting these species. At suitable locations within the study area, spotlighting was also conducted from a slow-moving vehicle.

Call playback

Call playback was used to detect nocturnal bird species that are highly cryptic, call infrequently, are wide-ranging and occur at naturally low population densities. Species targeted with call playback included:

- Koala;
- Barking Owl (*Ninox connivens*);
- Eastern Barn Owl (*Tyto delicatula*);
- Little Button Quail (*Turnix velox*);
- Masked Owl (Tyto novaehollandiae);
- Southern Boobook (*Ninox novaeseelandiae*); and
- Australian Owlet Nightjar (*Aegotheles cristatus*).

The species selected for call playback at each site were determined through assessment of the surrounding habitat, microhabitat features and the ecology of each species.

Habitat searches

Diurnal habitat searches were conducted at systematic survey sites and elsewhere within the study area based on habitat suitability to detect fauna that are active during the day. This survey method was used to target diurnal reptiles, amphibians and large mammals. To target reptile species, diurnal searches were conducted where preferred habitat was located (e.g. gilgai formations or dense ground debris). These habitat searches included recording evidence of fauna through the detection of tracks, scats and traces (e.g. tree trunk scratches). Habitat searches were typically undertaken during the late morning to allow for reptile activity to increase with rising temperatures but before the maximum heat of the day. At systematic survey sites, searches were undertaken on two separate occasions for a minimum of 30 minutes. Within the study area, additional searches were undertaken according to habitat suitability. The survey effort implemented at each survey location and at additional locations within the study area is detailed in Section 7.4.3.

Micro bat echolocation detection surveys

Micro bats rely primarily on echolocation for orientation and navigation in flight and to hunt for food. The use of echolocation call detectors is a non-invasive method used to record the echolocation calls. One Anabat was set at each systematic survey site for three to four nights. Additional micro bat echolocation detection was conducted at supplementary micro bat survey sites MH02–MH04 for three consecutive nights.

Supplementary micro bat surveys

All micro bat species identified by desktop searches as potentially occurring within the study area or surrounds are identifiable to sufficient taxonomic level by electronic detection of echolocation calls, with the exception of species of the *Nyctophilus* genus. A Long-eared Bat (*Nyctophilus* sp.) was detected *via* echolocation records at systematic survey sites during the 2019 autumn survey (at sites MF01, MF02, MF03 and MF04), and the call could not be identified to a species level.

Six supplementary survey sites (MH01 to MH06, Figure 7.2) were established during the autumn 2020 survey to target the Corben's Long-eared Bat (*Nyctophilus corbeni*) listed as Vulnerable under the EPBC Act and NC Act. Survey methods conducted at the supplementary survey sites included harp trapping, mist netting and additional echolocation call detection (at sites MH02–MH04).

Harp trapping

Harp traps (two-bank 4.2 m^2) were deployed at survey sites in areas of likely micro bat flyways within suitable habitat. These flyways were typically narrow, clear sections of vegetated areas along creeks or tracks. The harp traps were deployed shortly before dusk and retrieved at dawn or early morning. Traps were checked several hours after dusk and again before dawn each day.

Mist netting

Mist nets were deployed at survey sites of likely micro bat habitat. Mist nets approximately 12 m wide by 5 m tall were deployed simultaneously to spotlighting searches that were monitored continuously while deployed. The spotlighting concentrated on insect activity in the survey sites that are an attractant to micro bats.

Threatened species habitat assessment and mapping

Habitat assessment and mapping was undertaken in spring 2021 for the following threatened species:

- Ornamental Snake;
- Squatter Pigeon;
- Australian Painted Snipe;
- Koala; and
- Greater Glider.

The methodology used to assess habitat amenity within the study area is described below.

Habitat mapping for each species is described in Section 6.2.1 and is informed by the assessment of the habitat available within the study area and information contained in DAWE's Species Profiles and Threats (SPRAT) database, including the relevant statutory documents and published research.

<u>Ornamental Snake</u>

For habitat assessment, amenity surveys have been conducted along transects of 100 m within areas of potentially suitable habitat (Figure 7.2). The total extent of gilgai formations and their maximum depths were recorded along the transect. Observations were made of dominant shrub vegetation, dominant ground cover vegetation, presence of woody debris and presence of soil cracks. Additional observations of Ornamental Snake habitat suitability were made incidentally throughout the study area.

<u>Squatter Pigeon</u>

Potential permanent, semi-permanent and seasonal water sources (watercourses, farm dams and wetlands) within the study area were inspected to determine their suitability as water sources for Squatter Pigeon breeding and foraging. The habitat assessment involved observations of the characteristics of the potential water sources and the ground cover and other microhabitat features in areas surrounding the water sources.

<u>Australian Painted Snipe</u>

Habitat assessment of the Australian Painted Snipe involved inspection of permanent, semi-permanent and seasonal water sources to assess their suitability for Australian Painted Snipe breeding and/or foraging and included observations of water body sizes, their likelihood to retain water, presence of mud flats and the structure of aquatic and fringing vegetation.

Koala

The habitat assessment survey for the Koala comprised 20 transects of 100 m x 50 m used to assess the availability of suitable Myrtaceae 'eucalypt' trees (species of E*ucalyptus, Angophora* and *Corymbia*) within remnant vegetation and high value regrowth vegetation within the study area. The number of Myrtaceae eucalypts with a diameter at breast height (DBH) of >10 cm were counted along each transect.

Greater Glider

For habitat assessment, amenity surveys have been conducted for the Greater Glider along transects of 100 m x 50 m within areas of potentially suitable vegetation. The canopy cover of Myrtaceae eucalypt species (*Eucalyptus, Angophora* and *Corymbia*) was recorded using the intercept method (Neldner *et al.* 2020) and the number of trees with suitable hollows (diameter >20 cm, alive or dead) was recorded. Spotlighting along a 500 m transect was undertaken at a subset of these sites to record the number of observed Greater Glider individuals.

Opportunistic observations

All incidental and opportunistic observations of fauna made during the field surveys were recorded.

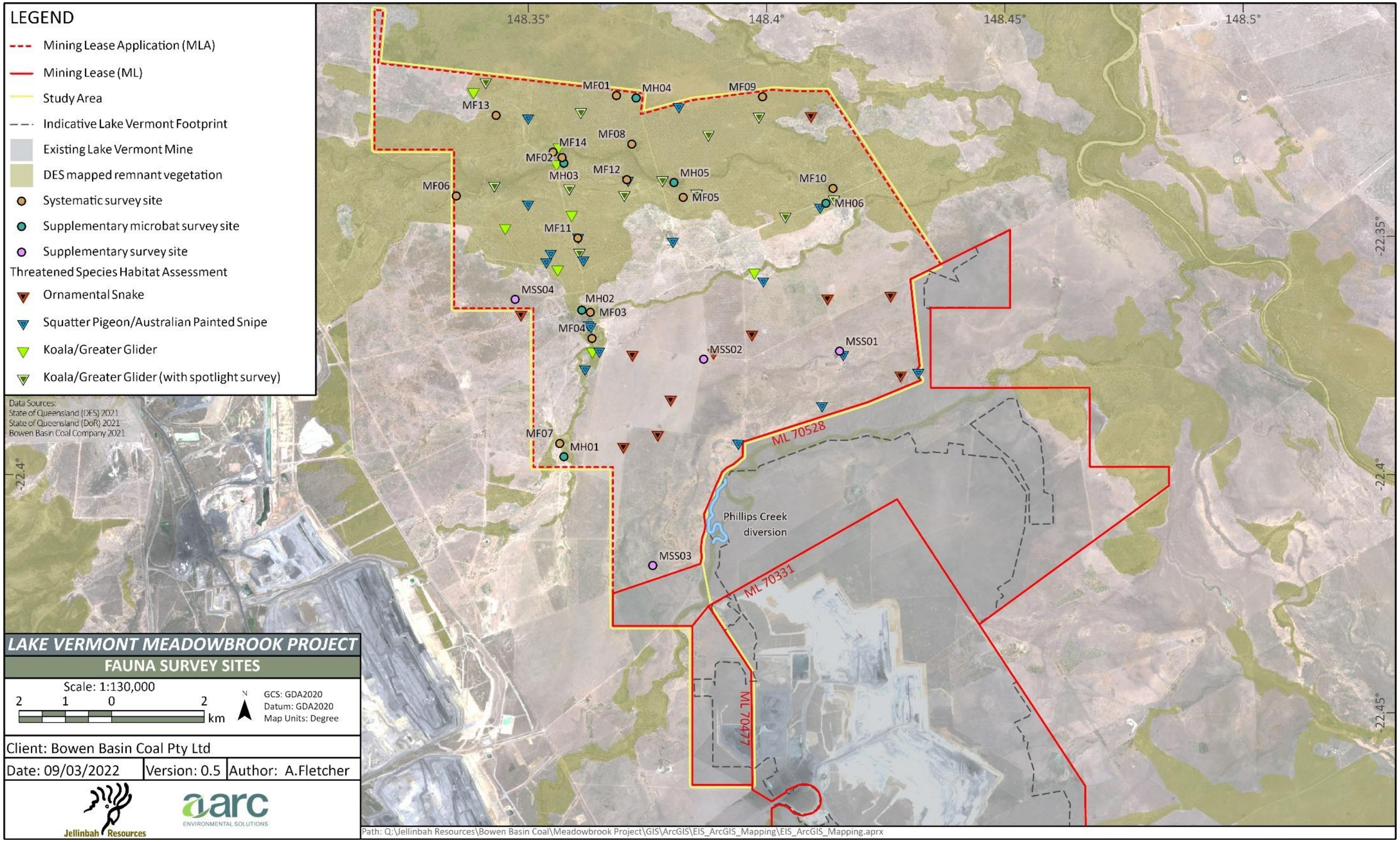


Figure 7.2: Fauna survey sites

7.4.3 Fauna survey effort

The survey effort implemented during the autumn 2019, spring 2019, autumn 2020, autumn 2021 and spring 2021 surveys is described in Sections 7.4.3.1 to 7.4.3.3, and a summary of each fauna sampling technique is provided in Table 7.3.

7.4.3.1 Systematic survey sites

Fourteen systematic survey sites were established during the field surveys on the study area:

- four systematic survey sites (MF01, MF02, MF03, and MF04) during the autumn 2019 field survey;
- nine sites (MF05, MF06, MF07, MF08, MF09, MF10, MF11, MF12 and MF13) during the spring 2019 field survey; and
- one site (MF14) during the autumn 2020 survey.

The majority of systematic survey sites consisted of:

- 20 Elliott A traps;
- 4 pitfall traps;
- 6 funnel traps;
- an automated camera trap; and
- an echolocation call detector.

Three systematic survey sites (MF11, MF12, MF13) did not include Elliott trapping, funnel trapping or pitfall trapping. Sites MF11 and MF12 occurred within the freshwater wetland major habitat type, and the habitat was not large enough to allow for all trapping methods to be undertaken. Only one systematic survey site from the field surveys did not include an echolocation call detector (site MF09); this site occurred within the Eucalypt dry woodlands on inland dispositional plains major habitat type (RE 11.5.3). During the spring 2019 survey, this habitat type had echolocation call detectors set up at two alternate sites (MF05, MF13).

All systematic survey sites included the following survey techniques:

- camera traps;
- bird surveys;
- spotlighting;
- call playback; and
- habitat searches.

Across the surveys, the total level of survey effort comprised:

- 880 trap nights of Elliott trapping;
- 176 trap nights of pitfall trapping;
- 264 trap nights of funnel trapping;
- 56 trap nights of automated camera trapping;
- 41 echolocation call detection nights;
- 23 person hours of bird surveys;
- 15 person hours of spotlighting;
- 25 call playback sessions; and
- 20 person hours of habitat searches.

A detailed summary of the survey effort undertaken per survey method is provided in Table 7.3.

7.4.3.2 Supplementary micro bat survey sites

Six supplementary micro bat survey sites (MH01, MH02, MH03, MH04, MH05, MH06) were established during the 2020 autumn survey.

Harp traps were deployed at supplementary micro bat survey sites (MH01–MH06) for five nights. Mist nets were deployed at three supplementary micro bat survey sites (MH01, MH05, MH06) and one systematic survey site (MF14).

Echolocation call detectors were set for three consecutive nights at three supplementary micro bat survey sites (MH02–MH04). Spotlighting searches were also undertaken at three of the supplementary micro bat survey sites (MH01, MH05, MH06).

Across the surveys, the total level of survey effort at the supplementary micro bat survey sites comprised:

- 30 trap nights of harp trapping;
- four trap hours of mist netting;
- nine echolocation call detection nights; and
- six person hours of spotlighting.

A detailed summary of the survey effort undertaken per survey method is provided in Table 7.3.

7.4.3.3 Supplementary surveys

Across the surveys, ecologists have targeted searches and surveys within various habitats on cryptic fauna species and species of conservation significance. These surveys were conducted at suitable locations, often at flora survey sites.

Supplementary survey sites targeting Ornamental Snake habitat were established for the Autumn 2021 survey, and spotlighting was conducted at sites MSS01–MSS04 (Figure 7.2).

Supplementary targeted habitat assessments were conducted on Koalas and Greater Gliders at 20 sites. Squatter Pigeon (Southern) and Australian Painted Snipe habitat assessments were undertaken at 20 water bodies and each watercourse within the study area. An Ornamental Snake habitat assessment was undertaken at 11 sites (Figure 7.2).

Across the surveys, the total level of supplementary survey effort undertaken comprised:

- 60 person hours of bird surveys;
- 37 person hours of spotlighting; and
- 55 person hours of habitat searches.

A summary of the survey effort undertaken is provided in Table 7.3.

Table 7.3: Summary of fauna survey site survey effort

Survey method	Survey effort					Total survey effort
	Autumn survey 2019	Spring survey 2019	Autumn survey 2020	Autumn survey 2021	Spring survey 2021	
Systematic fauna site						
Elliott trapping	4 sites (MF01–MF04) x 20 traps x 4 nights = 320 trap nights	6 sites (MF05 –MF10) x 20 traps x 4 nights = 480 trap nights	1 site (MF14) x 20 traps x 4 nights = 80 trap nights	—	—	880 total trap nights
Pitfall trap lines	4 sites (MF01–MF04) x 4 pitfalls x 4 nights = 64 trap nights	6 sites (MF05 –MF10) x 4 pitfalls x 4 nights = 96 trap nights	1 site (MF14) x 4 pitfalls x 4 nights = 16 trap nights	—	—	176 total trap nights
Funnel trapping	4 sites (MF01–MF04) x 6 funnels x 4 nights = 96 trap nights	6 sites (MF05 –MF10) x 6 funnels x 4 nights = 144 trap nights	1 site (MF14) x 6 funnels x 4 nights = 24 trap nights	—	—	264 total trap nights
Automated camera trapping	4 sites (MF01–MF04) x 1 camera x 4 nights = 16 trap nights	9 sites (MF05 –MF13) x 1 camera x 4 nights = 36 trap nights	1 site (MF14) x 1 camera x 4 nights = 4 trap nights	—	—	56 total trap nights
Bird surveys	2 person hours per site (MF01–MF04) = 8 person hours	Minimum 1 person hour per site (MF05–MF13) = 12 person hours at fauna sites	2 person hours per site (MF14) = 2 person hours	—	—	22 total person hours
Spotlight searches	1 person hour per site (MF01–MF04) = 4 person hours	1 person hour per site (MF05–MF13) = 9 person hours at fauna sites	2 person hours per site (MF14) = 2 person hours	—	—	15 total person hours
Call playback sessions	2 sessions per site (MF01–MF04) = 8 sessions	2 sessions per site (MF05 - MF10) + 1 session per site (MF11–MF13) = 15 sessions	2 sessions per site (MF14) = 2 sessions	—	—	25 sessions
Habitat searches	2 person hours per site (MF01–MF04) = 8 person hours	Minimum 1 person hour per site (MF05–MF13) = 11 person hours at fauna sites	1 person hour per site (MF14) = 1 person hour	—	—	20 total person hours

Survey method	Survey effort					Total survey effort
	Autumn survey 2019	Spring survey 2019	Autumn survey 2020	Autumn survey 2021	Spring survey 2021	
Echolocation call detection	(2 sites [MF01, MF02] x 1 bat detector x 3 nights) + (2 sites [MF03, MF04] x 1 bat detector x 4 nights) = 14 detection nights	8 sites (MF05 –MF08, MF10 –MF13) x 1 bat detector x 3 nights = 24 detection nights	1 site x 1 bat detector x 3 nights = 3 detection nights	—	—	41 total detection nights
Supplementary micro bat survey sites						
Harp trapping	—	—	6 sites (MH01-MH06) x 1 trap x 5 nights = 30 trap nights	—	—	30 total trap nights
Mist netting	—	—	4 sites (MH01, MH05, MH06, MF14) x 1 mist nets x 1 hour = 4 trap hours	—	—	4 total trap hours
Echolocation call detection	—	—	3 sites (MH02 –MH04) x 1 bat detector x 3 nights = 9 detection nights	—	—	9 total detection nights
Spotlight searches	—	—	2 person hours at 3 sites (MH01, MH05, MH06) = 6 person hours	—	—	6 total person hours
Supplementary surveys						
Bird surveys	20 person hours of bird surveying	30 person hours of bird surveying	10 person hours of bird surveying	—	—	60 total person hours
Spotlight searches	4 person hours of spotlighting	6 person hours of spotlighting	5 person hours of spotlighting	35 mins per site x 2 persons per site (MSS01, MSS02, MSS03 and MSS04) + 7 person hours of opportunistic spotlighting = 11.6 person hours	11 person hours of spotlighting	37.6 total person hours

Survey method	**Survey effort**					**Total survey effort**
	Autumn survey 2019	**Spring survey 2019**	**Autumn survey 2020**	**Autumn survey 2021**	**Spring survey 2021**	
Habitat searches	20 person hours of habitat searching	30 person hours of habitat searching	5 person hours of habitat searching	—	—	55 total person hours
Habitat assessment	—	—	—	—	20 Koala and Greater Glider sites. 11 Ornamental Snake sites. 20 water body assessments of Squatter Pigeon and Australian Painted Snipe.	

7.4.4 Targeted survey for conservation significant fauna

Conservation significant fauna species identified by the desktop assessment (Appendix B) or identified in the Project TOR for MNES as requiring assessment were targeted during the fauna surveys. The survey effort implemented for each threatened species is outlined in Appendix G and for each migratory species in Appendix H. Appendix G and Appendix H describe the survey effort undertaken and how the survey effort compares to relevant Commonwealth and State guidelines and best practice survey guidelines and, where relevant, provide justification for divergence between these relevant guidelines at the time of the surveys.

8 Flora results

8.1 Vegetation communities

Sixteen vegetation communities associated with remnant or high-value regrowth vegetation have been identified across the study area during the field surveys. The vegetation communities are summarised in Table 8.1 and described in Sections 8.1.1 to 8.1.4.

Approximately 5,557 ha in the study area is not associated with remnant or high-value regrowth vegetation. Instead, there are cleared areas with a sparse, shrubby layer of Brigalow (< 1 m) and a ground layer of introduced pasture species (predominantly Buffel Grass). This report describes these areas as cleared agricultural areas.

The distribution of these ground-truthed vegetation communities is shown on Figure 8.1.

8.1.1 Brigalow woodlands

Four vegetation communities associated with Brigalow woodlands have been identified within the study area. A description of their distribution within the study area and their floristic characteristics is provided in Sections 8.1.1.1 to 8.1.1.4.

Table 8.1: Ground-truthed vegetation communities within the study area

Map unit	Vegetation community	Associated RE	VM Act status[1]	BD status[2]
1: Brigalow Woodlands				
VC 1a	Remnant Brigalow woodland on alluvial plains.	11.3.1	Endangered	Endangered
VC 1b	Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains.	11.4.8	Endangered	Endangered
VC 1c	Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains.	11.4.9	Endangered	Endangered
VC 1d	High value regrowth Brigalow.	—	—	—
2: Eucalypt Woodlands				
VC 2a	Remnant Poplar Box woodland on alluvial plains.	11.3.2	Of Concern	Of Concern
VC 2b	Remnant Coolibah woodland on alluvial plains.	11.3.3	Of Concern	Of Concern

Map unit	Vegetation community	Associated RE	VM Act status[1]	BD status[2]
VC 2c	Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains.	11.3.4	Of Concern	Of Concern
VC 2d	Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains.	11.3.9	Least Concern	No Concern at Present
VC 2e	Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains.	11.5.3	Least Concern	No Concern at Present
VC 2f	Remnant Poplar Gum woodland on Cainozoic sand plains.	11.5.8c	Least Concern	No Concern at Present
VC 2g	Remnant Narrow-leaved Red Ironbark woodland on Cainozoic sand plains.	11.5.9c	Least Concern	No Concern at Present
VC 2h	Remnant Clarkson's Bloodwood and Poplar Gum woodland, often with a dense low tree layer dominated by Paperbark Tea-tree.	11.5.12	Least Concern	No Concern at Present
3: Riparian Woodlands				
VC 3a	Remnant River Red Gum or Blue Gum woodland fringing drainage lines.	11.3.25	Least Concern	Of Concern
4: Vegetation Associated with Wetlands				
VC 4a	Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands.	11.3.27b	Least Concern	Of Concern
VC 4b	Remnant Coolibah open woodland fringing palustrine wetlands.	11.3.27f	Least Concern	Of Concern
VC 4c	Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces.	11.5.17	Endangered	Endangered

[1] Endangered; Of Concern; Least Concern

[2] Endangered; Of Concern; No Concern at Present

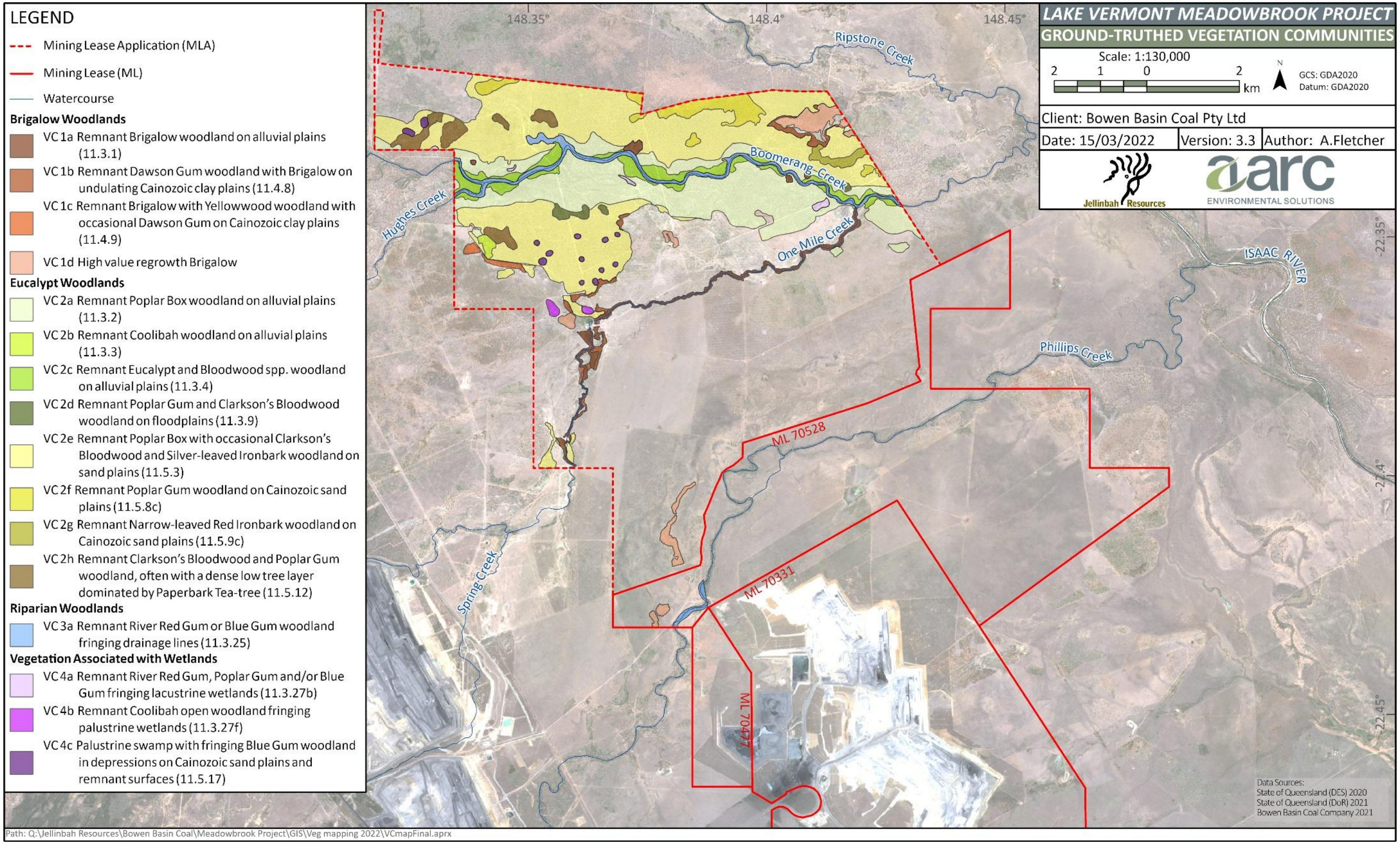


Figure 8.1: Ground-truthed vegetation communities within the study area

8.1.1.1 Remnant Brigalow woodland on alluvial plains (VC 1a)

The remnant Brigalow woodland on alluvial plains consists of Brigalow dominated woodlands with emergent Dawson Gum (*Eucalyptus cambageana*) or Coolibah (*Eucalyptus coolabah*) occasionally dominating some patches (Plate 1). This vegetation community occurs along the banks of One Mile Creek (Figure 8.1). The remnant Brigalow woodland on alluvial plains vegetation community covers an area of approximately 106.2 ha within the study area.This vegetation community is consistent with the description of RE 11.3.1 (DES 2021a).

The canopy height within this community ranges from 12 to 16 m and consists of Brigalow with emergent Dawson Gum or Coolibah. Poplar Box has also been recorded within the upper canopy of this community, and low tree canopies have been recorded consisting primarily of Brigalow, Sally Wattle (*Acacia salicina*) and Ebony Tree (*Bauhinia carronii*). The average crown canopy cover for this community is 57%.

Minimal to no shrub layer is present, and the ground layer is low and sparse with an assortment of native and introduced grass species. Where the shrub layer is present, it ranges from 1 to 6 m and is dominated by Ebony Tree, Thorn Bush (*Pittosporum spinescens*) and Broom Bush (*Capparis anomala*).

The ground layer is sparse with species present, including Australian Dropseed (*Sporobolus australasicus*), Common Joyweed (*Alternanthera nodiflora*), Feathertop Wiregrass (*Aristida latifolia*) and Curly Windmill Grass (*Enteropogon ramosus*) and exotics, such as Buffel Grass (*Cenchrus ciliaris*) and Red Natal Grass (*Melinis repens*). On average, bare ground comprises 45% of the total area, whilst organic litter comprises 33%.

Plate 1: Remnant Brigalow woodland on alluvial plains (VC 1a)

8.1.1.2 Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains (VC 1b)

Remnant Dawson Gum woodland with Brigalow on an undulating Cainozoic clay plains vegetation community is present in three small patches within the study area (Figure 8.1). The community dominated by Dawson Gum and Brigalow (Plate 2) is consistent with the description of RE 11.4.8 (DES 2021a) and covers approximately 51.4 ha of the study area.

The canopy height within this community ranges from 14 to 18 m and is dominated by Dawson Gum with associated Brigalow and occasional Yellowwood (*Terminalia oblongata*). The average crown canopy cover for this community is 32%.

A shrub layer is present ranging from 1 to 2.5 m tall and is dominated by Currant Bush (*Carissa ovata*) with occasional False Sandalwood (*Eremophila mitchelli*) and Desert Lime (*Citrus glauca*).

The ground layer is sparse with species present, including Feathertop Wiregrass, *Psydrax forsteri* and Woodland Lovegrass (*Eragrostis sororia*) and exotics, such as Buffel Grass. On average, bare ground comprises 37% of the total area, whilst organic litter comprises 45%.

Plate 2: Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains

8.1.1.3 Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains (VC 1c)

The remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on a Cainozoic clay plains vegetation community is primarily dominated by Brigalow and Yellowwood (Plate 3). The community is present in small patches throughout the study area (Figure 8.1) and is similar in composition and floristic structure to the remnant Dawson Gum woodland with Brigalow on an undulating Cainozoic clay plains vegetation community. This vegetation community is consistent with the description of RE 11.4.9 (DES 2021a) and covers approximately 19.4 ha of the study area.

The canopy height within this community ranges from 8 to 16 m and is dominated by Brigalow and Yellowwood with occasional Belah (*Casuarina cristata*). The average crown canopy cover for this community is 33%. A shrub layer is present ranging from 1 to 2 m tall and is dominated by Currant Bush with occasional Bitterbark (*Alstonia constricta*) and Holly Bush (*Alectryon diversifolius*). The ground layer is sparse with species present, including Dark Wiregrass (*Aristida calycina*), Buffel Grass, Rhyncho (*Rhynchosia minima*) and Curly Windmill Grass. On average, bare ground comprises 36.4% of the total area, whilst organic litter comprises 47%.

Plate 3: Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains (VC 1c)

8.1.1.4 High value regrowth Brigalow (VC 1d)

A high value regrowth Brigalow vegetation community occurs in small patches—the largest in the north-west of the study area (Figure 8.1). This community includes elements of the remnant Dawson Gum woodland with Brigalow on an undulating Cainozoic clay plains vegetation community and covers approximately 110.3 ha of the study area (Plate 4). The vegetation community has been subject to historic clearing and thinning. The canopy height within this community ranges between 4 and 5 m and is dominated by Brigalow and Yellowwood. The average crown canopy cover for this community is 63%. Based on the composition, structure, and approximate age, it has been determined that the vegetation within this community is high value regrowth.

Areas of this vegetation community supports areas of undulating cracking clays and good condition gilgais that would assist with water retention. A shrub layer is present approximately 1 m tall and is dominated by Currant Bush. The ground layer is dominated by Feathertop Wiregrass and Curly Windmill Grass and occasionally Broom Bush. On average, bare ground comprises 42% of the total area, whilst organic litter comprises 51%.

Plate 4: High value regrowth Brigalow (VC 1d)

8.1.2 Eucalypt Woodlands

Eight vegetation communities associated with Eucalypt woodlands have been identified within the study area. A description of their distribution and floristic characteristics is provided in Sections 8.1.2.1 to 8.1.2.8.

8.1.2.1 Remnant Poplar Box woodland on alluvial plains (VC 2a)

The remnant Poplar Box woodland on alluvial plains vegetation community consists of Poplar Box dominated woodlands (Plate 5). The vegetation community distribution is restricted to alluvial areas associated with Boomerang Creek (Figure 8.1). The remnant Poplar Box woodland on the alluvial plains vegetation community covers approximately 960.2 ha of the study area. This is consistent with the description of RE 11.3.2 (DES 2021a).

The canopy height within this community ranges from 12 to 16 m and contains Poplar Box with occasional Silver-leafed Ironbark (*Eucalyptus melanophloia*) and Moreton Bay Ash (*Corymbia tessellaris*). A low tree canopy is present comprising primarily of Brewster's Cassia and Sally Wattle. The average crown canopy cover for this community is 21.4%.

Minimal to no shrub layer is present, and the ground layer is low and sparse with an assortment of native and introduced grass species. Where the shrub layer is present, it ranges from 1 to 6 m and is dominated by Currant Bush or Brewster's Cassia.

The ground layer is generally dominated by Black Speargrass (*Heteropogon contortus*), Feathertop Wiregrass, Dark Wiregrass, Curly Windmill Grass, Buffel Grass and Red Natal Grass. On average, bare ground comprises 31.4% of the total area, whilst organic litter comprises 27.5%.

Plate 5: Remnant Poplar Box woodland on alluvial plains (VC 2a)

8.1.2.2 Remnant Coolibah woodland on alluvial plains (VC 2b)

The remnant Coolibah woodland on alluvial plains vegetation community is dominated by Coolibah with occasional Clarkson's Bloodwood (*Corymbia clarksoniana*) and Moreton Bay Ash (Plate 6). This vegetation community occurs in one isolated patch on the western side of the study area, which is associated with alluvial soils (Figure 8.1). The remnant Coolibah woodland on the alluvial plains vegetation community covers approximately 12.2 ha of the study area. This is consistent with the description of RE 11.3.3 (DES 2021a).

The canopy height within this community ranges from 14 to 18 m, with an average crown canopy cover of 52.5%. Minimal to no shrub layer is present; where present, it ranges from 1 to 3 m and is dominated by Currant Bush, Brewster's Cassia or Velvet Hibiscus (*Melhania oblongifolia*).

The ground layer is generally dominated by Buffel Grass, and occasionally Feathertop Wiregrass, Curly Windmill Grass and Australian Dropseed. On average, bare ground comprises 18% of the total area, whilst organic litter comprises 46%.

Plate 6: Remnant Coolibah woodland on alluvial plains (VC 2b)

8.1.2.3 Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains (VC 2c)

The remnant Eucalypt and Bloodwood spp. woodland on the alluvial plains vegetation community was formed by a mix of canopy species, including Clarkson's Bloodwood, Moreton Bay Ash, Poplar Gum and occasional Blue Gum (*Eucalyptus tereticornis*) (Plate 7).

This vegetation community occurs on the floodplains along Boomerang Creek (Figure 8.1). The community covers approximately 178.0 ha of the study area and is consistent with the description of RE 11.3.4 (DES 2021a). The canopy height within this community ranges from 14 to 17 m, with an average crown canopy cover of 66.5%.

A shrub layer of 1–4 m is present containing Ebony Tree, Brewster's Cassia and *Grewia rutisifolia*. The ground layer for this community is low and sparse with an assortment of native and introduced grass species. The ground layer is generally dominated by Buffel Grass and *Ecinochloa turneriana*, with Black Speargrass and Sabi Grass also recorded as abundant. On average, bare ground comprises 14.5% of the total area, whilst organic litter comprises 28%.

Plate 7: Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains (VC 2c)

8.1.2.4 Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains (VC 2d)

The remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains vegetation community is dominated by Poplar Gum (*Eucalyptus platyphylla*) with a fringing edge of Clarkson's Bloodwood (Plate 8). This vegetation community occurs as small patches across central and north-east of the study area (Figure 8.1). The remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains vegetation community covers approximately 22.8 ha of the study area. This is consistent with the description of RE 11.3.9 (DES 2021a).

The canopy height within this community ranges from 16 to 18 m with. Minimal to no shrub layer is present; where present, it contains only Brewster's Cassia and occasional Paperbark Tea-tree. The ground layer for this community is low and sparse with an assortment of native and introduced grass species. The ground layer is generally dominated by the following species: *Chamaecrista mimosoides*, Sabi Grass and *Cyperus difformis*. No bareground or leaf litter has been recorded at this vegetation community at the time of the autumn survey. However, at the time of the spring survey, the Poplar Gum present within this community was shedding its leaves, and as a result, this community had a high level of organic litter.

Plate 8: Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains (VC 2d)

8.1.2.5 Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains (VC 2e)

The remnant Poplar Box with Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains vegetation community consists of primarily Poplar Box dominated woodlands with small patches of Clarkson's Bloodwood and Silver-leaved Ironbark (Plate 9). This community is similar in floristic structure to the remnant Poplar Box woodland on alluvial plains (VC 2a) vegetation community; however, this community does not occur on alluvial soils. The remnant Poplar Box with Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains vegetation community covers approximately 1,593.8 ha of the study area. This community is the most widespread vegetation community within the study area, occurring in the northern and central areas. This is consistent with the description of RE 11.5.3 (DES 2021a).

The canopy height within this community ranges from 12 to 16 m and contains Poplar Box, Silver-leafed Ironbark and Clarkson's Bloodwood. The average crown canopy cover for this community is 54.5%. Minimal to no shrub layer is present, and the ground layer was low and sparse with an assortment of native and introduced grass species. Where the shrub layer is present, it is approximately 1 m tall and dominated by Currant Bush with occasional Sally Wattle and *Grewia latifolia*. The ground layer is generally dominated by Dark Wiregrass, Velvet Hibiscus, Curly Windmill Grass and Buffel Grass. On average, bare ground comprises 40% of the total area, whilst organic litter comprises 37.5%.

Plate 9: Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains (VC 2e)

8.1.2.6 Remnant Poplar Gum woodland on Cainozoic sand plains (VC 2f)

The remnant emergent Poplar Gum woodland on Cainozoic sand plains (Plate 10) is similar in floristic structure to the remnant Poplar Gum and Clarkson's Bloodwood woodland on alluvial plains (VC 2d) vegetation community; however, this community is located in sand plains. This vegetation community's canopy is predominantly Poplar Gum with occasional Clarkson's Bloodwood.

This vegetation community occurs in patches primarily in the north of the study area (Figure 8.1). This community is consistent with the description of RE 11.5.8c (DES 2021a) and covers approximately 126.5 ha of the study area. The canopy height within this community ranges from 14 to 16 m, with the emergent reaching about 18 m. A sparse lower canopy is also present within this community, mostly represented by Sally Wattle. The average crown canopy cover for this community is 37%.

Shrub layer is present but sparse within this community, ranging from 1 to 3 m and reaching a cover of 3.5%. The ground layer for this community contains a variety of native and introduced grass species, including Dark Wiregrass*,* Black Speargrass, Buffel Grass, and Feathertop Wiregrass. On average, bare ground comprises 29% of the total area, whilst organic litter comprises 56.5%.

Plate 10: Remnant Poplar Gum woodland on Cainozoic sand plains (VC 2f)

8.1.2.7 Remnant Narrow-leaved Red Ironbark woodland on Cainozoic sand plains (VC 2g)

This vegetation community is characterised by the dominance of Narrow-leaved Red Ironbark (*Eucalyptus crebra*) and occurs in one patch in the north-east of the study area. This community covers approximately 28.0 ha and is described in the REDD as RE 11.5.9c (DES 2021a).

The canopy height within this community is an average of 13 m, with 15% canopy cover. The shrub layer is very sparse with 4% cover and an average of 1.2 m height (DES 2018-2021b). The ground layer for this community is low and sparse with an assortment of native and introduced grass species, consistent with the surrounding vegetation.

8.1.2.8 Remnant Clarkson's Bloodwood and Poplar Gum woodland often with a dense low tree layer dominated by Paperbark Tea-tree (VC 2h)

This vegetation community (Plate 11) often contains a dense low tree layer of Paperbark Tea-tree (*Melaleuca nervosa*), sometimes forming the main canopy layer with Clarkson's Bloodwood predominantly forming emergent canopy.

This community occurs in patches primarily in the north of the study area (Figure 8.1), is approximately 94.5 ha of the study area and is consistent with the description of RE 11.5.12 (DES 2021a). The canopy height within this community ranges from 17 to 19 m for emergent, with the low tree layer reaching approximately 6 m. The average crown canopy cover for this community is 58.5%.

Minimal shrub layer is present within this community. The ground layer is low and sparse with an assortment of native and introduced grass species generally dominated by Black Speargrass, Buffel Grass, Feathertop Wiregrass and Dark Wiregrass. On average, bare ground comprises 30% of the total area, whilst organic litter comprises 58.5%.

Plate 11: 8.1.2.8 Remnant Clarkson's Bloodwood woodland often with a dense low tree layer dominated by Paperbark Tea-tree (VC 2h)

8.1.3 Riparian woodlands

One Eucalypt riparian woodland vegetation community has been identified within the study area, namely the remnant River Red Gum and the Blue Gum woodland fringing drainage lines vegetation community. A description of this community's distribution within the study area and floristic characteristics is provided in Section 8.1.3.1.

8.1.3.1 Remnant River Red Gum or Blue Gum woodland fringing drainage lines (VC 3a)

The remnant River Red Gum and Blue Gum woodland fringing drainage lines vegetation community occurs in association with the riparian areas of Boomerang Creek and Phillips Creek (Figure 8.1). It is limited to the banks of these creeks and the low-lying areas directly adjacent to the creek lines. The canopy height within this community ranges from 18 to 24 m and is dominated by Blue Gum and River Red Gum (*Eucalyptus camaldulensis*), with small areas dominated by Broad Leafed Tea-tree (*Melaleuca leucadendra*) (Plate 12). The average crown canopy cover for this community is 75%.

This vegetation community is consistent with the description of RE 11.3.25 (DES 2021a) and covers approximately 135.8 ha of the study area. Previous studies conducted for the Lake Vermont Mine and Saraji East Mine indicate this vegetation community continues along Phillips Creek upstream and downstream.

A shrub layer is present ranging from 1 to 3 m tall and is dominated by Brewster's Cassia (*Cassia brewsteri*), Creek Sandpaper Fig (*Ficus coronata*) with occasional *Grewia rutisifolia*. The ground layer is densely dominated by Feathertop Wiregrass and Longleaf Matrush (*Lomandra longifolia*). On average, bare ground comprises 3.3% of the total area, whilst organic litter comprises 59%.

Plate 12: Remnant River Red Gum and Blue Gum woodland fringing drainage lines (VC 3a)

8.1.4 Vegetation associated with wetlands

Three vegetation communities are associated with wetlands within the study area. A description of each vegetation community, including its distribution within the study area and floristic characteristics, is provided in the Sections 8.1.4.1 to 8.1.4.2.

8.1.4.1 Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands (VC 4a)

The remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands occurs as small patches within the study area (Plate 12 and Figure 8.1). This vegetation community is consistent with the description of RE 11.3.27b (DES 2021a) and covers approximately 10.6 ha of the study area. During the spring 2019 survey, these wetlands were dry. During the autumn 2020 surveys, several of these wetlands were observed to hold water.

This canopy height within this community ranges from 17 to 20 m and is dominated by Blue Gum or River Red Gum with occasional Poplar Box, Poplar Gum, Swamp Box (*Lophostemon suaveolens*) and Moreton Bay Ash (Plate 12). The average crown canopy cover for this community is 32%.

A shrub layer is present ranging from 1 to 2 m tall and is dominated by Brewster's Cassia, Sally Wattle with occasional *Eremophila debilis*. The ground layer is dominated by Matrush, Green Couch (*Cynodon dactylon*) and Indian Couch (*Bothriochloa pertusa*) and occasionally Curly Windmill Grass. On average, bare ground comprises 26% of the total area, whilst organic litter comprises 34%.

Plate 12: Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands (VC 4a)

8.1.4.2 Remnant Coolibah open woodland fringing palustrine wetlands (VC 4b)

The remnant Coolibah open woodland fringing palustrine wetland occurs as a small patch to the north of One Mile Creek (Figure 8.1). This vegetation community is consistent with the description of RE 11.3.27f (DES 2021a) and covers approximately 11.1 ha of the study area. The community is classified as a freshwater wetland and occurs within the alluvial plains of One Mile Creek. The wetland has heavy cracking clays at its base and contained large amounts of water during the autumn 2019 and autumn 2020 surveys. During the spring 2019 survey this wetland was dry.

The canopy height within this community ranges from 15 to 18 m and is dominated by Coolibah (Plate 13). The average crown canopy cover for this community on the fringing vegetation is 22%. No shrub layer is present within this community.

This wetland has a dense ground layer of aquatic associated groundcovers including species of *Eleocharis*, *Juncus*, *Cyperus* and *Lomandra*. On average, bare ground comprises 30% of the total area, whilst organic litter comprises 18%. The groundcover varies between survey seasons due to changes in climatic conditions and rainfall.

Plate 13: Remnant Coolibah open woodland fringing palustrine wetlands (VC 4b)

Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces (VC 4c)

The palustrine swamp with fringing Blue Gum woodland in depressions on the Cainozoic sand plains and remnant surfaces vegetation community occurs as a number of small wetlands in the west of the study area Figure 8.1). These wetlands do not occur within the alluvial areas of any waterway and are primarily surrounded by the remnant Poplar Box with Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains (VC 2e).

This vegetation community is consistent with the description of RE 11.5.17 (DES 2021a) and covers approximately 21.3 ha of the study area. These wetlands are approximately 50 to 100 m wide and are primarily treeless with a fringing woodland dominated by Blue Gum (Plate 14). This community can form freshwater wetlands during high rainfall events. During the 2019 spring survey these wetlands were dry. During the 2020 autumn survey many of these wetlands showed signs of having recently held water.

The canopy height within this community is approximately 17 m and is dominated by Blue Gum with occasional Poplar Box, Moreton Bay Ash and Poplar Gum. The average crown canopy cover for this community is 16% on the fringing vegetation. No shrub layer is present within this community. The ground layer is dominated by Woodland Lovegrass and Green Couch. On average, bare ground comprises 33.5% of the total area, whilst organic litter comprises 34%.

Plate 14: Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces (VC 4c)

8.2 Vegetation condition

The condition of vegetation and the nature of disturbance present within the vegetation communities has been assessed within the study area. Disturbances noted during the field surveys include previous vegetation clearing for agricultural activities, cattle grazing activities, roads/tracks, mining exploration drill holes and the occurrence of weeds.

A summary of the types and extent of disturbance observed within each vegetation community is provided in Table 8.2.

8.3 Native flora species

A total of 188 flora species have been recorded during the field surveys; this represents 58 families and 133 genera. The dominant family group is Poaceae (38 species) with Fabaceae (9 species), Myrtaceae (15 species) and Malvaceae (12 species) also prominent. The dominant family groups demonstrate the overall composition and condition of the vegetation communities surveyed, with the ground layer being the most diverse. No Endangered, Vulnerable, or Near Threatened Flora species under the NC Act or the EPBC Act have been identified within the study area.

A complete list of flora species recorded is provided in Appendix I, together with their native or introduced status.

Table 8.2: Ground-truthed vegetation community condition

Map Unit	Vegetation Community	Disturbance Description
1: Brigalow Woodlands		
VC 1a	Remnant Brigalow woodland on alluvial plains	Localised areas are dominated by Buffel Grass, with signs of light grazing and cattle access tracks. There is historical disturbance associated with vegetation clearing for cattle grazing activities. Vegetation remaining on the banks of One Mile Creek is in good condition. Edge effects resulting from clearing activities were noted. Minimal weed presence was recorded within this community. Weed species of note include Parthenium (*Parthenium hysterophorus*) and Harrisia Cactus (*Harrisia martinii*). This community has limited connectivity with other remnant vegetation; however, it provides a regionally significant riparian corridor and connectivity to the Isaac River.
VC 1b	Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains	This community contains signs of light grazing and cattle access tracks, with some localised areas of higher intensity cattle grazing. There is historical disturbance associated with vegetation clearing for cattle grazing activities. Edge effects resulting from clearing activities were noted. Several weed species of management concern were recorded within this community, including Harrisia Cactus, Parthenium and Velvety Tree Pear (*Opuntia tomentosa*); however, they were low in abundance.
VC 1c	Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains	This community contains signs of light grazing and cattle access tracks, with some localised areas of higher intensity cattle grazing. There is historical disturbance associated with vegetation clearing for cattle grazing activities. Edge effects resulting from clearing activities were noted. Several weed species of management concern were recorded within this community, including Parthenium and Velvety Tree Pear. These weed species were occasional and had minimal coverage within this community.
VC 1d	High value regrowth Brigalow	There is evidence of historic clearing and thinning of Brigalow. The gilgais present in the north-western patch of this community are generally intact and in good condition. This community contains signs of light grazing and cattle access tracks. Edge effects resulting from clearing activities were noted. Parthenium was recorded within the ground layer of this community.
2: Eucalypt Woodlands		
VC 2a	Remnant Poplar Box woodland on alluvial plains	This community was heavily grazed at the time of the surveys, reducing the potential presence of forbs and herbaceous species. It is considered to be in good condition overall, with only the ground layer experiencing disturbance from cattle grazing. Access tracks are present. Parthenium and Velvety Tree Pear were recorded within the ground layer of this community. This community has connectivity with other Eucalypt woodlands.
VC 2b	Remnant Coolibah woodland on alluvial plains	A moderate level of disturbance was noted within this community primarily relating to cattle grazing. In particular, disturbance was noted in the form of cattle access tracks, dominance of pasture species (i.e. Buffel Grass) and grazing pressure. Access tracks are present. Parthenium was recorded within the ground layer of this community. This community has connectivity with other Eucalypt woodlands.
VC 2c	Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains	A moderate level of disturbance was noted within this community primarily relating to cattle grazing. In particular, disturbance was noted in the form of cattle access tracks, dominance of pasture species (i.e. Buffel Grass) and grazing pressure. Localised areas of higher intensity cattle grazing and clearing activities were observed. Weed species of management concern were recorded within this vegetation community, such as Parthenium and Noogoora Burr (*Xanthium orientale*). This community has connectivity with other Eucalypt woodlands.

Map Unit	Vegetation Community	Disturbance Description
VC 2d	Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains.	A moderate level of disturbance was noted within this community primarily relating to cattle grazing. In particular, disturbance was noted in the form of cattle access tracks, dominance of pasture species (i.e. Buffel Grass) and grazing pressure. Access tracks are present. No weed species of management concern were recorded within this vegetation community. This community has connectivity with other Eucalypt woodlands.
VC 2e	Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains.	A moderate level of disturbance was noted within this community primarily relating to cattle grazing. Disturbance was noted in the form of cattle access tracks, dominance of pasture species (i.e. Buffel Grass) and grazing pressure. Localised areas of higher intensity cattle grazing and cattle access tracks were observed. Clearing impacts within this community include vehicle access tracks and minor disturbance associated with mining exploration activities. Minimal weed presence was recorded within this community; species of note include Parthenium and Velvety Tree Pear. This community has connectivity with other Eucalypt woodlands.
VC 2f	Remnant Poplar Gum woodland on Cainozoic sand plains	This community was heavily grazed at the time of the surveys, reducing the potential presence of forbs and herbaceous species. It is considered to be in good condition overall, with only the ground layer experiencing disturbance; particularly from cattle grazing. Buffel Grass, Sabi Grass and Opuntia sp. were recorded within the ground layer of this community. This community has connectivity with other Eucalypt woodlands.
VC 2g	Remnant Narrow-leaved Red Ironbark woodland on Cainozoic sand plains	As recorded in surrounding vegetation, a moderate level of disturbance is present within this community primarily relating to cattle grazing. This includes cattle access tracks, dominance of pasture species (i.e. Buffel Grass) and grazing pressure. This community has connectivity with other Eucalypt woodlands.
VC 2h	Remnant Clarkson's Bloodwood and Poplar Gum woodland with a dense low tree layer dominated by Paperbark Tea-tree.	This community is considered to be in good condition overall, with only the ground layer experiencing disturbance particularly from cattle grazing. Buffel Grass and Velvety Tree Pear were recorded within the ground layer of this community. This community has connectivity with other Eucalypt woodlands.
3: Riparian Woodlands		
VC 3a	Remnant River Red Gum or Blue Gum woodland fringing drainage lines.	Localised areas dominated by Buffel Grass, with signs of light grazing and cattle access tracks. Vegetation remaining on the banks of Boomerang Creek and Phillips Creek is in good condition. Several weed species of management concern were identified within this community; species of note include Harrisia Cactus, Parthenium, and Rubber Vine (*Cryptostegia grandiflora*). This community has connectivity with other Eucalypt woodlands and with riparian vegetation associated with the Isaac River to the east of the study area. Pieces of coal of variable size were observed within the study area along Boomerang Creek. As the pieces of coal were observed to commence at the western boundary of the study area and coal size reduced downstream, it is considered likely to have originated from upstream mining operations potentially from historical flooding events. The catchment of Boomerang Creek does not occur within the receiving environment of the Lake Vermont Mine.
4: Vegetation Associated with Wetlands		
VC 4a	Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands.	This community contains signs of light grazing and cattle access tracks. No weed species of management concern were recorded within this community. This community has connectivity with other Eucalypt woodlands.

Map Unit	Vegetation Community	Disturbance Description
VC 4b	Remnant Coolibah and/or Blue Gum open woodland fringing palustrine wetlands.	This community contains signs of light grazing and cattle access tracks. One weed species of management concern was recorded within this community, being Parthenium; however, this species is in low abundance. This community has connectivity with other Eucalypt woodlands.
VC 4c	Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces.	This community contains signs of light grazing and cattle access tracks. One weed species of management concern was recorded within this community being Parthenium; however, this species is low in abundance. This community has connectivity with other Eucalypt woodlands.

8.4 Introduced flora species

Thirty-five introduced species have been identified within the study area. Of these, seven are listed as restricted matters under the Biosecurity Act (Qld) (Harrisia Cactus, Balloon Vine, Parthenium, Lantana [*Lantana camara*], Rubber Vine, Velvety Tree Pear and Common Prickly Pear). No species listed as prohibited matters have been identified within the study area.

Introduced plant species may also be classified by the Federal Government as Weeds of National Significance (WoNS) if they present a serious threat to industry, water supply, human health/safety, plant communities and/or cultural values. Four species identified within the study area are classed as WoNS, namely:

1) Parthenium;
2) Lantana;
3) Rubber Vine; and
4) Velvety Tree Pear.

The species identified as restricted matters or as WoNS within the study area are known to occur commonly throughout the broader region. Exotic pasture grasses such as Buffel Grass dominated the ground layer, both within remnant and non-remnant vegetation. A range of other introduced grasses and forbs are also present across the study area in low to moderate abundance. A complete list of the flora species, indicating their native or introduced status, is provided in Appendix I.

8.5 VM Act Endangered and Of Concern regional ecosystems

Four vegetation communities listed as Endangered and three communities listed as Of Concern under the VM Act have been identified within the study area (Table 8.3).

Table 8.3: Ground-truthed vegetation communities associated with VM Act Endangered and Of Concern REs

Map unit	Vegetation community	Associated RE	VM Act Status	Area within study area
1: Brigalow Woodlands				
VC 1a	Remnant Brigalow woodland on alluvial plains.	11.3.1	Endangered	106.2
VC 1b	Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains.	11.4.8	Endangered	51.4
VC 1c	Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains.	11.4.9	Endangered	19.4
2: Eucalypt Woodlands				
VC 2a	Remnant Poplar Box woodland on alluvial plains.	11.3.2	Of Concern	960.2
VC 2b	Remnant Coolibah woodland on alluvial plains.	11.3.3	Of Concern	12.2
VC 2c	Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains.	11.3.4	Of Concern	178.0
4: Vegetation Associated with Wetlands				
VC 4c	Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces.	11.5.17	Endangered	21.3

8.6 EPBC Act Threatened Ecological Communities

The field-validated vegetation mapping identified vegetation that could potentially represent two TECs listed as Endangered under the EPBC Act, namely:

- the Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC (Brigalow TEC); and the
- Poplar Box Grassy Woodland on Alluvial Plains TEC (Poplar Box TEC).

Vegetation that could potentially represent the Natural Grasslands of the Queensland Central Highlands and Northern Fitzroy Basin EEC, Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions EEC or Weeping Myall Woodlands EEC has not been identified within the study area.

The vegetation has been assessed against the key diagnostic characteristics and condition thresholds described in the relevant Commonwealth listing advice to determine whether the vegetation meets TEC status. The relevant condition thresholds and key diagnostic characteristics of the two TECs and results of the assessments are described in Sections 8.6.1 and 8.6.2.

8.6.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC

Brigalow vegetation within the study area has been assessed against the key diagnostic characteristics and condition thresholds described in the Commonwealth approved conservation advice (DoE 2013b) and is summarised below.

Condition Thresholds and Key Diagnostic Characteristics

A patch must include each of the following key diagnostic characteristics to represent the Brigalow TEC:

- The presence of *Acacia harpophylla* as one of the most abundant tree species in the patch. *A. harpophylla* is either dominant in the tree layer, or co-dominant with other species (notably *Casuarina cristata*, other species of *Acacia*, or species of *Eucalyptus*).
- In Queensland, the patch is in one of the following Queensland bioregions (Queensland Brigalow Belt Bioregion, Southeast Queensland Bioregion or Mulga Lands Bioregion), and it meets the description of one of 16 Queensland REs determined at the time of the national listing of the Brigalow ecological community under the EPBC Act. The REs relevant to the study area (i.e. within the Queensland Brigalow Belt Bioregion), as described by the Queensland Herbarium include (DES 2021a):
  - RE 11.3.1, RE 11.4.3, RE 11.4.7, RE 11.4.8, RE 11.4.9, RE 11.4.10, RE 11.5.16, RE 11.9.1, RE 11.9.5, RE 11.9.6, RE 11.11.14 and RE 11.12.21.

In addition, a patch must meet the following condition thresholds to be considered the Brigalow ecological community (TSSC 2001):

- the patch is 0.5 ha or more in size; and
- exotic perennial plants comprise less than 50% of the total vegetation cover of the patch, as assessed over a minimum sample area of 0.5 ha (100 m by 50 m), that is representative of the patch.

The Brigalow TEC can include vegetation considered to be non-remnant; in particular, Brigalow regrowth greater than 15 years old. Areas of Brigalow woodland regrowth are not considered part of the Brigalow ecological community if they are of poor quality (e.g. more than 50% perennial weeds).

The remnant vegetation communities and patches of non-remnant regrowth vegetation within the study area that could represent the Brigalow TEC have been assessed against the key diagnostic characteristics and condition thresholds and the outcomes are described below.

Assessment Outcomes

Patches of Brigalow vegetation have been assessed as meeting the key diagnostic characteristics and condition thresholds to represent the Brigalow TEC. These patches included:

- 88.5 ha of remnant Brigalow woodland on alluvial plains (VC 1a);
- 46.6 ha of remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains (VC 1b); and
- 19.4 ha remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains (VC 1c).

A total of 154.5 ha of the Brigalow TEC has been identified within the study area, the extent of which is shown on Figure 8.2.

No areas of non-remnant regrowth vegetation within the cleared agricultural areas have been determined to meet the condition thresholds. Discussions with the landholder and aerial imagery validated that these areas had been cleared within the last 15 years. Patches of the Brigalow woodland vegetation communities found not to meet the key diagnostic characteristics have also been excluded from the Brigalow TEC mapping; specifically, patches in association with RE 11.4.8 or RE 11.4.9 where the Brigalow was not dominant or co-dominant in the canopy layer. In addition, patches mapped as high value regrowth Brigalow (Figure 8.1) where the patch has been cleared within the last 15 years have also been excluded.

The distribution of the Brigalow TEC within the study area is shown in Figure 8.2.

8.6.2 Poplar box grassy woodland on alluvial plains TEC

Condition thresholds and key diagnostic characteristics

The Poplar Box TEC is associated with ancient and recent depositional alluvial plains with clay, clay-loam, loam and sandy loam, typically duplex soils or sodosols (DoEE 2019c) and occurs in:

- Brigalow Belt North;
- Brigalow Belt South;
- South East Queensland;
- Cobar Peneplains;
- Darling Riverine Plains;
- NSW South-western Slopes; and
- Riverina and Murray Darling Depression IBRA bioregions.

The following Queensland REs have the potential to represent the Poplar Box TEC: RE 11.3.2, RE 11.3.17, RE 11.4.7, RE 11.4.12 and RE 12.3.10. To represent the Poplar Box TEC, the vegetation community must meet key diagnostic characteristics and condition thresholds (DoEE 2019c).

The Poplar Box TEC has the following structure:

- a grassy woodland to grassy open woodland with a tree crown cover of 10% or more at patch scale;
- a tree canopy present that shows the following features:
  - canopy tree species that are capable of reaching 10 m or more in height; and
  - *Eucalyptus populnea* (Poplar Box) present in the canopy and the dominant tree species;
- low mid layer (1–10 m) crown cover of shrubs to small trees—about 30% or less; and
- ground layer (<1 m) mostly dominated across a patch by native grasses, other native herbs and sometimes chenopods.

Where hybrids of Poplar Box are present with other *Eucalyptus* spp, they should be counted as part of the *Eucalyptus populnea* component of the tree canopy when assessing the previous criterion.

A list of native plants associated with this TEC is provided in Appendix A of the Conservation Advice (DoEE 2019c).

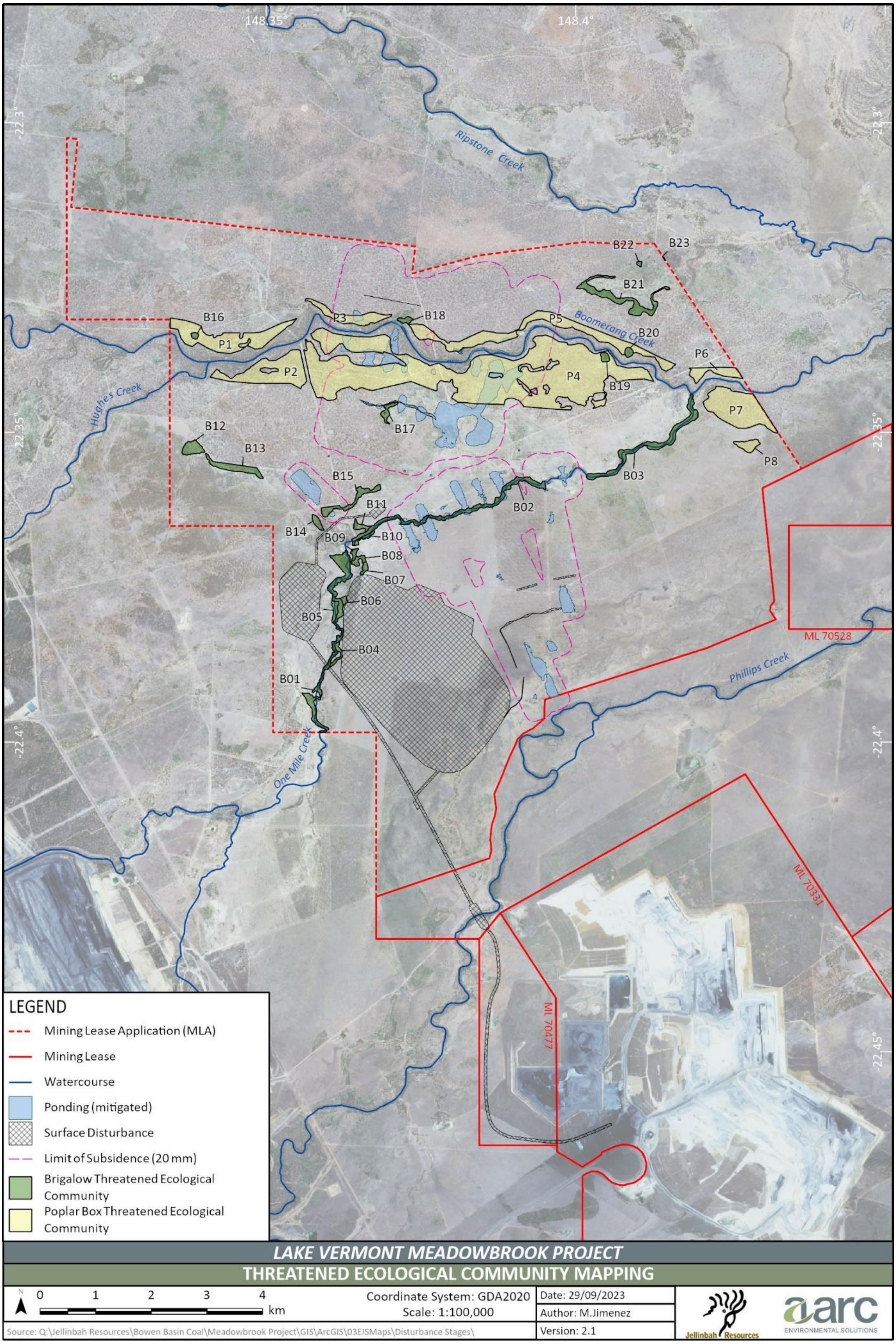


Figure 8.2: Threatened Ecological Communities within the study area

Three condition and minimum patch size thresholds (Class A = highest quality, Class B = good quality and Class C = moderate quality) are defined in the Conservation Advice (DoEE 2019c) to identify good quality patches (moderate to high value).

The vegetation communities mapped within the study area that could represent the Popular Box TEC have been assessed against the key diagnostic characteristics and condition thresholds. The results of the assessment are provided below.

Assessment outcomes

Within the study area, only one vegetation community has been found to contain areas consistent with the key diagnostic characteristics (DoEE 2019c) of the Poplar Box TEC, namely the remnant Poplar Box woodland on alluvial plains vegetation community (VC 2a) (Figure 8.1). The majority of this vegetation community meet the structure requirements for this TEC. Some patches do not meet the relevant criteria due to the one or more of the following:

- Silver-leaved Ironbark dominant in the canopy layer;
- low native species cover and/or low species diversity in the ground layer;
- patch size is smaller than 5 ha; or
- gaps in the canopy where canopy cover is less than 10% and the gap is greater than 30 m wide.

A total of 656.6 ha of the Poplar Box TEC (Class B/good quality) has been identified within the study area, the extent of which is shown on Figure 8.2.

No patches of the remnant Poplar Box woodland on alluvial plains vegetation community met the threshold requirements for Category A1 or A2, as the ground layer did not contain ≥ 30 native plant species per patch. The mapped Poplar Box TEC has been determined to meet the condition requirements of Category B/good quality.

The distribution of the Poplar Box TEC within the study area is shown on Figure 8.2.

8.7 Threatened flora species

As described in Section 7.3.2.4, conservation significant flora species identified by the desktop assessment have been targeted during the flora surveys. No conservation significant flora species have been recorded during the field surveys.

9 Fauna results

9.1 Major habitat types

Field surveys identified five major habitat types for fauna within the study area. The major habitat types within the study area are shown on Figure 9.1 and are described in Sections 9.1.1 to 9.1.5.

9.1.1 Brigalow woodlands

The Brigalow woodlands on clay soils major habitat type includes remnant woodlands dominated by Brigalow, occasionally with Dawson Gum (*Eucalyptus cambageana*) and Belah on clay plains. Within this habitat type, the ground cover is primarily dominated by Currant Bush (*Carissa ovata*) with a variety of native (Australian Dropseed [*Sporobolus australasicus*]) and introduced (Buffel Grass [*Cenchrus ciliaris*]) flora species present in the ground cover layer. Approximately 287.3 ha of this habitat type occurs within the study area (Figure 9.1).

Regional Ecosystems associated with the Brigalow woodlands on clay soils major habitat type within the study area include RE 11.3.1, RE 11.4.8, RE 11.4.9 and areas of high value regrowth associated with Brigalow communities.

This habitat type contains areas of cracking soils and gilgais and has been observed to contain standing pools for a period of time following rainfall. Cracking clays provide important microhabitat features for some amphibians, as they assist in the retention of moisture and provide shelter (Wassens *et al.* 2008). These features also provide suitable refuge and foraging habitat for the Ornamental Snake and foraging habitat for the Australian Painted Snipe.

This habitat type contains large amounts of coarse woody debris from fallen trees (Plate 15). The areas dominated by Brigalow provide shelter for amphibians, small reptiles and ground-dwelling mammals. Areas with Belah contain higher levels of leaf litter in the understorey. These woodlands provide suitable foraging habitat for a range of woodland birds; however, nesting habitat is limited due to the lack of hollow-bearing trees. This habitat is primarily void of Koala food trees; however, *Acacia* woodlands can provide dispersal and shelter habitat for the Koala.

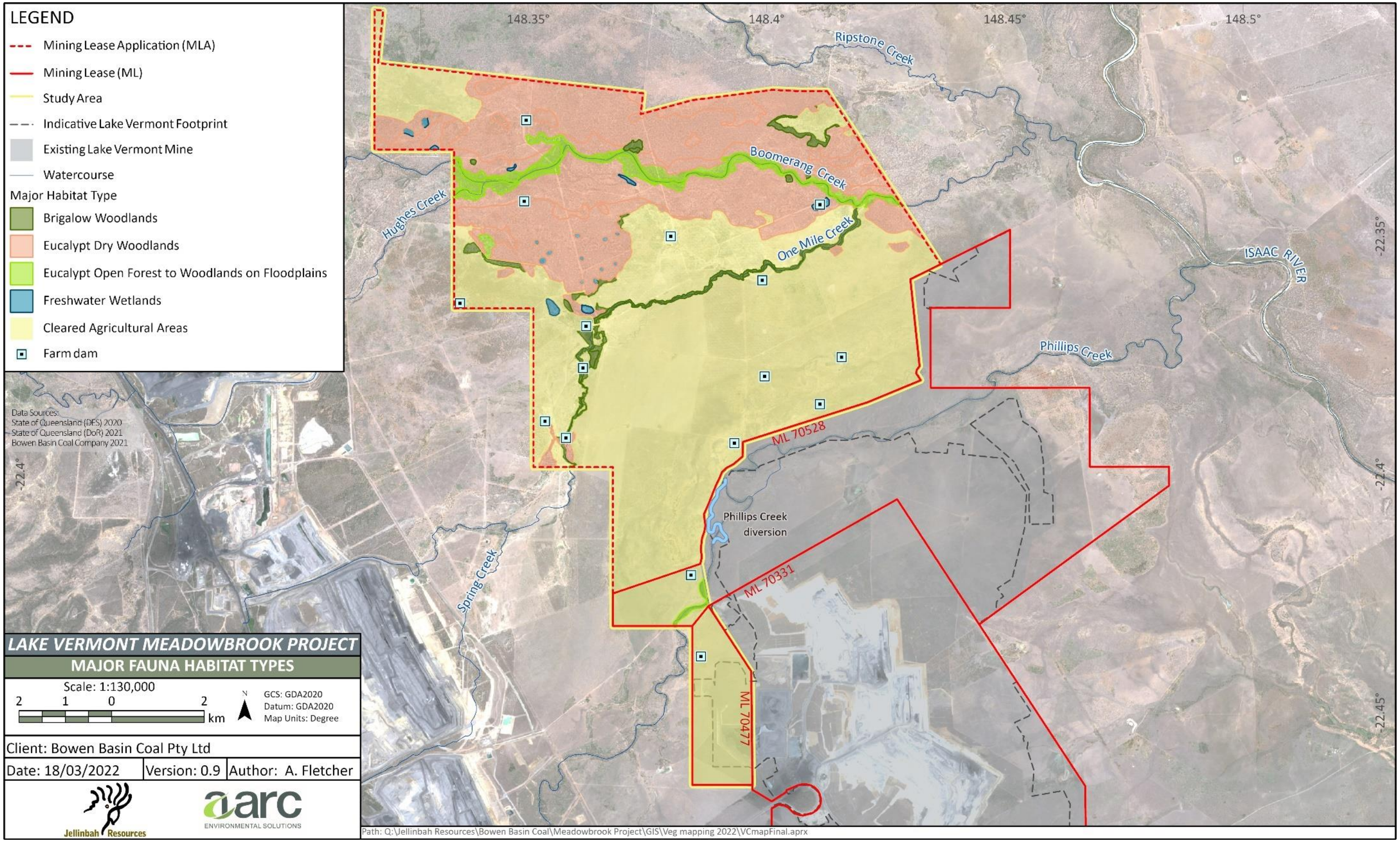


Figure 9.1: Major fauna habitat types

Plate 15: Brigalow Woodlands on Clay Soils

The majority of this habitat type is lightly grazed; however, some areas are subject to a higher level of grazing intensity. Connectivity between patches of this habitat type is limited due to historic agricultural clearing. Cattle tracks and the presence of invasive species, such as Parthenium (*Parthenium hysterophorus*) and Harrisia Cactus (*Harrisia martinii*), are common throughout this habitat type.

9.1.2 Eucalypt dry woodlands

Eucalypt dry woodlands major habitat type include remnant grassy woodlands with Eucalyptus spp., such as:

- Poplar Box (Eucalyptus populnea);
- River Red Gum (E. camaldulensis);
- Poplar Gum (E. platyphylla);
- Clarkson's Bloodwood *(Corymbia clarksoniana)*; and
- Narrow-leaved Red Ironbark *(E. crebra)*.

The shrub layer within this habitat type is absent to minimal; when present, it is comprised primarily of Conkerberry or Brewster's Cassia (*Cassia brewsteri*). The ground layer contains a wide variety of native and introduced grass species, with minimal bare ground. This habitat type is widespread across the study area, covering approximately 2,825.7 ha (Figure 9.1) and provides connectivity between and to other habitat types.

Regional Ecosystems associated with the Eucalypt dry woodlands major habitat type within the study area include RE 11.3.2, 11.3.9, 11.5.3, 11.5.8c, 11.5.9c and 11.5.12.

Key habitat characteristics include a variety of shelter, including small and large hollows, small and large logs, leaf litter and dense grass cover (Plate 16). This habitat type provides foraging habitat for the Koala and the Greater Glider, containing a wide variety of food and shelter tree species. This habitat also provides suitable shelter and foraging habitat for a range of amphibians, reptiles, woodland bird species, ground-dwelling mammals and arboreal mammals. Sections of this habitat type provide a seasonal high level of organic litter.

This habitat has been subject to light to moderate grazing related disturbance, edge effects from historic clearing and storm related damage (fallen branches and trees). Invasive species such as Parthenium and Prickly Pear species (*Opuntia* spp.) are common within this habitat type.

Plate 16: Eucalypt Dry Woodlands on Inland Depositional Plains

9.1.3 Eucalypt open forest to woodlands on floodplains

This habitat type contains remnant open forests to woodlands of River Red Gum and/or Blue Gum (*Eucalyptus tereticornis*), with occasional patches dominated by Weeping Paperbark (*Melaleuca leucadendra*). This habitat type primarily occurs along Boomerang Creek and Phillips Creek. Approximately 326.0 ha of this habitat type occurs within the study area (Figure 9.1). The shrub layer within this habitat type is sparse to dense. Where present, the shrub layer is dominated by Brewster's Cassia or Sandpaper Fig (*Ficus coronata*). The ground layer is typically dominated by Feathertop Wiregrass (*Aristida latifolia*) and Longleaf Matrush (*Lomandra longifolia*).

Regional Ecosystems associated with the Eucalypt open forest to woodlands on floodplains major habitat type within the study area include RE 11.3.3, 11.3.4 and 11.3.25.

Key habitat characteristics include shelter habitat in the form of large hollow-bearing trees containing small and large hollows, leaf litter and logs, creek banks, dense grass and shrub cover (Plate 17). The hollows provide roosting and breeding habitat for a diverse range of bird and arboreal mammals as well as micro-bat species. In particular, this habitat type provides important refuge habitat and riparian corridors that provide connectivity with riparian vegetation along the Isaac River for the Koala and Greater Glider. Logs, leaf litter and shrub/grass cover provide refuge and foraging habitat for amphibians, reptiles and ground-dwelling mammals.

The vegetation within this habitat type was lightly grazed at the time of the surveys. Moderate to high levels of erosion were observed in particular sections along the streams. Several invasive species were observed within this habitat type, including Parthenium and Noogoora Burr (*Xanthium occidentale*).

Pieces of coal of variable sizes have been observed within the study area along Boomerang Creek. As the pieces commence at the western boundary of the study area and their size reduces downstream, it is considered likely they have originated from upstream mining operations possibly from historical flooding events. The catchment of Boomerang Creek does not occur within the receiving environment of the Lake Vermont Mine.

Plate 17: Eucalypt Open Forest to Woodlands on Floodplains

9.1.4 Freshwater wetlands

The freshwater wetlands major habitat type includes remnant freshwater wetlands with or without fringing woodlands dominated by River Red Gum, Poplar Gum or Blue Gum and vegetation (remnant and non-remnant) associated with farm dams (Plate 18). Where present, the shrub layer is typically dominated by Brewster's Cassia. The ground cover is typically sparse and contains native grass species (e.g. Woodland Lovegrass [*Eragrostis sororia*]) and introduced grass species (e.g. Green Couch [*Cynodon dactylon*], Indian Bluegrass [*Bothriochloa pertusa*]). Approximately 43.0 ha of this habitat type occurs within the study area (Figure 9.1).

Regional Ecosystems associated with the freshwater wetland major habitat type within the study area include RE 11.3.27b, RE 11.3.27f and RE 11.5.17.

The fringing woodlands within this habitat type provide habitat for amphibians, reptiles and ground-dwelling mammals through the presence of small and large hollows, leaf litter and coarse woody debris. The wooded areas provide foraging habitat for birds and arboreal mammals. The wetlands and farm dams provide a seasonal or permanent supply of fresh water, providing foraging, shelter and breeding habitat for a variety of fauna species. Farm dams within the study area provide a permanent source of water required by the Squatter Pigeon.

Light grazing and cattle access related disturbance were observed within the remnant vegetation associated with this habitat type. Wetlands/farm dams mapped across the study area in non-remnant vegetation were found to contain higher levels of disturbance, primarily related to clearing and agricultural activities. The introduced Parthenium species was recorded sporadically across this habitat type.

Plate 18: Freshwater Wetlands

9.1.5 Cleared agricultural areas

A large portion of the study area has been historically cleared for agricultural purposes and covers approximately 5,446.7 ha of the study area (Figure 9.1). Remnant woodland areas also show evidence of ongoing grazing activity.

This habitat type contains areas identified as non-remnant and regrowth vegetation and is characterised by pasture land, either cleared or containing regrowth vegetation bordering patches of remnant vegetation. The ground layer is dominated by Buffel Grass and other pasture species, while the shrub layer is sparse and comprised mainly of Conkerberry (Plate 19). Trees were typically absent within this habitat type, with only isolated *Acacia* spp. or Eucalypts occurring throughout the cleared areas. The habitat value of the cleared agricultural areas is limited by the lack of shelter/cover and the disturbance from agricultural activities (ploughing and clearing of Brigalow regrowth) to gilgai habitats. However, these open areas provide hunting habitat for birds of prey and provide some foraging habitat for ground-dwelling mammals. Some of the cleared agricultural areas contain gilgais of varying sizes and depths and provide habitat for a range of amphibian species and reptiles, such as the Ornamental Snake.

Plate 19: Cleared Agricultural Areas

9.2 Native fauna species

A total of 167 native vertebrate species have been identified within the study area during the field surveys:

- 11 amphibians;
- 20 reptiles;
- 109 birds; and
- 27 mammals.

A description of the amphibian, reptile, bird and mammal assemblages within the study area is provided in Sections 9.2.1 to 9.2.4. A complete list of fauna species recorded is provided in Appendix J, together with their conservation status under the EPBC Act and NC Act.

9.2.1 Amphibians

Eleven native amphibian species have been identified by the field surveys comprising three species from the Limnodynastidae family and eight species from the Hylidae family. The amphibian assemblage includes three tree dwelling, four burrowing frog and four ground dwelling species. Each of these species is listed as Least Concern species (NC Act) and are found commonly throughout the region. The species recorded are generally observed along creek lines, near wetlands or within areas with cracking clay soils.

9.2.2 Reptiles

Twenty native reptile species have been recorded during field surveys within the study area, with only one individual from the *Carlia* genus identifying with the genus level. The reptile species assemblage includes:

- six skink;
- four gecko;
- four lizard;
- one legless lizard; and
- five snake.

The Ornamental Snake, which is listed as Vulnerable under the EPBC Act and NC Act, has been recorded within and adjacent to gilgai formations. All reptile species other than the Ornamental Snake are Least Concern species (NC Act) found commonly throughout the region.

The study area provides a variety of habitat types to promote reptile diversity, such as vegetated drainage features, woodlands, open forests and gilgais .Also, microhabitats, such as fallen timber, bark crevices, decorticating bark, ponds and soil cracks, provide shelter from extreme climate, protection from aerial predators and foraging habitat.

9.2.3 Birds

A total of 109 bird species have been recorded during the field surveys, with only one species of *Ardea* identifying with genus level. A variety of avian feeding guilds have been observed within the study area, with the avian assemblage including:

- carnivores;
- Insectivores;
- Granivores;
- Omnivores;
- Nectarivores;
- wetland herbivores; and
- frugivores.

Three species of conservation significance have been recorded within the study area:

1) Squatter Pigeon (Southern);
2) White-throated Needletail; and
3) Crested Tern.

Most species observed within the study area are common species and representative of the woodland habitats dominating the study area.

Avian assemblages are generally determined by factors such as food sources (e.g. fruit, nectar, seeds and insects) as well as a mosaic of habitat structures such as grasslands and open woodlands to closed forests, with variation in vertical habitat complexity. Generally, the more heterogenous the habitat and the more food sources available, the more diverse the avifauna will be. Food sources across the study area comprise seeds, fruit, nectar, insects and vertebrate prey matter (or carrion). The diversity of forage resources available in the surveyed habitats indicates that the study area can support a variety of native avian species.

9.2.4 Mammals

Twenty-seven native mammal species have been recorded within the study area comprising:

- two macropods;
- four arboreal mammals;
- three ground-dwelling mammals;
- one Dasyurid;
- one flying fox; and
- 16 confirmed micro-bat species.

Three species of conservation significance have been recorded within the study area, namely:

1) Koala;
2) Greater Glider; and
3) Short-beaked Echidna.

The study area provides a variety of habitat types suitable for small ground-dwelling mammals, including:

- Brigalow woodlands on clay soils;
- Eucalypt dry woodlands on inland depositional plains;
- Eucalypt open forest to woodlands on floodplains;
- Poplar Gum and *Corymbi*a spp. woodlands on alluvial plains; and
- cleared agricultural areas.

The majority of arboreal mammals identified within the study area have been recorded in habitats with a higher number of hollow-bearing trees, primarily within the freshwater wetlands, Eucalypt open forest to woodlands on floodplains, and the Poplar Gum and *Corymbia* spp. woodlands on alluvial plains habitat types.

Micro-bats are reliant on roosting sites such as thick foliage, loose decorticating bark, rock caves or cavities and tree hollows (Churchill 2008). Potential roosting sites in the study area include tree hollows and decorticating bark, which are present across all vegetation communities.

9.3 Conservation significant fauna species

Five fauna species listed as threatened under the EPBC Act and NC Act have been identified during the field surveys (Table 9.1), namely;

1) Ornamental Snake;
2) Squatter Pigeon (Southern);
3) White-throated Needletail;
4) Koala; and
5) Greater Glider.

All of these species are listed as Vulnerable under the EPBC Act and NC Act the time of the controlled action decision (and Terms of Reference determination) for the Project. Since the time of the controlled action decision for the Project, it is noted that some changes have occurred to the listing status of some of these five species. Specifically, the EPBC Act listing status for the Koala and the Greater Glider has changed from Vulnerable to Endangered (during 2022). With this change occurring after the controlled action decision (and Terms of

Reference determination) for the proposed Project, this assessment considers the impacts to these species a in accordance with their listing status' at the time of the controlled action decision (and Terms of Reference determination) for the Project.

One additional species listed as threatened, the Australian Painted Snipe, is considered to have a moderate likelihood of occurring within the terrestrial ecology study area.

Two species listed as migratory under the EPBC Act and as Special Least Concern (migratory) species under the NC Act have been recorded by the surveys: White-throated Needletail (also listed as Vulnerable) and Crested Tern (*Thalasseus bergii*).

The Short-beaked Echidna, listed as a non-migratory Special Least Concern species under the NC Act, has also been recorded during the surveys.

A detailed description of the distribution, ecology, survey outcomes and habitat assessment for each species is provided in Sections 11.1 and 11.2.

The location at which the conservation significant fauna has been recorded in the study area is shown in Figure 9.2.

Table 9.1: Conservation significant fauna species recorded within the study area

Family	Scientific name	Common name	NC Act status[1]	EPBC Act status[2]
Reptiles				
Elapidae	*Denisonia maculata*	Ornamental Snake	V	V
Birds				
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	V, SLC	V, Mi
Columbidae	*Geophaps scripta scripta*	Squatter Pigeon (Southern)	V	V
Laridae	*Thalasseus bergii*	Crested Tern	SLC	Mi
Mammals				
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V
Pseudocheiridae	*Petauroides volans*	Greater Glider	V	V
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	SLC	-

[1] NC Act conservation status: E= Endangered, V = Vulnerable, SLC = Special Least Concern
[2] EPBC Act conservation status: V = Vulnerable; Mi = migratory

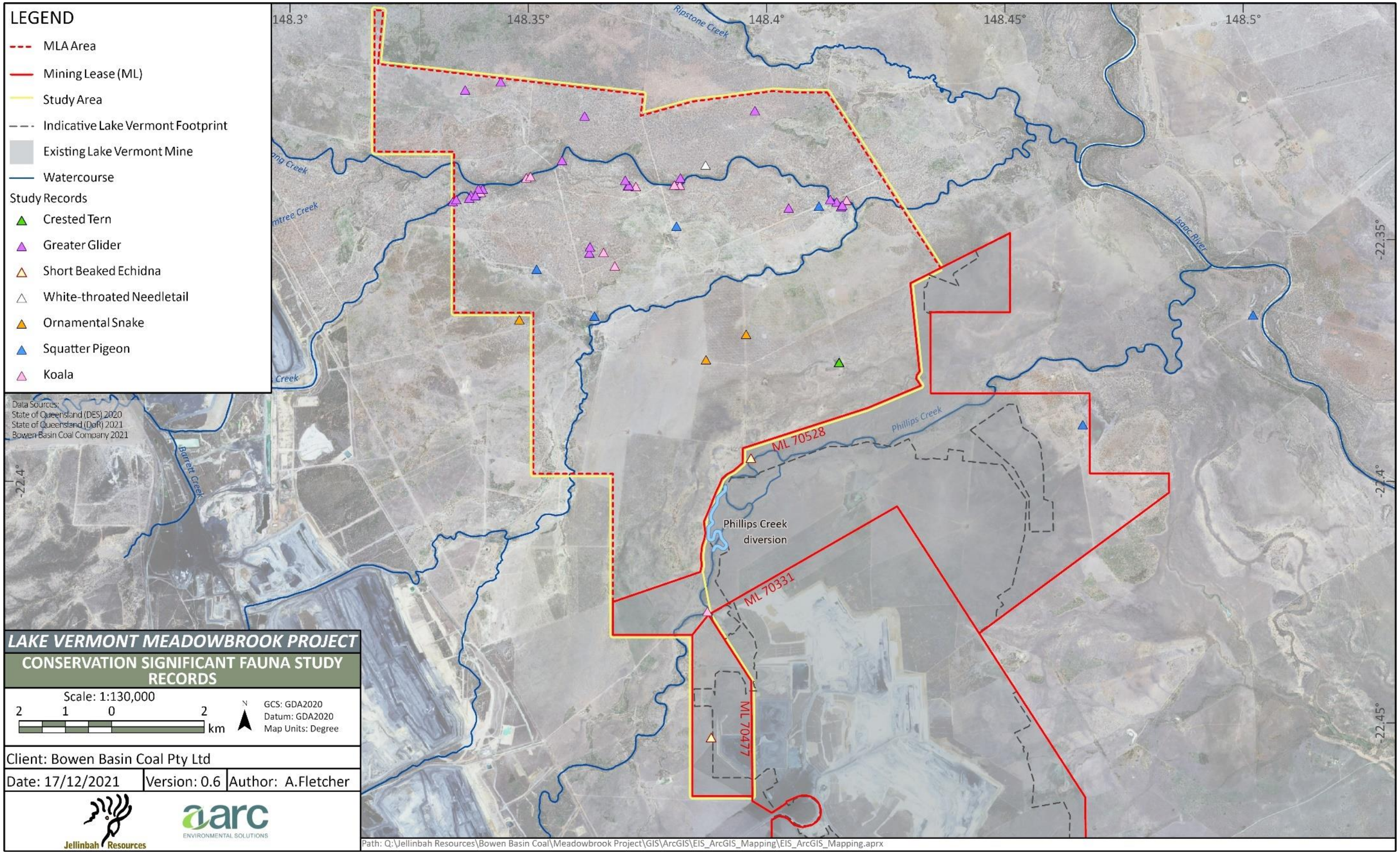


Figure 9.2: Conservation significant fauna study records

9.4 Introduced fauna species

Nine introduced fauna species have been recorded within the study area through the detection of scats, tracks, or other traces (e.g. skulls), sensor camera detection and/or direct observation:

1) Cane Toad (*Rhinella marina*);
2) European Cattle (*Bos taurus*);
3) Wild Dog (*Canis famuiliaris*);
4) European Red Fox (*Vulpes vulpes*);
5) Red Deer (*Cervus elaphus*);
6) Feral Cat (*Felis catus*);
7) House Mouse (*Mus musculus*);
8) Rabbit (*Oryctolagus cuniculus*); and
9) Feral Pig (*Sus scrofa*).

Six the introduced species are listed as a restricted matter and none are a prohibited matter under the Biosecurity Act (Qld).

10 Potential impacts, avoidance, mitigation and management measures

The proposed Project development can be split into four Project stages, each with identifiable impacts. The areas impacted by each stage are presented in Figure 10.1, with the activities of the four stages including:

- Stage 1–project construction—occurs over approximately 2 years (Project Year 1 to Project Year 2);
- Stage 2–mining of the southern longwall panels—occurs over approximately 8 years (Project Year 1 to Project Year 8);
- Stage 3–mining of the northern longwall panels—occurs over approximately 15 years (Project Year 9 to Project Year 23); and
- Stage 4–open cut pit—occurs over approximately 11 years (Project Year 20 to Project Year 30).

The potential impacts of the Project on terrestrial flora and fauna and their habitats will occur under each Project stage:

- direct impacts through vegetation clearance and habitat disturbance;
- indirect impacts including;
  - mine subsidence effects (e.g. changes to surface water hydrology, residual ponding post mining);
  - changes to surface or groundwater hydrology (e.g. groundwater drawdown);
  - fragmentation and edge effects;
  - weeds and pests;
  - noise and vibration;
  - dust;
  - artificial lighting; and
  - bushfires.
- cumulative impacts; and
- facilitated impacts.

The potential impacts of the Project and the measures developed to avoid, mitigate and manage impacts on terrestrial flora and fauna are described in Sections 10.1 to 10.13. Section 11 describes the potential impacts and avoidance, mitigation and management measures specific to MNES and MSES and assesses the significance of the impacts on these matters.

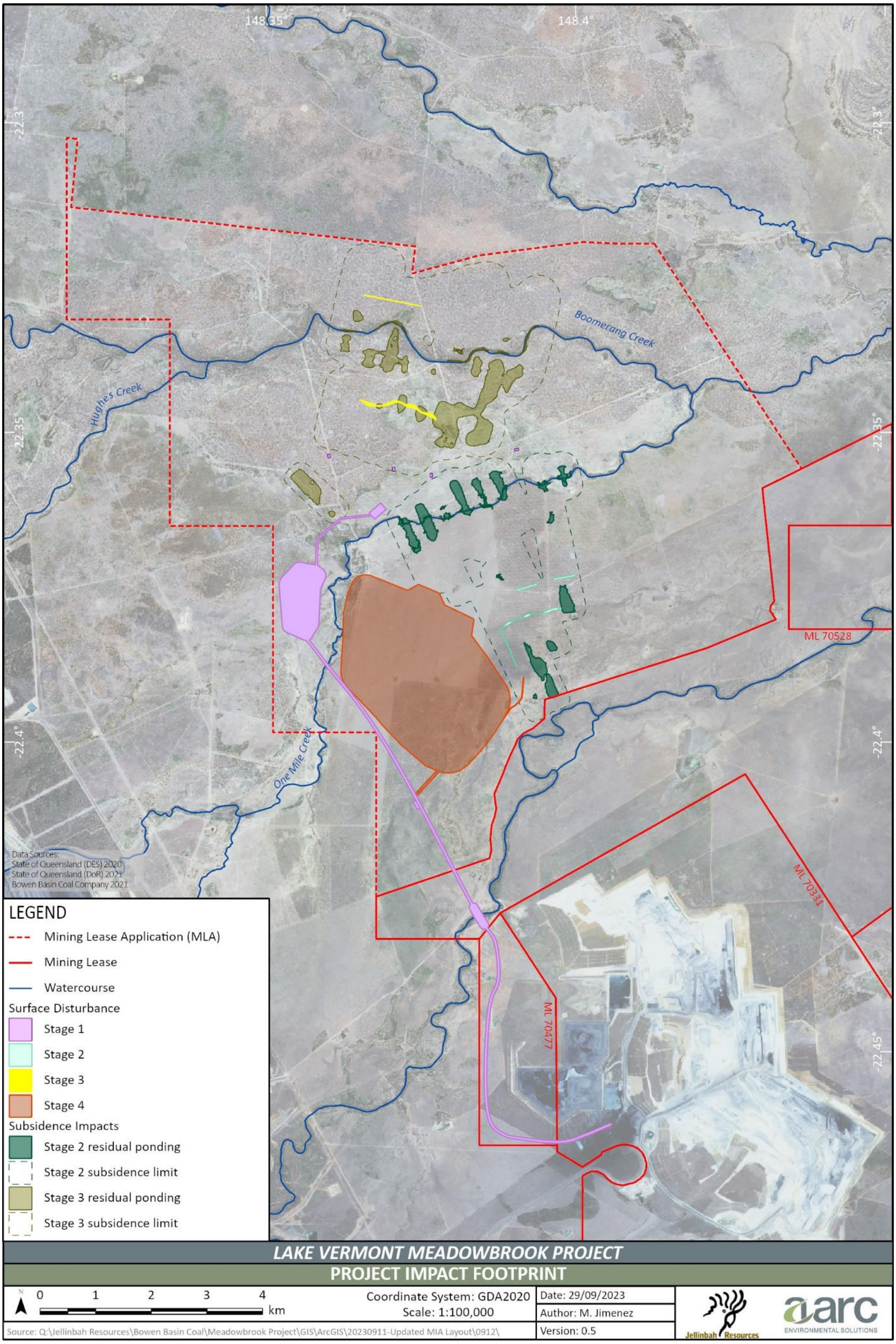


Figure 10.1: Project impact footprint

10.1 Vegetation clearance and habitat disturbance

Project infrastructure has been sited to avoid or minimise disturbance to remnant vegetation when possible. However, all four Project stages will include some direct vegetation clearance and habitat disturbance:

- Stage 1 includes the majority of clearance for Project infrastructure.
- Stages 2 and 3 include some surface works for subsidence ponding mitigation and access for gas drainage.
- Stage 4 includes some vegetation clearance.

Details of the direct disturbance and vegetation removal for the Project stages are outlined below.

Stage 1

Stage 1 of the Project is the construction phase, which commences in Project Year -1 (indicatively 2024) with completion in Project Year 0 (indicatively 2025). Direct disturbance will occur in stage 1 including vegetation removal for the construction of the infrastructure corridor, MIA, ETL and supporting infrastructure. Greater detail of the components of the Project layout are provided in the EIS project description. Whenever possible, infrastructure has been located so as to minimise the clearance of vegetation.

Stage 2 and 3

Stage 2 represents the mining of the underground longwall panels located south of the main headings (Figure 1.3). Stage 2 of the Project commences in Project Year 1 (indicatively 2026) and runs through to Project Year 8 (indicatively 2033). Stage 3 represents the underground mining of the longwall panels located north of the main headings (Figure 1.3) and involves mining of two laterally located coal seams. Stage 3 of the Project commences in Project Year 8 and runs through to Project Year 23 (indicatively 2048). Stage 2 and 3 involve some vegetation clearance for the construction of subsidence ponding drainage mitigation works as well as an additional access track to support gas drainage activities.

Proposed ponding mitigation works include construction of drainage ‘mitigation channels’ and ‘mitigation bunds’ (Figure 1.3). Bunds will also be constructed to prevent water moving into subsided longwall panels, as a mechanism to reduce the extent of ponding (Figure 1.3). The proposed ‘mitigation channels’ and ‘mitigation bunds’ involve additional direct disturbance, however substantially reduce the otherwise unmitigated ponding footprint. The proposed drainage works are located to minimise disturbance to Brigalow and Poplar Boc TECs.

Areas of residual subsidence induced ponding will be subject to periods of inundation, being estimated to retain water for a maximum period of several months every few years depending on inflow volumes and soil permeability (WRM 2022). For the purposes of this ecological assessment these areas of periodic ponding are considered to undergo impacts equivalent to the loss of existing vegetation. This is a conservative approach (as ponding areas will provide an ecological function similar to existing gilgai’s). Potential impacts of surface subsidence and periodic ponding is described in further detail in Section 10.2.

Vegetation clearance will occur in Stage 3 for an access track to allow surface access to the western longwall panels (to support proposed gas drainage activities). This area is currently not connected to existing access tracks. The proposed access track is located to minimise impacts to Brigalow and Poplar Box TEC (Figure 1.3).Stages 2 and 3 will result in surface subsidence from underground mining activities, and changes to surface water hydrology resulting in the creation of residual ponding areas post mining.

The potential impacts of surface subsidence and periodic ponding are described in further detail in Section 10.2.

Stage 4

Stage 4 involves the disturbance of vegetation for the satellite open cut pit; this includes:

1) the pit levee construction;

2) development of waste rock emplacements;
3) sediment dams; and
4) mining disturbance.

Stage 4 is predominantly in the cleared agricultural areas, although the north end of the pit will involve some clearance of remnant vegetation. Stage 4 has been designed to minimise the clearance of vegetation and avoid disturbance to watercourses.

10.1.1 Vegetation clearance

A total of 12.2 ha of remnant vegetation will be cleared and 96.9 ha impacted by predicted periodic ponding as a result of the Project, resulting in 109.1 ha of remnant vegetation disturbed by the Project. This represents some 3.2% of remnant vegetation within the study area.

Table 10.1 details the proposed clearance of each vegetation community identified in the study area.

The vegetation within the study area provides terrestrial fauna with opportunities for foraging, breeding, nesting, predator avoidance and movement between areas, facilitates dispersal/migration and promotes genetic diversity. These opportunities could potentially be reduced for fauna by clearance activities associated with the Project. Notwithstanding this, ponding areas induced by subsidence will create additional (seasonal) water sources for fauna not completely dissimilar to local gilgai functionality. Where practicable, Project infrastructure has been sited within cleared agricultural areas. The majority of disturbance associated with the proposed open cut satellite pit will be to cleared agricultural land. Table 10.2 details the proposed clearance of each major habitat type identified in the study area.

Temporary disturbance for gas drainage

The drainage of inseam gas will be undertaken *via* a system of wells and control equipment located on a relocatable skid. Access to the surface of each panel for gas drainage will be gained predominantly *via* the existing track network. Additional access will be required to panels in the west end of the Stage 3 underground mining area isolated from existing tracks. One track proposed to provide access for the movement of gas drainage equipment, which is included in the stage 3 direct disturbance footprint and shown on Figure 10.1. Further access from the existing and proposed track network (to support gas drainage activity) will be achieved without ground disturbance, with slashing as opposed to blade clearing of any additional tracks. Gas drainage wells will be developed over each panel as mining progresses through the underground area, and the relocatable control equipment will be transported on the surface to new locations as required.

Temporary disturbance created for the deployment of drilling vehicles and gas control equipment will be progressively rehabilitated. Previously disturbed areas will be in stages of regeneration and rehabilitation and in the order of two hectares at any one time. Gas drainage activities will preferentially avoid areas of Brigalow TEC, Poplar Box TEC, areas of fauna habitat of conservation significance and vegetation in proximity to watercourses. No gas drainage activities will be conducted within 100 m of the defining bank of a 5th order stream (Boomerang Creek) or 50 m from the defining bank of a 4th or 3rd order stream (Phillips Creek and One Mile Creek)

Table 10.1: Proposed disturbance of vegetation communities

Map unit	Vegetation community	Associated RE	Extent within study area (ha)	Area of disturbance (ha)		
				Stages 1,2,3 clearing	Stage 2 and 3 residual ponding	Stage 4 clearing
1: Brigalow Woodlands						
VC 1a	Remnant Brigalow woodland on alluvial plains.	11.3.1	106.2	0.3	8.2	3.6
VC 1b	Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains.	11.4.8	51.4	0.3	0.1	3.5
VC 1c	Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains.	11.4.9	19.4	0.0	0.0	0.0
VC 1d	High value regrowth Brigalow.	—	110.3	1.0	5.1	2.2
2: Eucalypt Woodlands						
VC 2a	Remnant Poplar Box woodland on alluvial plains.	11.3.2	960.2	0.0	58.3	0.0
VC 2b	Remnant Coolibah woodland on alluvial plains.	11.3.3	12.2	0.0	0.0	0.0
VC 2c	Remnant Eucalypt and Bloodwood spp. woodland on alluvial plains.	11.3.4	178.0	0.0	4.9	0.0
VC 2d	Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains.	11.3.9	22.8	0.3	0.0	0.0
VC 2e	Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains.	11.5.3	1,593.8	2.6	17.7	0.0
VC 2f	Remnant Poplar Gum woodland on Cainozoic sand plains.	11.5.8c	126.5	0.0	0.0	0.0
VC 2g	Remnant Narrow-leaved Red Ironbark woodland on Cainozoic sand plains.	11.5.9c	28.0	0.0	0.0	0.0
VC 2h	Remnant Clarkson's Bloodwood woodland often with a dense low tree layer dominated by Paperbark Tea-tree.	11.5.12	94.5	0.0	0.0	0.0
3: Riparian Woodlands						
VC 3a	Remnant River Red Gum or Blue Gum woodland fringing drainage lines.	11.3.25	135.8	1.5	5.2	0.0

Map unit	Vegetation community	Associated RE	Extent within study area (ha)	Area of disturbance (ha)		
				Stages 1,2,3 clearing	Stage 2 and 3 residual ponding	Stage 4 clearing
4: Vegetation Associated with Wetlands						
VC 4a	Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands.	11.3.27b	10.6	0.0	2.4	0.0
VC 4b	Remnant Coolibah open woodland fringing palustrine wetlands.	11.3.27f	11.1	0.1	0.0	0.0
VC 4c	Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces.	11.5.17	21.3	0.0	0.0	0.0

Table 10.2: Proposed disturbance of major habitat types within the study area

Major habitat type	Extent within study area (ha)	Area of disturbance (ha)		
		Stage 1,2,3 clearing (ha)	Stage 2 and 3 residual ponding (ha)	Stage 4 clearing (ha)
Brigalow woodlands	287.3	1.7	13.4	9.3
Eucalypt dry woodlands	2,825.7	2.9	76.0	0.0
Eucalypt open forest to woodlands on floodplains	326.0	1.5	10.2	0.0
Freshwater wetlands	43.0	0.1	2.4	0.0
Cleared agricultural areas	5,446.7	138.2	111.7	656.2

10.1.2 Vegetation clearance protocols

The following management measures will be implemented where vegetation clearance is necessary:

- Clearing activities will be undertaken progressively in accordance with the mine schedule and Project requirements and not before.
- Vegetation/habitat adjoining proposed clearance areas will be delineated and clearly marked to prevent accidental damage through a 'Permit to Disturb' process.
- Areas to be cleared will be inspected to identify fauna at direct risk from clearing activities.
- Vegetation will be felled in the direction of the clearance zone to avoid impacts to adjoining retained vegetation and habitat.
- Clearing operations will be managed to maximise the reuse of cleared vegetative material. This will include the salvage and reuse of select habitat resources from the cleared vegetation (e.g. logs) for habitat enhancement either in the rehabilitation program, proposed offset areas located on Bowen Basin Coal land or elsewhere on site.

As described in Section 10.1, temporary vegetation/habitat disturbance above the underground mining area will be undertaken for the deployment of gas drainage wells. These surface works will be sited to minimise the amount of vegetation disturbance required (e.g. the positioning of infrastructure and vehicle access routes to avoid the removal of trees or the siting of infrastructure in previously disturbed areas, such as adjacent to existing tracks). Management measures for areas of disturbance required above the underground mining area include the following criteria:

- Existing tracks will be used to access sites to minimise the disturbance of soils and creation of new tracks.
- Vegetation clearance will be restricted to the slashing of vegetation (i.e. leaving the lower stem and roots *in-situ* to maximise the potential for natural regrowth), where practicable.
- Branches will be lopped, rather than removing trees, where practicable.
- The amount of soil disturbance will be limited to the minimum required for the mobilisation, placement and operation of equipment and for maintaining access to equipment.
- Rehabilitation measures will be implemented in the event that natural regeneration is considered not to be progressing (e.g. weed control measures or active planting). Details of proposed rehabilitation measures are provided in the Project PRC Plan.

10.1.3 Clearing Management Program

A Clearing Management Program will be prepared for the Project by a suitably qualified ecologist in accordance with guidelines prior to Project clearance activities.

The Clearing Management Program will include the following criteria:

- Measures will be implemented to minimise disturbance and salvage and reuse of select habitat features in accordance with the vegetation clearance protocols.
- Protocols will be implemented to handle fauna encountered prior to or during clearing activities, including their relocation as necessary to suitable habitat.
- An appropriately qualified fauna spotter/catcher will be present during clearing.
- Specific measures will be implemented to minimise impacts to threatened species, including the Ornamental Snake, White-throated Needletail, Squatter Pigeon, Koala and Greater Glider.
- Protocols will be implemented to handle injured wildlife, including emergency euthanasia.

10.1.4 Rehabilitation

Land disturbed by mining activities will be rehabilitated progressively as it becomes available. Details of the proposed rehabilitation program are provided in the main text of the EIS and in the draft Progressive Rehabilitation and Closure Plan (PRC Plan) prepared for the Project. In accordance with the Queensland government's policy objectives defined in the 'Mined land rehabilitation policy' (Queensland Government 2018), the general rehabilitation goals for the Project are to leave an area that is safe and stable, does not cause environmental harm and is able to sustain the post-mining land use approved in the PRC Plan.

10.2 Subsidence effects and residual ponding

The proposed underground mining activities in Stages 2 and 3 will cause surface subsidence. The potential subsidence movements have been predicted by Gordon Geotechniques Pty Ltd who used an influence function method and validated it using an application in comparable mining operations (Gordon Geotechniques 2022). Subsidence predictions have also been externally peer reviewed (Seedsman 2022). Subsidence vertical movement is predicted to occur over the underground mining areas to a maximum of 2.9 m deep for the Stage 2 southern mining area and a maximum of 5 m deep for the Stage 3 northern mining area. The maximum horizontal ground movements are typically less than 1 m in the Stage 2 southern mining area and up to 1.6 m in the Stage 3 northern mining area. The maximum tilt modelled to develop as a result of subsidence is 38 mm/m. These subsidence effects are expected to develop within six weeks after single seam longwall mining is complete.

10.2.1 Surface cracking

Some surface soil cracking is also predicted as a result of subsidence. Tension cracks are expected to develop and close after short periods as the transient tensile train passes above the retreating longwall. Longer lasting tension cracks can develop in areas of residual tensile strain, which will be the perimeter of each longwall panel.

Maximum surface crack widths of 200 mm are predicted above the shallower underground mining areas, with a maximum of 50 mm crack widths above the deeper underground mining areas. Cracking depths are predicted to be predominantly less than 1 m up to a potential maximum of 15 m, with no connective cracking from the surface to the mined seams.

Soils affected by cracking are predominantly expected to self-ameliorate through wetting/drying cycles, particularly in areas with shrink swell vertosols which are dominant in the stage 2 underground mining subsidence area and the southeast portion of the stage 3 underground mining subsidence area (AARC 2022). Soil cracks that do not resolve are expected to be amenable to small scale crack rehabilitation involving excavating and backfilling.

The surface cracking is not expected to result in impacts to vegetation, however if surface cracking creates conditions which allow soil erosion to develop, vegetation could be impacted as a result of erosion.

10.2.2 Surface crack rehabilitation

Crack rehabilitation works will be initiated in consideration of locations of conservation significant species and ecosystems, with work to be undertaken without machinery where necessary. The Subsidence Management Plan will integrate an adaptive soil crack monitoring and management approach such that, where unpredicted subsidence impacts and environmental consequences occur, previously approved processes will be considered to prevent their reoccurrence. Crack rehabilitation will include the following:

- surveys for persistent surface cracking;
- scarifying or ripping of minor cracks using light machinery;
- removal of topsoil from cracked areas, excavation and backfilling, and re-spreading topsoil to affected areas;
- natural regeneration through soil seed bank, rootstock material and recruitment; and
- post rehabilitation monitoring.

Rehabilitation works is expected to be limited to areas three meters wide and will not require the removal of trees. Livestock will be excluded from areas undergoing active subsidence and will not be present in areas subject to crack rehabilitation.

10.2.3 Predicted impacts from surface cracking and crack rehabilitation

Tension cracks may form around the perimeter of each longwall panel and the nature and persistence of cracks will be dependent on the depth of cover, panel and pillar width, geology and soil properties. Where persistent soil cracks develop, crack rehabilitation will be conducted in accordance with the Subsidence Management Plan. The rehabilitation of soil cracks will not require any routine clearing of vegetation and will only be conducted where cracks fail to self-ameliorate and the risk of erosion develops. Trees will not be removed for crack rehabilitation. Crack rehabilitation works will be conducted with light machinery and targeted to affected areas in an approach that avoids clearing of understory vegetation. Where targeted understory vegetation removal is required for crack rehabilitation, the site will be immediately remediated, and re-vegetation will be started. Rehabilitated areas will remain under observation to allow monitoring of success of the approaches used.

Where soil cracks are temporary and self ameliorating, they are not expected to cause any significant impacts to vegetation and fauna habitat quality. The remediation of soil cracks is expected to adequately rehabilitate persistent cracking and the rehabilitation works are not expected to result in significant impact to terrestrial ecology values.

10.2.4 Subsidence and ponding area impact

The surface water assessment has identified the areas of subsidence footprint that will develop potential for residual ponding (post-mining). Mitigation measures to minimise ponding by facilitating drainage in the subsidence footprint have been designed and incorporated into the Project design to minimise the extent of subsidence-induced ponding (WRM 2022). Areas subject to predicted residual ponding which cannot be mitigated by drainage works are predicted to experience ponding after flooding events for a maximum period of several months in every few years. This changed hydrological regime is considered to be potentially deleterious to the existing vegetation communities particularly ecological values associated with tree species (Section 10.1).

Outside of predicted ponding areas, the broader subsidence footprint is expected to demonstrate no material changes to the surface landform, with impacts to have a short duration (i.e. land movement once the panel is mined). Subsidence-induced changes to the surface landform are not expected to impact ecological values, outside of areas where residual ponding is resultant or disturbance for mitigation works is proposed.

Monitoring results from similar mining operations in the Bowen Basin have demonstrated that subsidence from underground mining has no broad patterns of impact on vegetation. An assessment of subsidence impacts on vegetation for comparable operations has identified that there would be no change in woodland canopy height or projected foliar cover over the entire longwall panel area (Eco Logical Australia 2015), including the most subsided areas that are likely to be inundated with ponding. Subsidence monitoring of additional existing underground mining projects in the Bowen Basin indicates that subsidence impacts can be minor and non-damaging to the viability and habitat provision of open Eucalypt Woodland and riverine woodland vegetation. At the Grosvenor project, monitoring of impacts on vegetation demonstrates that subsidence-affected areas show no substantial deleterious impact on vegetation conditions in areas of Eucalypt Woodlands (including areas of Poplar Box vegetation, RE 11.3.2) and Brigalow Woodlands (including RE 11.4.9). This is based on an assessment of:

- habitat continuity;
- vegetation cover;
- dominance of natives;
- debris; and
- other indicative features (Engeny 2020).

At the Moranbah North project, monitoring demonstrates that the condition of vegetation impacted by subsidence and waterway diversion is comparable to control sites (Engeny 2021).

Notwithstanding this, for the purposes of the Project terrestrial ecology assessment, the impact to vegetation from residual ponding is considered to be equivalent to the clearance of vegetation. This represents a conservative assessment of the potential subsidence impacts. The habitat values provided by cleared agricultural areas are considered to be retained, despite residual ponding development because the pre-mining conditions of these areas involve intermittent ponding of gilgai depressions which will continue post-subsidence. The areas of ponding impact on vegetation communities is presented in Table 10.1, impacts to major habitat types are presented in Table 10.2 The portions of the subsidence footprint not predicted to undergo ponding are expected to retain viability and provision of habitat values and are, therefore, considered not to be subject to any substantial impacts resulting from subsidence. Subsidence footprint areas excluding ponding areas is presented in Table 10.3.

Table 10.3: Vegetation within subsidence footprint excluding ponding areas

Map unit	Vegetation community	Associated RE	Extent within study area (ha)	Area within unponded subsidence footprint (ha)
1: Brigalow Woodlands				
VC 1a	Remnant Brigalow woodland on alluvial plains	11.3.1	106.2	25.0
VC 1b	Remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains	11.4.8	51.4	7.1
VC 1c	Remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains	11.4.9	19.4	0.0
VC 1d	High value regrowth Brigalow	—	110.3	1.6
2: Eucalypt Woodlands				
VC 2a	Remnant Poplar Box woodland on alluvial plains	11.3.2	960.2	313.2
VC 2b	Remnant Coolibah woodland on alluvial plains	11.3.3	12.2	0.0
VC 2c	Remnant Eucalypt and Bloodwood spp. Woodland on alluvial plains	11.3.4	178.0	61.0
VC 2d	Remnant Poplar Gum and Clarkson's Bloodwood woodland on floodplains	11.3.9	22.8	10.2
VC 2e	Remnant Poplar Box with occasional Clarkson's Bloodwood and Silver-leaved Ironbark woodland on sand plains	11.5.3	1,593.8	496.7
VC 2f	Remnant Poplar Gum woodland on Cainozoic sand plains	11.5.8c	126.5	32.2
VC 2g	Remnant Narrow-leaved Red Ironbark woodland on Cainozoic sand plains	11.5.9c	28.0	0.0
VC 2h	Remnant Clarkson's Bloodwood woodland often with a dense low tree layer dominated by Paperbark Tea-tree	11.5.12	94.5	0.0
3: Riparian Woodlands				
VC 3a	Remnant River Red Gum or Blue Gum woodland fringing drainage lines	11.3.25	135.8	35.0
4: Vegetation Associated with Wetlands				
VC 4a	Remnant River Red Gum, Poplar Gum and/or Blue Gum fringing lacustrine wetlands	11.3.27b	10.6	<0.1
VC 4b	Remnant Coolibah open woodland fringing palustrine wetlands	11.3.27f	11.1	0.0
VC 4c	Palustrine swamp with fringing Blue Gum woodland in depressions on Cainozoic sand plains and remnant surfaces	11.5.17	21.3	4.5

10.3 Hydrological changes

10.3.1 Surface water

The predicted changes to watercourses as a result of the Project are identified in WRM (2022). A summary of the predicted changes with reference to potential impacts to terrestrial ecology values is presented as follows.

Boomerang Creek

The predicted subsidence would result in a series of six small troughs in the Boomerang Creek channel bed. In these troughs which are predicted to be limited to the stream channel, channel velocity will be decreased, and aggradation of sediment into the stream bed will be promoted in these areas. Where the creek drains into the subsidence zone, increased channel velocity is predicted, with potential for marginal increase in bank erosion. The pillars between the subsidence troughs are expected to undergo initial bank erosion during the initial flows after subsidence; however, the grade is expected to revert to pre-mining grade as troughs infill with the sediment that is abundant upstream in the creek.

The predicted subsidence troughs in the Boomerang Creek channel are not expected to represent an impact to terrestrial ecology values. The channel is an unvegetated sandy stream substrate and, therefore, does not contain any conservation significant vegetation or fauna habitat value. The marginal risk of increased bank erosion where the creek enters the first subsidence trough is not expected to result in an impact to the vegetation adjoining the creek (WRM 2022).

One Mile Creek

The predicted subsidence would result in a series of eight main troughs in the channel bed aligning perpendicularly to the channel. The troughs align with residual ponding areas extending laterally from the watercourse. During floods, water would flow laterally and inundate the subsidence troughs. Where the channels intersect with subsidence troughs, channel velocity is expected to decrease, and sediment transport capacity will drop promoting sediment aggradation. Where the channel enters the subsidence zone, channel velocity will increase, and some channel erosion is expected. Bank erosion may also potentially occur. Some localised channel bed erosion is also expected where the channel enters the second to fifth subsidence troughs. The infilling of these troughs is expected to require more time than the troughs in Boomerang Creek due to less availability of sediment in the watercourse. The temporary levee proposed for the open cut pit will also cause minor impact to flow in One Mile Creek.

The predicted subsidence troughs within the channel of One Mile Creek and the associated lateral areas connected to the channel ponds are considered to represent areas of direct impact to the existing vegetation. The surface water assessment has identified that some creek bank erosion may occur where the creek enters the subsidence zone; however, this erosion is predicted to be minor and will be subject to monitoring. Management measures are available should this impact occur (WRM 2022). The troughs are predicted to extend into areas of riparian vegetation including Brigalow TEC vegetation and impacts to this vegetation is assessed in Section 11.1.1.

Philips Creek

Philips Creek channel is not predicted to be impacted by any subsidence. The predicted subsidence and open cut pit levee within the Philips Creek flood plain may cause some minor impact on flooding and drainage. The drainage works in the subsidence area and design of drainage around the open cut pit levee are expected to maintain the flow of water through the subsidence zone and prevent the drainage of water from the Phillips Creek floodplain into One Mile Creek.

The Project is not expected to have any substantial impact on the catchment or stream channel of Phillips Creek. No terrestrial ecology values are expected to be impacted by hydrological changes in this stream.

10.3.1.1 Surface water impacts summary

The Subsidence Management Plan will include measures for the monitoring of creek morphology and stream bed and bank impacts. Where erosion of stream banks with demonstrable impact on channel form is identified bank protection measures will be considered (WRM 2022). The bank protection measures are expected to be effective in securing stream banks from erosive processes and prevent the impact to terrestrial ecology values including riparian vegetation along subsidence affected watercourses. Notwithstanding this, it should be noted that the predicted ponding areas include the subsidence troughs in Boomerang Creek and One Mile Creek and these predicted ponding areas are considered to be subject to impacts to vegetation comparable to the removal of vegetation (refer Section 10.2.4).

10.3.2 Flooding

The predicted changes to the flooding regime as a result of the Project are identified in WRM (2022). Across the Project area during flood events, the extent of inundation is predicted to be increased at the margins of subsided areas. A summary of the predicted changes within the floodplain of the Project area with reference to terrestrial ecology values is presented below.

- Boomerang Creek meanders across a broad floodplain. The undrained depressions on the floodplain will substantially increase after the predicted subsidence and partially fill with local rainfall and runoff. The extent of the depressions that remain undrained after flooding will be reduced by the proposed ponding drainage mitigation, but areas of residual ponding are predicted to remain. During flood events, the extent of inundation is predicted to be increased by the proposed project as a result of back water flowing up subsidence troughs. Peak flood levels within the subsidence zone are predicted to be reduced during flood events, and flow velocities will significantly reduce as water is stored in subsided areas.
- One Mile Creek shares a floodplain with Boomerang Creek. Within the subsidence zone, peak flood levels would be reduced during flood events of approximately 2% AEP and smaller. For flood events larger than 2% AEP, the impact of predicted subsidence on peak flood levels would be minimal.
- The Phillips Creek floodplain is the location of the open cut pit and a portion of the underground mine panels, which all have the potential to impact flood hydrology. Proposed drainage mitigation measures are predicted to allow the movement of flood waters to be consistent with pre-mine conditions.

Flow velocities are predicted to be reduced in portions of the floodplain as water is stored in subsided areas and increase in areas where overbank floodwater drains into subsidence troughs (WRM 2022). The increased velocities are predicted to generally remain below 0.75 m/s for the 50% AEP event and 1 m/s for a 2% AEP event, which are predicted to be unlikely to significantly alter floodplain morphology (WRM 2022).

Any changes to flood hydrology are predicted not to result in any significant impacts on terrestrial ecology values. The function of flood regimes is expected to be retained for vegetation and habitat features, including areas of gilgai features that undergo inundation in periodic flood conditions.

10.3.3 Groundwater dependent ecosystems

The Groundwater Dependent Ecosystems Assessment (3D Environmental 2022) has identified that there are two types of GDEs present within the potential impact area of the Project potential impact area, being:

1) groundwater dependent vegetation developed on drainage features and associated alluvial landforms present along Boomerang Creek and Hughes Creek in the Project area (and Phillips Creek and Isaac River outside the Project area); and
2) groundwater dependent wetland vegetation developed on perched groundwater lenses to the east of the Project area.

The GDEs present on alluvial landforms use groundwater that is seasonally recharged by surface flows and flooding. The GDEs on perched groundwater lenses use water that is recharged from percolating surface water captured at the alluvial unconformity. Neither identified GDE type uses water held in regional tertiary aquifer or coal seams.

The recharge to the perched lenses sustaining GDEs is controlled by surface water infiltration that will not be impacted by the Project. The recharge to alluvial systems sustaining alluvial GDEs are subject to natural fluctuations in response to changing seasonal conditions.

The tree species that characterise the vegetation of both GDE types is resilient to the possible reductions in soil moisture availability that may propagate as a result of groundwater drawdown in the Project area (3D Environmental 2022). There is no predicted significant impact to any environmental matters associated with GDEs in the vicinity of the Project area (3D Environmental 2022).

The Groundwater Dependent Ecosystem Assessment report (3D Environmental 2022) proposes the following management measures to further characterise the function and condition of GDEs and detection of any change:

- Surface water quality monitoring through a receiving environment monitoring program and the groundwater monitoring program should be designed to identify any impacts to water quality that may have a detrimental impact on GDE function.
- The Project Water Management Plan should contain the following objectives:
  - minimise capture of clean surface water from external catchments via catchment diversion;
  - maximise recycle and reuse of first mine affected water then sediment runoff for site demands, including processing and dust suppression;
  - preferential supply of water demands from site water storages over external raw water supply and surface water harvesting;
  - minimise and manage controlled releases of water to receiving waterways:
    - no water release points are proposed for the Project, and
    - all surplus water produced will be transferred to and managed within the existing Lake Vermont Mine operation;
  - prevent uncontrolled release of mine affected water to receiving waterways in 95% of years.
- GDE baseline data collection should be for a period of up to two years including:
  - collection of ecological condition data (biocondition and Leaf Area Index) over areas where the alluvial landform GDEs intersects areas of modelled groundwater drawdown >5 m in the Tertiary sediments and where drawdown in the alluvium is predicted;
  - collection of ecological condition data over areas where alluvial landform GDEs intersect areas of modelled groundwater drawdown >1 m to <5 m in Tertiary sediments; and
  - collection of ecological condition data over areas where alluvial landform GDEs intersect areas of where modelled groundwater drawdown is <1 m (control sites) in the Tertiary sediments.

The proposed recommendations on surface water quality monitoring and the water management plan are expected to be fulfilled by the proponent adhering to best practise protocols. Considering the prediction of no significant impact, recommendations for continued GDE condition data collection are expected to be considered in the event that the water monitoring program indicates a change in conditions with potential to impact GDEs.

10.4 Habitat fragmentation and connectivity

Vegetation clearing has the potential to fragment vegetation remnants and impact on the continuity of corridors. As described in Section 10.1, the majority of vegetation clearance for the Project will occur in the MIA, infrastructure corridor and open cut mining area. The landscape within which these components are proposed to be situated is already fragmented from nearby areas of woodland vegetation.

The northern portion of the study area contains a large contiguous area of remnant vegetation that provides fauna with significant dispersal opportunities. The relatively small (and temporary) areas of disturbance associated with temporary Project activities (such as gas wells) and residual ponding are unlikely to limit the opportunities for faunal dispersal through the woodland habitats.

Riparian corridors associated with Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek provide east–west fauna movement opportunities through the landscape. The riparian vegetation along these streams is mapped as regionally significant (Boomerang Creek, Hughes Creek, One Mile Creek) or state significant (Phillips Creek) corridors connecting to state significant riparian vegetation along the Isaac River. The riparian corridors associated with these streams provide species with opportunities for movement and dispersal, in particular the Koala and Greater Glider. While the Project infrastructure corridor primarily traverses cleared agricultural areas, it will also traverse the riparian corridors of Phillips Creek and One Mile Creek. The proposed infrastructure corridor will fragment the riparian vegetation at these locations and may impact on species' ability to disperse along the riparian corridors. The predicted residual ponding on One Mile Creek may impact on species' ability to disperse through the ponding areas.

The avoidance, mitigation and management measures that have been described for direct vegetation clearance/habitat disturbance are also relevant to minimising habitat fragmentation and impacts on connectivity.

10.5 Weeds and pests

Many introduced flora species are effective competitors for resources and have the potential to reduce the floristic structure and diversity of native plant communities.

Thirty-five introduced flora species have been recorded within the Study area. Seven flora species recorded are listed as restricted matters under the Biosecurity Act (Qld) and/or as WONS:

1) Harissia Cactus;
2) Balloon Vine;
3) Parthenium;
4) Lantana;
5) Rubber Vine;
6) Velvety Tree Pear; and
7) Common Prickly Pear.

Activities that could introduce or spread weeds include soil disturbance and vehicle movements. Vegetation clearing can also result in 'edge effects', when the clearing activities cause modifications to the interface with natural habitats. Areas to be directly disturbed by the Project are predominantly associated with cleared agricultural areas where introduced plants (such as Buffel Grass) dominate the ground layer. Parthenium is the most common Biosecurity Act (Qld)/WONS weed species recorded throughout the study area and occurs in higher densities within cleared agricultural areas.

Nine introduced fauna species that present risk to native fauna and their habitat have been recorded in the study area:

1) Cane Toad *(Rhinella marina);*
2) European Cattle *(Bos taurus);*
3) Wild Dog *(Canis familiaris);*
4) European Red Fox *(Vulpes vulpes);*
5) Red Deer *(Cervus elaphus*);
6) Feral Cat *(Felis catus);*
7) House Mouse *(Mus musculus);*
8) Rabbit *(Oryctolagus cuniculus);* and
9) Feral Pig *(Sus scrofa).*

Relative to these introduced species, the following are listed as key threatening processes under the EPBC Act[3]:

- biological effects, including lethal toxic ingestion, caused by Cane Toads;
- predation by the European Red Fox;
- predation by Feral Cats;
- predation, habitat degradation, competition and disease transmission by Feral Pigs; and
- competition and land degradation by rabbits.

The provision of scavenging areas (e.g. discarded food scraps and other rubbish) has the potential to increase populations of introduced fauna species in and around the Project area.

The Lake Vermont Mine Pest and Weed Management Plan will be reviewed and revised when appropriate to incorporate pest and weed management measures for the Project. The Pest and Weed Management Plan for the Lake Vermont Mine complex will include:

- inspections within the mining lease to identify areas requiring weed management to be implemented;
- weed management measures (e.g. mechanical removal and application of approved herbicides) in consideration of weed control strategies outlined by the Department of Agriculture and Fisheries and the 'Isaac Regional Biosecurity Plan 2020–2023' (Isaac Regional Council 2020);
- requirements for follow up inspections to assess the effectiveness of the weed management measures implemented and requirement for any additional management measures;
- requirements for maintenance of a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna;
- requirements for storage of domestic waste in appropriate receptacles and locations;
- feral animal control strategies in consideration of pest control strategies outlined by the Department of Agriculture and Fisheries, 'Isaac Regional Biosecurity Plan 2020–2023' (Isaac Regional Council 2020) and Threat Abatement Plans applicable to the EPBC Act listed key threatening processes; and
- requirements for minimisation of the period that areas remain in disturbed and or unvegetated condition.

It is considered unlikely that the Project will increase the occurrence or diversity of weeds or feral pests with the given management measures to be implemented.

10.6 Noise and vibration

Noise and vibration associated with construction and operation of the Project has the potential to disrupt the routine activities of fauna species.

Potential sources of noise or vibration in the proposed underground mining area include the ventilation shafts, vehicle movements and the operation of equipment (e.g. haulage trucks, loaders, dozers, drill rigs, compressors and other drilling-related equipment). The potential for noise and vibration generation in the proposed underground mining area is expected to be low. Construction related noise generating activities in the underground mining area will typically be localised and of short duration and may induce small movements of fauna species.

The indirect noise impacts on the woodland and other habitats from the open cut mining activities proposed to be undertaken in the latter stages of the Project or from vehicle movements on the haul road, will be localised and minor given fauna often readily habituate to continuous noise. While sudden noise (e.g. blasting activities) has the potential to startle native fauna, animals are likely to adapt to the disturbance and/or move to similar habitats in the surrounding landscape.

[3] A threatening process is defined as a key threatening process under the EPBC Act if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

10.7 Dust

Studies have shown that excessive dust generation from construction works can impact the health and viability of surrounding vegetation. The potential for dust generation in the proposed underground mining area is expected to be low and limited to short-term construction activities (e.g. MIA, infrastructure corridor,) or vehicle movements.

Recent studies on the impacts of dust from unsealed roads on vegetation and fauna (Cumberland Ecology 2015; Jones *et al.* 2016) found no evidence that dust has any detrimental impacts on vegetation or fauna abundance. Notwithstanding, personnel and contractors will be required to observe speed limits when driving on access tracks within the underground mining area and surrounds to minimise the generation of dust.

Air quality modelling for the Project has been undertaken, and predictions of dust deposition rates comply with the model mine condition limits at all sensitive receptors (Katestone 2022). Roads within the Project infrastructure corridor will be sealed to minimise the generation of dust. Open cut mining operations and exposed surface areas (e.g. windblown emissions from ROM stockpiles) have the greatest potential to result in the generation and dispersion of atmospheric dust. Dust control measures will be employed, including watering of potential dust generating surfaces and progressive rehabilitation of disturbance areas (such as mine waste rock emplacements) to minimise dust emissions. Given the predicted dust deposition associated with the Project (Katestone 2022), the health and viability of surrounding vegetation will not be deleteriously affected.

The Project will not result in an increase in total coal production, and a range of dust control measures will continue to be employed at the Lake Vermont Mine including the watering of potential dust generating surfaces.

10.8 Artificial lighting

Artificial lighting will be established in the Project area including within the MIA and infrastructure corridor. Project lighting has the potential to affect behavioural patterns of some species. Some bird and bat species, for example, are attracted to insects around lights and could become prey for larger predators (e.g. owls). Artificial lighting can also attract predators and invasive pests, both of which may pose a threat to native fauna (DoEE 2020).

The exterior lighting will be designed to provide a safe working environment. Australian Standard AS/NZS 4282:2019 'Control of the obtrusive effects of outdoor lighting' recognises the impact of artificial light on biota (DoEE 2020). To minimise potential impacts of artificial lighting, the placement, configuration and direction of lighting for the Project will be implemented in consideration of AS 4282:2019 'Control of the obtrusive effects of outdoor lighting' (Standards Australia 2019).

10.9 Vehicle strike

The movement of vehicles has the potential to increase the incidence of fauna mortality *via* vehicular strike. Ground-dwelling fauna are most susceptible to this potential impact. The risk of injury or mortality from vehicle strike is greatest where roads cross fauna movement corridors. The Project infrastructure corridor primarily traverses cleared agricultural areas; however, it will also traverse the riparian corridors of Phillips Creek and One Mile Creek.

Contributing risk factors for vehicle strike are the speed of vehicles on roads and tracks, and limiting speed can reduce the threat of vehicle strike to fauna species such as Koala (DES 2019b). Speed limits will be imposed on roads and tracks within the Project area to reduce the risk of vehicle strike on native fauna. Safe driving procedures will also be incorporated into site inductions to increase awareness of the risk of vehicle strike.

10.10 Bushfire

While plants and animals have a range of mechanisms to survive individual fires, accidental bushfires could potentially occur if mine activities are not appropriately managed. Bushfire prevention and management measures will be implemented for the Project, and fire awareness will be included in the induction of personnel and contractors to minimise the risk of bushfire. Given the implementation of management measures, the Project is unlikely to increase the bushfire potential within the surrounding landscape.

10.11 Erosion and sedimentation

The Project has the potential to result in erosion of disturbed areas and sedimentation of waterways through the following:

- clearing of vegetation for the development of open-cut pits;
- construction of haul roads and other infrastructure;
- erosion facilitated by soil cracking resultant of surface subsidence; and
- hydrological changes to watercourses due to subsidence.

Vegetation clearance protocols and erosion and sediment control measures will be implemented to minimise potential impacts, as described in section 10.1.2. Potential erosion resulting from subsidence and soil cracking and erosion of watercourses is considered in section 10.2.3.

10.12 Cumulative impacts

Cumulative impacts can be defined as the total impact on the environment that result from the incremental impacts of the action (the Project) added to other past, present and reasonably foreseeable future actions. Cumulative impacts include direct and indirect impacts on the environment.

Resource developments (approved and proposed) that occur within 50 km of the Project are provided in Table 2.1 and shown in Figure 1.2. The majority of developments named in Table 2.1 have been approved, with the most recent being the Olive Downs Coking Coal Project (in 2020) and the Vulcan Project (September 2021). Other subject to government assessment include the Saraji East Project (BMA 2021) and the Winchester South Project (Whitehaven Coal 2021).

The Project provides for the continuation and extension of the existing Lake Vermont Mine which is authorised for impacts to prescribed environmental matters including the following:

- regulated vegetation for REs occurring within a defined distance of a relevant watercourse;
    - RE 11.3.25 – 28.4 ha;
    - RE 11.3.27 – 3.9 ha; and
- protected wildlife habitat for the Squatter Pigeon – 39.2 ha.

Based on publicly available information, an assessment has been undertaken of the potential cumulative impact of the Project on ecosystem resilience. Ecosystem resilience is the capacity of an ecosystem to respond to changes and disturbances yet retain its basic functions and structures. For ecosystems to be resilient to threats, they need a healthy diversity of individuals, species and populations. The cumulative impact assessment has considered the species present (species diversity, abundance and dynamics), patterns of species distribution (the communities and ecosystem present that encompass all species), broad habitat types (the ecological niches for the range of species present) and ecosystem processes.

The Project is located within the Brigalow Belt Bioregion (Figure 2.1) and within the Isaac-Comet Downs subregion. The Brigalow Belt Bioregion has experienced considerable modification, particularly over the last 70 years due to agriculture and mining (DES 2018). Remnant vegetation cover has been reduced, with communities on the more fertile soils being the most affected (DES 2018). Habitat loss, fragmentation, inappropriate fire regimes, invasive plants and feral animals are relevant threats to the biodiversity values of the bioregion. The current extent of remnant vegetation in the Brigalow Belt Bioregion has been estimated by the Queensland Herbarium as being approximately 15,039,386 ha or 41.2% of the pre-clearing cover (Accad *et al.* 2021). The pre-clearing cover for the Isaac-Comet Downs subregion is estimated at approximately

2,693,397 ha compared to 574,501 ha of remnant vegetation (or 21.3% of the pre-clearing extent) remaining (Accad *et al.* 2021).

The Project has been designed to avoid and/or minimise impacts to remnant vegetation (e.g. by co-locating Project infrastructure and siting infrastructure in primarily cleared agricultural land) However, the Project will result in direct disturbance of 109.1 ha of remnant vegetation, which will add to the vegetation clearance that is proposed to occur for other Projects in the region. The remnant vegetation clearance for the Project represents approximately 0.016% of the current extent (Accad *et al.* 2021) of remnant vegetation in the Isaac-Comet Downs subregion. The area of remnant vegetation proposed to be impacted/cleared is comprised of 16 ha of Endangered REs (RE 11.3.1 and RE 11.4.8), 63.2 ha Of Concern REs (RE 11.3.2 and 11.3.4) and 29.8 ha of Least Concern REs (REs 11.3.9, 11.5.3, 11.3.25, 11.3.27b, and 11.3.27f).

The northern portion of the study area contains a large contiguous area of remnant vegetation that will be subject to small (and temporary) areas of disturbance due to gas drainage works to support underground operations. These areas will be progressively rehabilitated. Given the nature and extent of the disturbance, these activities are unlikely to result in a significant impact on the distribution and abundance of wildlife in the locality.

The Project infrastructure corridor will traverse the riparian corridors of Phillips Creek and One Mile Creek resulting in minor fragmentation of the riparian corridor at these locations. The Saraji East Project (BMA 2021) also proposes to construct a transport and infrastructure corridor, which will traverse One Mile Creek and Phillips Creek to the west of the study area, which may also affect west–east dispersal opportunities for fauna along these streams. To the east of the Project infrastructure corridor, a diversion of Phillips Creek has been approved for the existing Lake Vermont Mine open cut mining operations. Further east, dispersal opportunities along One Mile Creek and Phillips Creek would be maintained with connection to the Isaac River. The fragmentation and potential impacts to connectivity that would result from the Project is unlikely to significantly affect species' movements given the disturbance that cumulatively would occur to the west and east of the Project. The Project will retain the vast majority of the One Mile Creek and Phillips Creek riparian corridors to allow continued fauna movement.

The Project is predicted to have a negligible cumulative impact on surface water and groundwater quality and quantity (JBT Consulting 2022; WRM 2022) with a range of management and mitigation measures proposed to be implemented to minimise impacts on terrestrial flora, fauna and their habitats, as described in Sections 10.1 to 10.13. The key ecosystem cycles (e.g. water, nutrients) will remain intact and are not expected to be compromised as a result of cumulative impacts.

'Loss of Climatic Habitat Caused by Anthropogenic Emissions of Greenhouse Gases' is listed as a key threatening process under the EPBC Act and consists of reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human activities of greenhouse gases. Climate change and greenhouse gas emissions associated with the Project are described in the Project Air Quality and Greenhouse Gas Assessment (Katestone 2022). The Project greenhouse gas emissions will contribute to global emissions. The potential effects of climate change on the nature and extent of the Project potential impacts have been considered, including those relating to groundwater (JBT Consulting 2022) and surface water (WRM 2022). Climate change effects have been factored into the models used by the Surface Water Assessment (WRM 2022) and Groundwater Assessment (JBT Consulting 2022). Therefore, the predictions of changes to surface water and groundwater conditions as a result of the Project are representative of future climate conditions.

The likely impacts of climate change on terrestrial flora and fauna is difficult to predict. However, the potential impacts of the Project are unlikely to significantly exacerbate the expected effects of climate change.

Assessments have been conducted in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) and 'Queensland Environmental Offsets Policy Significant Residual Impact Guideline' (DEHP 2014) to assess the potential impacts of the Project on MNES and MSES, including those associated with direct, indirect and cumulative potential impacts. The assessments are provided in Section 11.1.

The provision of biodiversity offsets in line with Commonwealth and/or State Government policies provide an opportunity to mitigate cumulative impacts. Offsets have been required for many of the Projects within the region and increase the area of protected habitat that will be managed for conservation. Offsets will also be provided for the Project to provide adequate compensation for significant residual impacts on matters of environmental significance and to yield no net conservation loss. The Project's offset requirements are summarised in Section 12.

10.13 Facilitated impacts

Facilitated impacts relate to impacts from other Projects (including by third parties) which are made possible (facilitated) by the Project being assessed (this Project). Facilitated impacts may be expected to occur through the development of an infrastructure project (e.g. a dam, road or rail line), when that development would enable the development of other projects which otherwise may not have been viable (e.g. the development of a road leads to urban development in an undeveloped area).

The Project will not develop any infrastructure that will facilitate the development of any other Projects. Mining operations will not facilitate the development of any other Projects that could not already be developed. Proposed electrical, water supply and telecommunications infrastructure will link to existing infrastructure at the Lake Vermont Mine and does not facilitate the development of other future projects.

Post mining, it is expected that, when possible, the Project area will be reinstated to grazing land at a similar suitability to that existing prior to mining. When this cannot be achieved, an alternative land use that can provide a similar value to pre-mining or can provide long-term ecological value to the region will be established. It is not considered that the return of lands to an agricultural land use or an alternative land use that provides similar value will facilitate the development of other projects that would cause additional (facilitated) impacts to those identified for the Project.

As such, there is not expected to be any facilitated impacts from the Project on any flora or fauna values.

11 Impact assessments

11.1 Matters of national environmental significance

Sections 11.1.1 to 11.1.9 provide an assessment of the listed TECs and threatened species that are known to be impacted or have the potential to be impacted by the Project, namely:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (Brigalow TEC);
- Poplar Box Grassy Woodland on Alluvial Plains ecological community (Poplar Box TEC);
- Ornamental Snake;
- White-throated Needletail;
- Squatter Pigeon (southern subspecies);
- Australian Painted Snipe;
- Koala; and
- Greater Glider.

An assessment of the Australian Painted Snipe has been included because despite the likelihood of occurrence of the species being potential, the condition and extent of the potential habitat has justified assessment. Other potential likelihood of occurrence of species of conservation significance have not been assessed because the Project area does not contain habitat of condition or extent that justifies assessment. Each assessment includes:

- a description of communities or species' EPBC Act listing status, distribution and ecology;
- the desktop assessment methodology used to inform the Project field surveys;
- the survey effort implemented;
- the survey outcomes;
- a robust assessment and mapping of potential habitat;
- a description of the potential impacts to each threatened community and species;
- specific measures that are proposed to avoid, mitigate and manage the potential impacts;
- a description of the statutory requirements considered in the assessment; and
- an assessment of the likelihood of significant impacts.

Key terms relevant to the assessment of the likelihood of significant impacts are defined below in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

'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.*

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area (DoE 2013a).

> *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.*

For Vulnerable species under the EPBC Act, an:

> *[I]mportant population' is a population that is necessary for a species' long-term survival and recovery (DoE 2013a). 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.*

Section 11.1.9 provides an assessment of the listed migratory species that are known to be impacted or likely to be impacted by the Project.

11.1.1 Brigalow (*Acacia harpophylla* dominant and co-dominant) TEC

11.1.1.1 Description

The Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (Brigalow TEC) is listed as Endangered under the EPBC Act and occurs within Queensland and New South Wales. The Brigalow TEC generally occurs within the 500–750 mm annual rainfall belt with a predominance of summer rainfall, although winter rainfall peaks occur in the south of its distribution (DAWE 2021a).

In Queensland, the Brigalow TEC predominantly occurs on flat to gently undulating Cainozoic clay plains that are not associated with current alluvium and on gently undulating landscapes on horizontally bedded fine grained sedimentary rocks (DAWE 2021a). Some remnants, however, are associated with river and creek flats, or with old loamy and sandy plains, basalt plains and hills or hills and lowlands on metamorphic or granitic rocks (DAWE 2021a). Where Brigalow is dominant, the soils are predominantly cracking clays; however, texture contrast soils are common where *Eucalyptus* species are co-dominant (DAWE 2021a).

Brigalow flowers between April and October, however, do not flower every year. Brigalow seedlings are relatively rare in natural landscapes, as the seeds typically remain viable for less than a year (DAWE 2021a). Brigalow has a well-developed horizontal root system, and Brigalow is able to produce shoots from these horizontal roots (suckering) in response to disturbance as long as the root stocks remain intact.

The Brigalow TEC comprises patches of vegetation in which Brigalow is one of the most abundant tree species. The tree layer may be dominated by Brigalow or have a co-dominant presence with other species, such as Belah (*Casuarina cristata*) or other *Acacia* or *Eucalyptus* species. Within Queensland, the Brigalow TEC is defined by reference to 16 REs, all of which are listed as Endangered under the VM Act.

The Brigalow TEC can include some vegetation considered to be 'non-remnant' under state classifications; specifically, Brigalow regrowth that is more than 15 years old can be classified as the Brigalow TEC. Areas of Brigalow regrowth are considered not part of the EPBC Act listed Brigalow TEC if they are of poor quality (e.g. more than 50% perennial weeds) (DoE 2013b).

11.1.1.2 Desktop analysis

The Project is located within the Brigalow Belt North Bioregion (Figure 2.1), which is known to contain Brigalow *(Acacia harpophylla)* woodlands. A number of REs mapped by the Queensland Government within the study area have been identified as having the potential to represent the Brigalow TEC, namely:

- RE 11.3.1 *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains;
- RE 11.4.8 *Eucalyptus cambageana* woodland to open forest with *A. harpophylla* or *A. argyrodendron* on Cainozoic clay plains; and
- RE 11.4.9 *A. harpophylla* shrubby woodland with *Terminalia oblongata* on Cainozoic clay plains.

The desktop assessment found the Brigalow TEC has been identified during surveys undertaken for nearby and surrounding projects and is likely to occur within the study area.

11.1.1.3 Survey effort

Vegetation communities within the study area have been mapped and described in accordance with the 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.0)' (Neldner *et al.* 2019). This includes 245 quaternary sites, 54 secondary survey sites and approximately 500 rapid observation sites. Vegetation community boundaries have been validated in the field using a Global Positioning System (GPS) and refined using 50 cm resolution red/green/blue aerial imagery collected in April 2019 to produce a ground verified vegetation map.

Brigalow vegetation within the study area has been assessed against the key diagnostic characteristics and condition thresholds described in the Commonwealth approved conservation advice (DoE 2013b) to determine whether each patch of the vegetation community meets the Brigalow TEC status.

11.1.1.4 Survey outcomes

Four ground-truthed vegetation communities associated with Brigalow woodlands have been mapped within the study area and are shown in Figure 8.1.

Patches of Brigalow vegetation have been assessed as meeting the key diagnostic characteristics and condition thresholds to represent the Brigalow TEC:

- 88.5 ha of remnant Brigalow woodland on alluvial plains (VC 1a);
- 46.6 ha of remnant Dawson Gum woodland with Brigalow on undulating Cainozoic clay plains (VC 1b); and
- 19.4 ha of remnant Brigalow with Yellowwood woodland with occasional Dawson Gum on Cainozoic clay plains (VC 1c).

11.1.1.5 Habitat assessment

A total of 154.5 ha of the TEC occurs within the study area. The distribution of Brigalow TEC within the study area is shown on Figure 8.2.

11.1.1.6 Impact assessment

The Project will directly disturb 0.9 ha of the Brigalow TEC across four patches through vegetation removal for all Project stages (Figure 8.2, Table 11.1, patches B1, B4, B6, and B17). This will add to the vegetation clearance that is proposed to occur for other Projects in the region.

Above the underground mining area, temporary gas wells and temporary access tracks will be located to avoid impacts to patches of the Brigalow TEC.

Areas of residual ponding are expected to occur within the subsidence footprint area, including adjacent to Boomerang Creek and One Mile Creek. The predicted residual ponding will impact a total of 7.0 ha of Brigalow

TEC across three patches (patch B2, B15 and B17). The predicted ponding is considered to have potential to have a deleterious impact to Brigalow TEC vegetation are described in Section 10.2. Brigalow TEC vegetation occurs as riparian vegetation adjacent to One Mile Creek, including in reaches of the Creek that will be subject to stream morphology changes from subsidence. The potential stream morphology affected areas are co-located with areas of predicted ponding, and the assessment of stream morphology change impacts and mitigation measures are detailed in Section 10.3.

Brigalow TEC patch B16 and B18 are located within the subsidence footprint but outside the predicted residual ponding footprint. These areas are not expected to undergo any significant impacts relating from subsidence.

Table 11.1: Brigalow TEC extent of disturbance to each patch

Patch	description	RE	Current extent (ha)	Extent of disturbance (ha)		
				Stages 1,2,3 clearing (ha)	Stages 2 and 3 residual ponding (ha)	Stage 4 clearing (ha)
B1	Adjacent to One Mile Creek in the western portion of the study area	11.3.1	31.1	**0.3**	0.0	**<0.1**
B2	Adjacent to One Mile Creek in the central portion of the study area	11.3.1	24.9	0.0	**6.9**	0.0
B3	Adjacent to One Mile Creek in the eastern portion of the study area	11.3.1	23.0	0.0	0.0	0.0
B4	Patch to the west of the open cut pit	11.4.8	2.4	**~0**	0.0	**<0.1**
B5	Patch to the east of the MIA	11.4.9	2.8	0.0	0.0	0.0
B6	Patch to the west of the open cut pit	11.4.8	1.2	0.0	0.0	**0.2**
B7	Patch to the north of the open cut pit	11.4.8	1.6	0.0	0.0	0.0
B8	Patch to the north of the open cut pit	11.3.1	2.4	0.0	0.0	0.0
B9	Patch to the north of the open cut pit	11.4.8	1.5	0.0	0.0	0.0
B10	Patch to the north of the open cut pit	11.4.8	2.0	0.0	0.0	0.0
B11	Patch to the north of the open cut pit	11.4.8	2.5	0.0	0.0	0.0
B12	Isolated patch to the south of Hughes Creek	11.4.9	6.6	0.0	0.0	0.0
B13	Isolated patch to the south of Hughes Creek	11.4.9	10.0	0.0	0.0	0.0
B14	Isolated patch to the north of the MIA and ETL	11.4.8	2.6	0.0	0.0	0.0
B15	Isolated patch to the north of the MIA and ETL	11.4.8	9.0	0.0	**0.1**	0.0

Patch	description	RE	Current extent (ha)	Extent of disturbance (ha)		
				Stages 1,2,3 clearing (ha)	Stages 2 and 3 residual ponding (ha)	Stage 4 clearing (ha)
B16	Isolated patch to the north of Boomerang Creek	11.3.1	1.1	0.0	0.0	0.0
B17	Isolated patch to the south of Boomerang Creek	11.4.8	3.6	**0.3**	**<0.1**	0.0
B18	Isolated patch to the north of Boomerang Creek	11.3.1	2.0	0.0	0.0	0.0
B19	Isolated patch to the south of Boomerang Creek	11.3.1	2.0	0.0	0.0	0.0
B20	Isolated patch to the north of Boomerang Creek	11.3.1	1.9	0.0	0.0	0.0
B21	Isolated patch to the north of Boomerang Creek and adjoining Brigalow HVR	11.4.8	19.7	0.0	0.0	0.0
B22	Isolated patch in the north-east of the study area	11.4.8	0.6	0.0	0.0	0.0
B23	Isolated patch in the north-east of the study area adjoining offsite Brigalow vegetation	11.3.1	0.1	0.0	0.0	0.0
Total	—	**11.3.1**	**154.5**	**0.6**	**7.0**	**0.3**

Parts of patches B1, B4 and B6 are within the footprint of the Stage 4 open cut pit. The remaining vegetation of these patches will be greater than the minimum patch size TEC condition threshold of 0.5 ha, and they will retain connectivity to other adjoining Brigalow TEC patches. The affected patches are currently adjoining cleared agricultural land; therefore, the clearing for the open cut pit is not expected to increase edge effects or increase the likelihood of exotic species abundance or diversity. Therefore, the remaining patches are considered to be unimpacted.

The infrastructure corridor will traverse One Mile Creek that will fragment a patch of Brigalow TEC vegetation and disturb 0.3 ha of the Brigalow TEC. While the existing patch of Brigalow (patch B1) will be fragmented at this location, approximately 14 ha of Brigalow TEC will remain to the west of the corridor (within the study area), and approximately 30 ha of Brigalow TEC will remain to the east of the corridor. These remnant patches are in good condition and, given the extent of the patches remaining and their current condition, there is no evidence to suggest these patches would become unviable post-impact.

Subsidence drainage works (mitigation channels and mitigation bunds) will be implemented to reduce ponding impacts to the Brigalow TEC; however, some ponding is unable to be effectively mitigated. Mitigation channels and bunds are designed to be implemented away from the mapped Brigalow TEC as far as practicable (Figure 1.3). The northern mitigation channel will impact 0.3 ha of Brigalow patch B17. A very small area of Patch B17 (<0.01 ha) will be impacted by predicted subsidence related ponding. The remaining 3.3 ha of the patch exceeds the minimum TEC patch size criteria and is expected to remain viable.

Patch B2 is a narrow patch of riparian Brigalow adjacent to One Mile Creek, which will be fragmented by the predicted residual ponding. These areas are predicted to experience inundation during flooding events for up to several months every few years (WRM 2022). The patch is currently subject to edge effects from surrounding cleared agricultural areas, and the edge effects on the remaining patches resulting from the ponding is considered comparable to existing edge effect conditions. The predicted ponding will fragment this patch into a number of patches, which will each be larger than the minimum patch size TEC condition threshold of 0.5 ha. The surface water assessment report (WRM 2022) has identified that the intersection of One Mile Creek and the subsidence footprint area will experience increased channel velocity and may receive channel bed scouring and stream bank erosion. Changes to stream morphology within patch B2 will be subject to monitoring and interventions to control potential erosive processes within the creek, and TEC Patch will be prescribed within a subsidence management plan. The impacts are not expected to affect the viability of the patch.

Patch B15 will undergo a 0.1 ha reduction in patch size as a result of ponding. The patch will not be substantially fragmented and will remain above the minimum threshold size. The patch is therefore expected to retain viability after the subsidence related impact.

The proposed impact is equivalent to 0.5 % of the Brigalow TEC in the study area and <0.01 % for the subregion in which the Project is located. The impact is unlikely to contribute to cumulative impacts to TEC in the subregion. Further discussion of cumulative impacts is provided in Section 10.12.

The identified Brigalow TEC vegetation was within the groundwater dependent ecosystem assessment study area and no Brigalow TEC patches were identified as groundwater dependent (3D Environmental 2022). Impacts of erosion and subsidence related cracking and erosion are assessed in Section 10.2, Section 10.3 and Section 10.11. Given the proposed monitoring and management measures for erosion, it is considered unlikely that erosion will impact Brigalow TEC vegetation. The Project also has the potential to increase weed and animal pest populations which have the potential to affect patch viability if pest species are not appropriately managed and infestations develop. However, as described in Section 11.1.1.7 weed and pest management measures will be implemented for the Project. Indirect impacts associated with bushfire risk are considered unlikely given the bushfire prevention and management measures to be implemented (Section 10.10).

11.1.1.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Brigalow TEC where possible. The proposed avoidance and mitigation measures for the Brigalow TEC, including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis, is provided in Table 11.2.

Table 11.2: Brigalow TEC impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Locate the MIA in an area that will not disturb Brigalow TEC.	Mine planning/ construction	Highly effective—avoids impacts to the TEC.	Disturbance/vegetation clearance areas will be monitored against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	DoE (2013b) TSSC (2001)
Carefully select the infrastructure corridor crossing of One Mile Creek to minimise disturbance to Brigalow TEC vegetation.	Mine planning/ construction	Highly effective—minimises impacts to the TEC.		
Co-locate the transport, water, electrical and telecommunications infrastructure within the infrastructure corridor.	Mine planning/ construction	Highly effective—minimises impacts to the TEC.		
Minimise the northern extent of the open cut pit in the vicinity of One Mile Creek to minimise disturbance to Brigalow TEC vegetation.	Mine planning/ operations	Highly effective—minimises impacts to the TEC.		
Position the electrical infrastructure (transmission line and substation) in the vicinity of the underground drift to avoid clearance of the Brigalow TEC.	Mine planning/ construction	Highly effective—avoids impacts to the TEC.		
Position surface infrastructure required for underground mining (e.g. ventilation shafts and drainage wells) to avoid impacts to the Brigalow TEC.	Mine planning/ construction/ operations	Highly effective—avoids impacts to the TEC.		
Implement vegetation clearance protocols, including the delineation of vegetation adjoining proposed clearance areas to prevent accidental damage (Section 10.1.2).	Construction/ operations	Highly effective management technique to manage vegetation clearance activities.		

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Design and undertake subsidence drainage management works to minimise disturbance to the Brigalow TEC from drainage works and minimise ponding in areas of the Brigalow TEC.	Operations	Implementation of measures at other Bowen Basin Mines indicates such works are effective at minimising and managing impacts to the TEC.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (see Section 10.2) to be prepared for the Project. Subsidence monitoring will be conducted and follow up corrective measures (e.g. additional drainage works) implemented as required.	DoE (2015e)
Limit activities that cause disturbance to minimise occurrence and spread of weeds.	Construction/ operations	Highly effective management technique to manage the spread and occurrence of weeds.	Disturbance/vegetation clearance areas will be monitored against approved disturbance limits.	DoE (2013b)
Regularly inspect mine-related surface disturbance areas and Bowen Basin Coal owned land to identify areas requiring weed management measures to be implemented. Implement weed management measures (e.g. mechanical removal and application of approved herbicides).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the spread and occurrence of weeds.	Monitor and manage weeds in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	DoE (2013b), Commonwealth of Australia (2017a), Qld Department of Agriculture and Fisheries weed control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	DoE (2013b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of site will be carried out by environmental personnel. Waste generation will be monitored and audited in accordance with the Waste Management Plan. Additional measures (such as provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals.	DoE (2013b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)
Implement pest control measures in accordance with Weed and Pest Management Plan when substantial infestations develop.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	DoE (2013b), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoE (2015b), DoEE (2016b), DoEE (2017), DEWHA (2008b)
Consult with the Isaac Regional Council and neighbouring mines in relation to weed and pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Coordinated activities are predicted to achieve better regional outcomes for weed and pest species.	Audits will be implemented to monitor the consultation outcomes and the management measures implemented on site in accordance with the Weed and Pest Management Plan (Section 10.5).	DoE (2013b), Commonwealth of Australia (2017a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)
Bushfire prevention and management measures will be outlined in the Emergency Response Plan. Inductions of mine site personnel will include fire awareness.	Construction/ operations/ rehabilitation and decommissioning	Effective management procedure to reduce the risk of bushfire.	Any incidence of bushfire will be investigated to determine the requirement for additional controls. Potential adaptive management measures include revision of the Emergency Response Plan and/or a program to increase personnel awareness of bushfire risk (e.g. through tool box talks).	DoE (2013b)

11.1.1.8 Statutory requirements

Conservation, recovery and threat abatement plans relevant to the Brigalow TEC have been considered in the assessment of the TEC (Section 11.1.1.3), the development of avoidance, mitigation and management measures (Section 11.1.1.7) and/or assessment of significant impact for the Brigalow TEC (Section 11.1.1.9):

- The 'Approved Conservation Advice for Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community (DoE 2013b), developed at the time of EPBC Act listing, outlines the key diagnostic criteria and condition thresholds for the TEC and the priority conservation actions for the community. The conservation advice also describes areas considered critical to the survival of the community.
- The 'Brigalow (*Acacia harpophylla* dominant and co-dominant) ecological community' SPRAT profile provides information about the Brigalow TEC, including relevant regulatory considerations and information in relation to its distribution, regional ecosystems within Queensland and associated flora and fauna within the community.
- The SPRAT profile for this community indicates there is no adopted or made Recovery Plan for this community; however, a Recovery Plan is considered to be required. The SPRAT profile also indicates the national recovery plan for the listed Brigalow ecological community (Butler 2007) will provide the main framework for the community's recovery. The main objective proposed is:

  > *…to conserve and enhance the environmental values of the brigalow ecological community over the long term by working to increase the extent of both remnant and regrowth brigalow and improving its condition and management.*

- The SPRAT profile for this community indicates the 'Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads' is relevant to this community.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019) and Australia's actions for nature, including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Conservation of Nature in the South Pacific (Apia Convention) or other relevant international conventions.

Current threats to the Brigalow TEC include vegetation clearing, overgrazing of the understorey, fire, plant and animal pests, lack of knowledge, and climate change.

11.1.1.9 Significant impact assessment

Table 11.3 provides an assessment of the likelihood of significant impacts on the Brigalow TEC in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

Table 11.3: Brigalow TEC significant impact assessment

Significance criteria	Assessment of significance
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:	
Reduce the extent of an ecological community	The Project would require the clearance of 0.9 ha and result in the potential periodic inundation through residual ponding of 7.0 ha over portions of six patches of Brigalow TEC (Figure 8.2). The remaining vegetation of impacted patches of Brigalow TEC will continue to meet the minimum TEC patch size criteria. The Project will result in the total reduction of the extent of Brigalow TEC in the study area by 7.9 ha.
Fragment or increase fragmentation of an ecological community	All Brigalow TEC patches in the study area have been subject to past disturbance including clearing, thinning and grazing. Two patches of Brigalow TEC will be fragmented by the clearance and impacts of residual ponding for the Project (patches B1 and B2). Four patches will be partially cleared, but the remaining Brigalow TEC vegetation will retain its connectivity to adjoining vegetation (patches B4, B6, B15 and B17).
Adversely affect habitat critical to the survival of an ecological community	The patches of Brigalow TEC in the study area meet the key diagnostic characteristics for the TEC and are, therefore, critical to the survival of the TEC. The Project will result in the loss of approximately 7.9 ha of Brigalow TEC that is critical to the survival of the TEC. The remaining patches of Brigalow TEC will continue to meet the TEC characteristic criteria thresholds.
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 impacts of areas of periodic ponding due to surface subsidence, which modify conditions necessary for Brigalow TEC survival, are considered as a reduction in the extent of the TEC. Management measures will be applied to prevent erosion and sedimentation that may impact Brigalow TEC within the study area. Localised alteration of surface water drainage patterns will be monitored under a Subsidence Management Plan. The Brigalow TEC in the study area has not been identified as a GDE, and modifications to groundwater levels are unlikely to affect the TECs survival (3D Environmental 2022).
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	Parts of six Brigalow TEC patches will be impacted by the Project. The partial clearance of these patches may create potential for edge effects on these patches; however, these edge effects are comparable to the edge effects currently affecting the patches that have all been subject to past disturbances and fragmentation. Weed control measures outlined in Section 10.5 will be implemented throughout the study area to minimise the risk of degradation of Brigalow TEC through change in species composition. The result of the implementation of the mitigation measures proposed in this assessment will be that it is unlikely the retained TEC in the study area will experience a decline or loss of the functionally important species. Bushfire prevention and management measures will be implemented in accordance with the Emergency Response Plan, which will protect the functionally important species of the Brigalow TEC.

Significance criteria	Assessment of significance
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: • assisting invasive species, which 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	Parts of six Brigalow TEC patches will be impacted by the Project. The remaining areas of the impacted patches may be subject to edge effects. However, the impact is likely comparable to the edge effects currently affecting the patches from past disturbances and land management. The Brigalow TEC of the Project area occurs in a highly modified rural landscape where introduced species have been recorded throughout the TEC. The proposed Project is unlikely to produce pathways for invasive species that are not already present in the study area. Given adherence to the proposed avoidance and mitigation measures, it is unlikely that a substantial reduction will occur in the quality or integrity of the retained Brigalow TEC in the study area. The Project is unlikely to result in the mobilisation of pollutants of any kind into this TEC within or adjacent to the Project area. The Project is not likely to use fertilisers on-site or cause regular mobilisation of herbicides that may impact the Brigalow TEC. Control measures, such as sediment dams, will be in place to minimise the potential for pollutants to affect the Brigalow TEC in the study area.
Interfere with the recovery of an ecological community	The Project will result in the reduction of extent of the Brigalow TEC by approximately 7.9 ha. This impact represents an interference with the recovery of the Brigalow TEC.
Conclusion	The Project is considered to have a significant impact on 7.9 ha of the Brigalow TEC. The extent of these impact areas is shown in Figure 11.1.

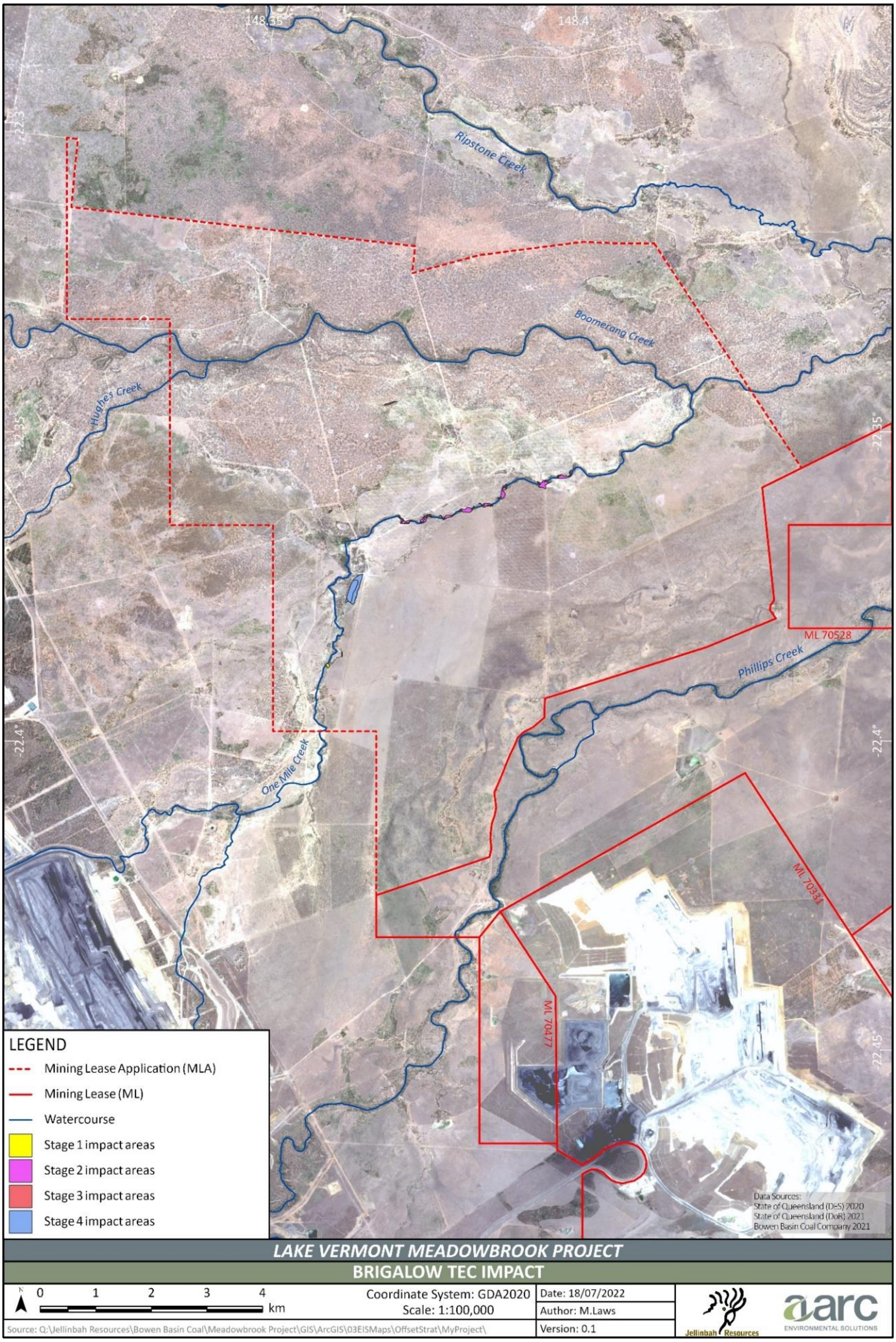


Figure 11.1: Brigalow TEC significant impact areas

11.1.2 Poplar Box Grassy Woodland on Alluvial Plains TEC

11.1.2.1 Description

The Poplar Box TEC was listed as Endangered under the EPBC Act on 4 July 2019.

This ecological community occurs west of the Great Dividing Range, typically at less than 300 m above sea level (ASL) and between latitudes 20°S to 34°S within the Brigalow Belt North, Brigalow Belt South, South East Queensland, Cobar Peneplain, Darling Riverine Plains, NSW South-western Slopes and Riverina IBRA bioregions (DAWE 2021a).

The Poplar Box TEC is typically a grassy woodland with a canopy dominated by *Eucalyptus populnea* and an understorey mostly of grasses and other herbs. The ecological community mostly occurs in gently undulating to flat landscapes and occasionally on gentle slopes on a wide range of soil types of alluvial and depositional origin (DoEE 2019b). Within Queensland, five REs have the potential to represent the Poplar Box TEC, namely: RE: 11.3.2, RE 11.3.17, RE 11.4.7, RE 11.4.12 and RE 12.3.10.

11.1.2.2 Desktop analysis

The Project is located within the Brigalow Belt North Bioregion (Figure 2.1), which is known to contain the Poplar Box TECs. One Regional Ecosystem mapped by the Queensland Government within the study area has the potential to represent the Poplar Box TEC, namely: RE: 11.3.2 *Eucalyptus populnea woodland on alluvial plains.*

The desktop assessment indicates that the Poplar Box TEC has been recorded to the north of the study area for the Winchester South Project. The community is considered likely to occur within the study area.

11.1.2.3 Survey effort

Vegetation communities within the study area have been mapped and described in accordance with the 'Methodology for surveying and mapping regional ecosystems and vegetation communities in Queensland (V5.0)' (Neldner *et al.* 2019). This includes 245 quaternary sites, 54 secondary survey sites and approximately 500 rapid observation sites. Vegetation community boundaries have been validated in the field using a Global Positioning System (GPS) and refined using the latest aerial imagery available for the study area to produce a ground verified vegetation map.

Poplar Box vegetation within the study area has been assessed against the key diagnostic characteristics and condition thresholds described in the Commonwealth approved conservation advice (DoEE 2019b) to determine whether the vegetation community meets the Poplar Box TEC status.

11.1.2.4 Survey outcomes

Within the study area, one vegetation community has been found to contain areas consistent with the key diagnostic characteristics (DoEE 2019b) of the Poplar Box TEC, namely the remnant Poplar Box woodland on alluvial plains vegetation community (VC 2a) (Figure 8.1). The majority of this vegetation community meets the structure requirements for this TEC and its condition has been assessed as Class B, good quality.

11.1.2.5 Habitat assessment

A total of 656.6 ha of the Poplar Box TEC (Class B, good quality) has been mapped within the study area. The distribution of Poplar Box TEC within the study area is shown on Figure 8.2.

11.1.2.6 Impact assessment

The Poplar Box TEC occurs within eight patches within the study area to the north and south of Boomerang Creek (Table 11.4 and Figure 8.2). The Project will not directly disturb the Poplar Box TEC, as no vegetation clearance or habitat disturbance will be undertaken within this community for Project infrastructure.

Above the underground mining area, ventilation shafts, ponding mitigation works and a gas drainage access track will be located to avoid impacts to patches of the Poplar Box TEC.

Areas of potential for ponding are expected to occur adjacent to Boomerang Creek, and these ponding areas are considered likely to impact Poplar Box TEC patches in this area. The predicted residual ponding will impact 44.4 ha over three patches of Poplar Box TEC. The ponding areas are predicted to be inundated periodically for several months every few years (WRM 2022) and affected areas are considered likley to experience conditions deleterious to the Poplar Box TEC (refer Section 10.2.4). The troughs predicted to form adjacent to streams are not predicted to impact Poplar Box TEC vegetation.

For patch P3, ponding is predicted to impact 1.6 ha of the 18.6 ha patch. The patch will not be fragmented by the ponding, and all remaining sections of the patch will retain existing connectivity. No substantial increase in edge effects are expected.

Patch P4 intersects the predicted ponding footprint, and five separate ponding areas are predicted to potentially occur within the patch. This will reduce the 395 ha (maximum predicted ponding) patch size by approximately 42 ha. The potential ponding is predicted to fragment the patch into three patches of 14.3 ha and 17.3 ha and 196.13 ha.

For patch P5, ponding is predicted to impact 0.8 ha of the 67.7 ha patch. The patch will not be fragmented by the ponding, and all remaining sections of the patch will retain connectivity. No substantial increase in edge effects is expected.

The increased patch edges around the ponded areas may increase the edge effects on affected Poplar Box patches. The predicted ponding areas are expected to undergo changes to suitability of plant species, but since no active soil disturbance or movement will be undertaken within the residual ponding areas, the ponding is not expected to generate conditions likely to cause weed incursion in the Poplar Box patches, and the monitoring and maintenance of weeds in accordance with the Weed and Pest Management Plan (Section 10.5) will effectively manage the occurrence and abundance of feral pests.

Subsidence is considered unlikely to represent a significant impact to the Poplar Box TEC. Woodland vegetation, including Poplar Box vegetation, is expected to retain viability after surface subsidence. Discussion of the expected impact of subsidence to open woodland vegetation is presented in Section 10.2.

Given the lack of direct disturbance to patches of the Poplar Box TEC and that the patches affected by residual ponding will not be fragmented by the intermittent ponding, all patches of Poplar Box TEC are expected to remain viable post the mining impact.

The proposed impact is equivalent to 5% of the Poplar Box TEC in the study area. The impacts are predominantly due to hydrological change affecting the resilience of the Poplar Box TEC ecosystem, and the modelling for these changes has incorporated the cumulative effects of nearby projects and climate change (WRM 2022). The impacts identified to Poplar Box TEC are unlikely to contribute to cumulative impacts in the subregion. Further discussion of cumulative impacts is provided in Section 10.12.

The identified Poplar Box TEC vegetation was within the groundwater dependent ecosystem assessment study area and no Poplar Box TEC patches were identified as groundwater dependent (refer 3D Environmental 2022). Impacts of subsidence related cracking and erosion are assessed in Section 10.2. Given the proposed monitoring and management measures for erosion, it is considered unlikely that erosion will impact Poplar Box TEC vegetation.The Project also has the potential to increase weed and animal pest populations if they are not appropriately managed. However, as described in Section 10.5, weed and pest management measures will be implemented for the Project. Indirect impacts associated with bushfire risk are considered unlikely given the bushfire prevention and management measures to be implemented (Section 10.10).

Table 11.4: Poplar Box TEC Extent of Disturbance to each Patch

Patch	Description	Current extent (ha)	Extent of disturbance (ha)		
			Stages 1,2,3 clearing (ha)	Stage 2 and 3 residual ponding (ha)	Stage 4 clearing (ha)
P1	Patch north of Boomerang Creek, in the west of the study area	52.7	0.0	0.0	0.0
P2	Patch south of Boomerang Creek in the west of the study area	49.5	0.0	0.0	0.0
P3	Patch north of Boomerang Creek	18.6	0.0	**1.6**	0.0
P4	Patch south of Boomerang Creek extending through the central portion of the study area	395.2	0.0	**42.0**	0.0
P5	Patch north of Boomerang Creek	67.7	0.0	**0.8**	0.0
P6	Patch north of Boomerang Creek extending from the eastern boundary of the study area	12.4	0.0	0.0	0.0
P7	Patch south of Boomerang Creek extending from the eastern boundary of the study area	54.7	0.0	0.0	0.0
P8	Isolated patch south of Boomerang Creek in the east of study area	5.8	0.0	0.0	0.0

11.1.2.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Poplar Box TEC where practicable. The proposed avoidance and mitigation measures for the Poplar Box TEC, including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis, is provided in Table 11.5.

Table 11.5: Poplar Box TEC impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Locate the MIA in an area that will not disturb Poplar Box TEC.	Mine planning/ construction	Highly effective—avoids impacts to the TEC.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated, with a corrective action plan to be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	DoEE (2019b)
Position surface infrastructure required for underground mining (e.g. surface access, ventilation shafts and drainage wells) to avoid impacts to the Poplar Box TEC.	Mine planning/ construction/ operations	Highly effective—avoids impacts to the TEC.		
Implement vegetation clearance protocols, including the delineation of vegetation adjoining proposed clearance areas to prevent accidental damage (Section 10.1.2).	Construction/ operations	Highly effective management technique to manage vegetation clearance activities.		
Design and undertake subsidence drainage management works to minimise disturbance to the Poplar Box TEC from drainage works, and minimise ponding in areas of the Poplar Box TEC.	Operations	Implementation of measures at other Bowen Basin Mines indicates such works are effective at minimising and managing impacts to remnant vegetation.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Subsidence monitoring will be conducted, and follow-up corrective measures (e.g. additional drainage works) will be implemented as required.	DoE (2015e)
Limit activities that cause disturbance to minimise occurrence and spread of weeds.	Construction/ operations	Highly effective management technique to manage the spread and occurrence of weeds.	Monitor disturbance/vegetation clearance areas against approved disturbance limits.	DoEE (2019b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Regularly inspect mine-related surface disturbance areas and Bowen Basin Coal owned land to identify areas requiring weed management measures to be implemented. Implement weed management measures (e.g. mechanical removal and application of approved herbicides).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the spread and occurrence of weeds.	Monitor and manage weeds in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts, or alternative control strategies) will be implemented, as necessary.	DoEE (2019b), Commonwealth of Australia (2017a), Qld Department of Agriculture and Fisheries weed control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of the site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	DoEE (2019b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of site will be carried out by environmental personnel. Waste generation monitoring and audit will be in accordance with the Waste Management Plan. Additional measures (such as provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals.	DoEE (2019b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Implement pest control measures in accordance with the Weed and Pest Management plan where infestations develop.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be prepared for the Project. Corrective actions (such as increasing the frequency or extent of control efforts, or alternative control strategies) will be implemented, as necessary.	DoEE (2019b), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoE (2015b), DoEE (2016b), DoEE (2017), DEWHA (2008b)
Consult with the Isaac Regional Council and neighbouring mines in relation to weed and pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Coordinated activities are predicted to achieve better regional outcomes for weed and pest species.	Audits will be implemented to monitor the consultation outcomes, and the management measures will be implemented on -site in accordance with the Weed and Pest Management Plan (Section 10.5)	DoEE (2019b), Commonwealth of Australia (2017a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)
Bushfire prevention and management measures will be outlined in the Emergency Response Plan to be prepared for the Project. Inductions of mine site personnel will include fire awareness.	Construction/ operations/ rehabilitation and decommissioning	Effective management procedure to reduce the risk of bushfire.	Any incidence of bushfire will be investigated to determine the requirement for additional controls. Potential adaptive management measures include revision of the Emergency Response Plan and/or a program to increase personnel awareness of bushfire risk (e.g. through tool box talks)	DoEE (2019b)

11.1.2.8 Statutory requirements

Conservation, recovery and threat abatement plans relevant to the Poplar Box TEC have been considered in the assessment of the TEC (Section 11.1.2.3), the development of avoidance, mitigation and management measures (Section 11.1.2.7) and/or assessment of significant impact for the Poplar Box TEC (Section 11.1.2.9):

- The 'Approved Conservation Advice for Poplar Box Grassy Woodland on Alluvial Plains' (DoEE 2019b), developed at the time of EPBC Act listing outlines the key diagnostic criteria and condition thresholds for the TEC and the priority conservation actions for the community. The conservation advice also describes areas considered critical to the survival of the community.
- The 'Poplar Box Grassy Woodland on Alluvial Plains' ecological community' SPRAT profile provides information about the indicative distribution of the Poplar Box TEC.
- The SPRAT profile for this species indicates there is no adopted or made Recovery Plan for this ecological community, as the listing and the implementation of actions in the Approved Conservation Advice (DoEE 2019b) provides sufficient protection and guidance on the recovery of the ecological community.
- No Threat Abatement Plan has been identified as being relevant the Poplar Box TEC.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019) and Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or Convention on Conservation of Nature in the South Pacific (Apia Convention).

Key threats to the Poplar Box TEC include (DoEE 2019b):

- clearance and fragmentation;
- invasive weeds and pests;
- inappropriate fire and grazing regimes;
- dieback;
- chemical impact and spray drift;
- invasive fauna;
- hydrological changes and salinization;
- nutrient enrichment; and
- climate change.

11.1.2.9 Significant impact assessment

Table 11.6 provides an assessment of the likelihood of significant impacts on the Poplar Box TEC in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

Table 11.6: Poplar Box TEC significant impact assessment

Significance criteria	Assessment of significance
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:	
Reduce the extent of an ecological community	The Project avoids the direct clearance of Poplar Box TEC. Surface subsidence will result in the creation of areas of predicted ponding that is expected to modify the factors necessary for the Poplar Box TECs. Ponding mitigation measures will be employed; however, residual ponding is predicted to impact 44.4 ha of Poplar Box TEC, such that the conditions necessary for the TECs survival will potentially be destroyed by the potential ponding.
Fragment or increase fragmentation of an ecological community	The Poplar Box TEC vegetation in the study area has been subject to past disturbance related to grazing land use. Three patches of Poplar Box TEC will be impacted by residual ponding (patches P3, P4, P5), and this will reduce the Poplar Box TEC vegetation by 44.4 ha across these three patches. One patch (P4) will be fragmented by the residual ponding.
Adversely affect habitat critical to the survival of an ecological community	Habitat critical to the survival of the Poplar Box TEC is 'Class A, High quality' patches (DoEE 2019b). The patches of Poplar Box TEC present in the study area are 'Class B Good quality' and, therefore, considered not to form habitat critical to the survival of the TEC. The Project is unlikely to affect habitat critical to the survival for the TEC.
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 impacts of areas of periodic ponding due to surface subsidence, which modify conditions necessary for Poplar Box TEC survival, are considered as a reduction in the extent of the TEC. Management measures will be applied to prevent erosion and sedimentation resulting from Project activities within the Poplar Box TEC habitat. Given these controls, the Project is not predicted to cause erosion-related impacts that will modify or destroy factors necessary for the survival of the Poplar Box TEC. The Poplar Box TEC in the study area has not been identified as a GDE, and modifications to groundwater levels are unlikely to affect the TEC's survival (3D Environmental 2022).
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	Parts of three Poplar Box TEC patches will be impacted by the Project. The partial impact on these patches may create potential for edge effects on these patches. Edge effects to remaining areas of this TEC adjacent to impact areas are unlikely to be significant, as the TEC is already subject to weed infestation of established ground cover species. Weed control measures will be implemented throughout the study area to minimise the risk of degradation of Poplar Box TEC through change in species composition. The result of the implementation of the mitigation measures proposed in this assessment will be that it is unlikely the retained TEC in the study area will experience a decline or loss of the functionally important species. Bushfire prevention and management measures will be implemented in accordance with the Emergency Response Plan, which will protect the functionally important species of the Poplar Box TEC.

Significance criteria	**Assessment of significance**
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	Three Poplar Box TEC patches will be partially impacted by the Project. The remaining areas of the impacted patches may be subject to edge effects; however, the Project area is within a modified rural landscape where introduced species have been recorded throughout the TEC. The proposed Project is unlikely to increase the threat of invasive species in the landscape. The Project is unlikely to result in the mobilisation of pollutants of any kind into this TEC either within or adjacent to the Project area. The Project is not likely to use fertilisers on-site or cause regular mobilisation of herbicides that may impact the Poplar Box TEC. Control measures such as sediment dams will be in place to minimise the potential for pollutants to affect the Poplar Box TEC in the study area.
Interfere with the recovery of an ecological community	There is no national recovery plan for the Poplar Box TEC. The Project will result in the reduction of extent of the Poplar Box TEC by approximately 44.4 ha.
Conclusion	The Project is considered to have a significant impact on 44.4 ha of the Poplar Box TEC. The extent of these impacts is shown in Figure 11.2.

Figure 11.2: Poplar Box TEC significant impact areas

11.1.3 Ornamental Snake

11.1.3.1 Description

The Ornamental Snake (*Denisonia maculata*) is listed as Vulnerable under the EPBC Act and NC Act.

The species is known from the Brigalow Belt North and parts of the Brigalow Belt South biogeographical regions and is sparsely distributed throughout its range (DoE 2014b, DAWE 2021a). The core of the species' distribution occurs within the drainage system of the Fitzroy and Dawson Rivers (McDonald *et al*. 1991; Cogger *et al.* 1993).

The Ornamental Snake occurs within woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions in Queensland Regional Ecosystem Land Zone 4 but also lake margins and wetlands (DAWE 2021a). These habitats are favoured by frogs (the Ornamental Snake's prey) and provide suitable microhabitat features for the species, such as deep cracking clay soils, logs and vegetation debris/litter in which the species shelters.

The Ornamental Snake has most commonly been recorded in Queensland Regional Ecosystem (RE) 11.4.3 and has commonly been recorded in RE 11.4.6, RE 11.4.8 and RE 11.4.9, and less commonly in RE 11.3.3 and RE 11.5.6 (DAWE 2021a, DSEWPaC 2011a). The Ornamental Snake also occurs in cleared areas where the abovementioned RE's formerly occurred, which comprises adequate ground cover to provide shelter (such as gilgai formations, logs, rocks and other debris) for the species. Gilgai formations are found where deep-cracking alluvial soils with high clay contents occur.

The Ornamental Snake is nocturnally active. The diet of this species consists predominantly of frogs, and the species forages in areas where frogs are abundant (DoEE 2019c). The Ornamental Snake has been observed consuming a variety of species (DoEE 2019c). The Ornamental Snake shelters during the day in logs and under coarse woody debris, ground litter and in deep soil cracks (DAWE 2021a). The species is thought to be active year-round, with the exception of cooler months. Peak activity occurs in early summer and through the wet season. During dry periods, *D. maculata* can remain inactive in suitable shelter sites (DAWE 2021a). The Ornamental Snake is viviparous (i.e. gives birth to young that have developed within the mother's body), and typically a litter size ranges from three to 11 (DAWE 2021a).

11.1.3.2 Desktop analysis

Desktop analysis of relevant databases has been conducted to identify records of the Ornamental Snake within the vicinity of the Project (Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia). The desktop assessment also includes a review of ecological survey and assessments of nearby developments for information/records relating to the Ornamental Snake. Details of the desktop analysis are provided in Section 6.

The Ornamental Snake has been identified during surveys undertaken for surrounding projects including, but not limited to, Isaac Downs (Ecological Survey and Management 2020a), Isaac Plains East (Ecological Survey and Management 2020b), Olive Downs Coking Coal Project (DPM Envirosciences 2018a), Saraji Mine/Saraji East Mining Lease Project (Aecom 2021) and Winchester South Project (e2m 2021).

Desktop analysis of Queensland government mapping, including regional ecosystem mapping, essential habitat mapping, land zone mapping and wetlands, has also been conducted to determine the potential vegetation communities and soil types present and the extent of potentially suitable habitat for the Ornamental Snake. Aerial photography has also been inspected to assess the presence of potentially suitable vegetation and gilgai.

11.1.3.3 Survey effort

Seasonal fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April) and autumn 2021 (16–25 April) over 45 days in consideration of relevant Commonwealth and Queensland surveys guidelines. The autumn surveys were conducted during optimal climatic conditions for the Ornamental Snake.

Fourteen systematic survey sites were established during the surveys. Three systematic survey sites were established Brigalow woodlands on clay soils, which is potential habitat for the Ornamental Snake (MF04, MF07 and MF08). Each site consisted of the recommended design and trap numbers for pitfalls and funnels as per the Queensland guideline (Eyre *et al.* 2018). Supplementary targeted spotlighting survey effort was conducted in Autumn 2021.

Survey effort for the Ornamental Snake at systematic and targeted sites included:

- Pitfall traps: 176 trap nights;
- Funnel traps: 264 trap nights;
- Diurnal searches: 75 person hours; and
- Spotlighting: 47 per hours in total, with 15 person hours over 3 nights in Brigalow and gilgai habitat.

Survey effort for active searching and spotlighting has not met the duration requirements as per the Commonwealth Guideline, which requires 1.5 person-hours diurnally and nocturnally per hectare over at least three days and nights. This was not practicable for the area of habitat within the study area. The Ornamental Snake is most likely to be encountered by searching in and around suitable gilgai habitats during the evening when frogs are most active. The targeted surveys conducted for the Ornamental Snake are considered the most appropriate means of survey. Despite not meeting the DAWE survey guidelines, the Ornamental Snake has been confirmed in the study area through targeted searches for this species.

For habitat assessment, amenity surveys have been conducted along transects of 100 m within areas of potentially suitable habitat. The total extent of gilgai formations and maximum gilgai depths have been recorded along the transect. Observations were made of:

- dominant shrub vegetation;
- dominant ground cover vegetation;
- presence of woody debris; and
- presence of soil cracks.

Additional observations of Ornamental Snake habitat suitability were made incidentally throughout the study area.

Further details of the survey timing, effort and methodology are provided in Section 7 and Appendix G.

11.1.3.4 Survey outcomes

The Ornamental Snake has been recorded at three locations within the study area by the terrestrial fauna surveys. All three records were recorded within Brigalow regrowth vegetation containing well developed gilgai (Figure 11.3).

The habitat assessment transect data and site survey/inspections informed the assessment of habitat amenity for the Ornamental Snake within the study area, as described in section 11.1.3.5.

11.1.3.5 Habitat assessment

Habitat mapping for the Ornamental Snake within the study area is shown on Figure 11.3 and is informed by in-field observations and transect data, aerial photography, soils mapping and information contained in DAWE's Species Profiles and Threats (SPRAT) database, including the relevant statutory documents and published research.

Habitat amenity for the Ornamental Snake within the study area has been mapped against the criteria outlined in Table 11.7.

Table 11.7: Ornamental Snake habitat amenity assessment criteria

Habitat amenity	Description
High	High amenity habitat is defined as areas of deep gilgai microrelief (60+ cm depth) or ephemeral creek lines (including older systems) on dark clays. Evidence of pooling surface water is common on aerial imagery. In these areas, Ornamental Snakes are known to occur (previous records) or are considered highly likely, and the area is expected to support comparatively higher densities.
Moderate	Moderate amenity habitat includes areas with less pronounced gilgai microrelief (20–60 cm depth) that occurs on either dark (predominantly) or loam (uncommonly) soils. There is reduced evidence of surface water pooling on aerial imagery. On balance, these areas are more likely to be inhabited by Ornamental Snakes than not, though the species may be absent from some areas or in low abundance. These habitats may not hold water in poor rainfall conditions (i.e. droughts).
Low	Low amenity habitat includes areas with slight microrelief (<20 cm) or low possibility of pooling water. Often associated with sand/loam soils. Ornamental Snakes, if present, are likely to be at comparatively low density though, on balance, it is anticipated that most areas will be uninhabited. These habitats are anticipated to contain water only in high rainfall conditions (i.e, well above average) and, even then, may not hold water for lengthy periods. Despite containing water, large dams or permanent waters are not typically frequented by abundant frogs. Considering the extent of more suitable habitat, these waterbodies are generally not mapped as suitable (with some exceptions).
Unsuitable	Unsuitable habitat for the Ornamental Snake includes areas that contain less appropriate soil types (sands and sandy loams), lack suitable microhabitat features, have been subject to historic blade-ploughing which has adversely affected microrelief (unless otherwise indicated by aerial photography or in-field observations) and are characterised by dense, non-native grass species. These habitats are typically not attractive to Ornamental Snakes or large aggregations of their prey (frogs).

Areas of habitat amenity have been determined based on in-field observations and aerial photography by EcoSmart Ecology and AARC. Dark clay soils, which are more likely to retain water and support abundant frog populations, have been assessed using the following hierarchy of confidence:

- direct in-field observations;
- the presence of dark shrub vegetation (Brigalow) on aerial photography and the absence of light green shrub vegetation (*Carissa ovata*); and
- soil mapping of the study area (AARC 2022).

Aerial photography of the study area (1 m resolution) was captured in May 2019 following above average rainfall (~45% greater than average for the months of June to April). At the provided resolution, larger and more substantial microrelief (i.e. gilgais) were visible, and the recent rainfall allowed the extent and/or likely presence of surface water to be assessed.

While the above habitats are relatively easy to define, assigning these criteria to areas within the site is problematic due to gradual transitions in gilgai formations (mapping of distinct boundaries oversimplifies in-field values), the complex patchwork of soils which can occur in some areas (e.g. to the north and west of One Mile Creek) and the history of ploughing to remove woody regrowth, which incrementally alters microrelief in areas that may otherwise show deep gilgai formations. On the site, *Acacia harpophyll*a is generally associated with darker clays, while *Carissa* sp. is generally associated with red soils. These two plant species can be differentiated with high resolution aerial imagery. However, in many areas, there is a mix of the two. While the soil mapping by AARC (2022) is suitable for its intended purpose, it does not provide a sufficient level of detail at the scale suitable for mapping Ornamental Snake habitat. As such, it has only been used to predict soil type when required.

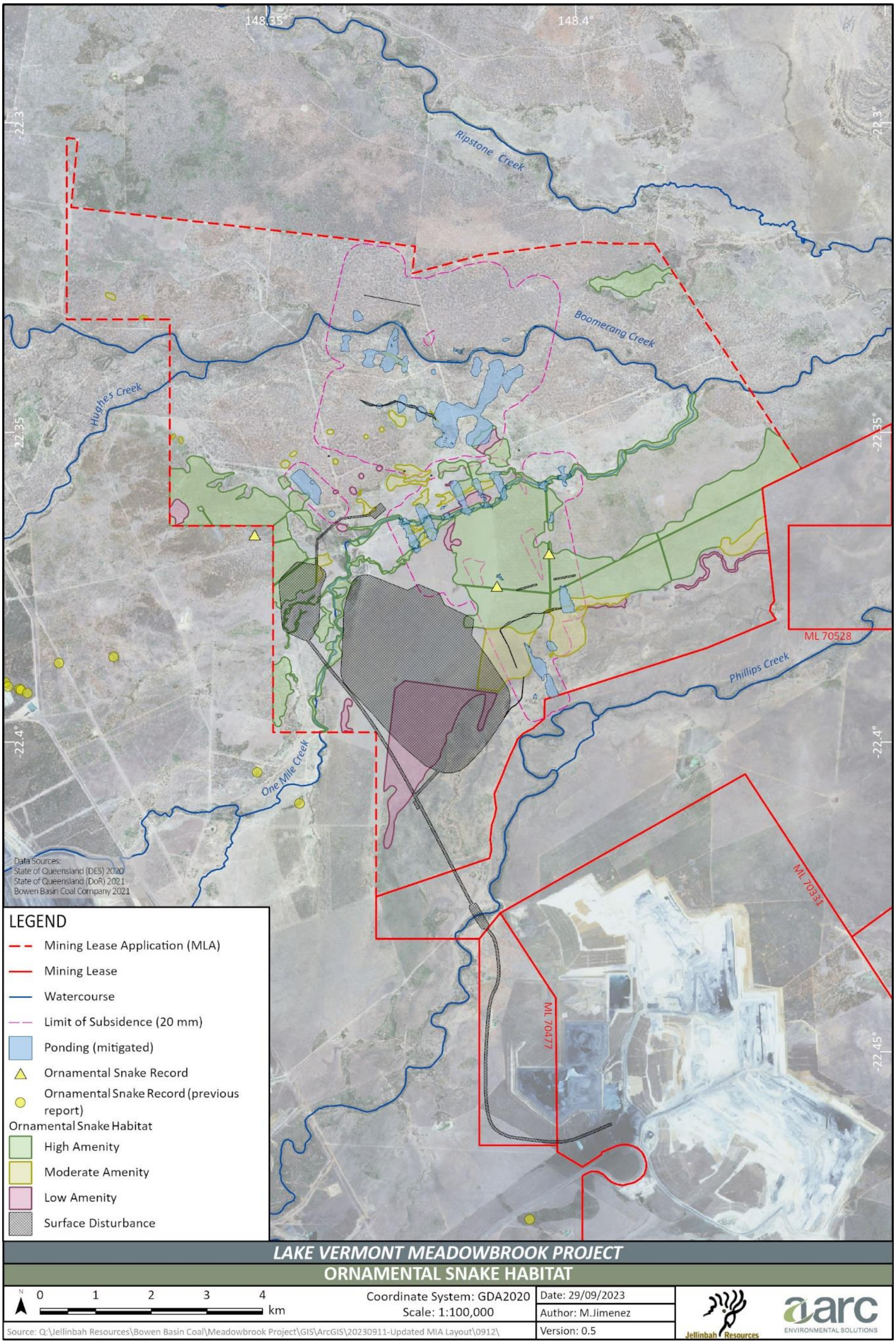


Figure 11.3: Ornamental Snake habitat mapping

11.1.3.6 Impact assessment

A total of 1,672.0 ha of Ornamental Snake habitat has been identified within the study area, including 1,192.5 ha of high amenity, 213.5 ha of moderate amenity and 266.0 ha of low amenity habitat (Table 11.8, Figure 11.3). A total of 207.1 ha of Ornamental Snake habitat is proposed to be cleared for the Project, including 39.4 ha of high amenity, 20.2 ha of moderate amenity and 147.5 ha of low amenity habitat.

The direct disturbance by clearing will impact Ornamental Snake habitat, which will add to habitat disturbance that is proposed to occur for other Projects in the region. However, it is noted that proposed Project and other existing and approved projects are granted approval in accordance with legislation, and where significant impacts occur as a result, appropriate offsets of these impacts are provided.

Direct disturbance associated with the infrastructure corridor will intersect high amenity Ornamental Snake habitat at One Mile Creek and low amenity habitat located south of the proposed open cut pit. The clearing for the infrastructure corridor crossing at One Mile Creek will intersect the habitat adjacent to the southern portion of One Mile Creek, and these two patches will be dissected by the Project feature. The mobility of the species and its ability to use shallow water and mobilise through boxed culverts will likely allow the species to continue to disperse along the watercourse despite the infrastructure corridor crossing. The southern portion of the habitat adjacent to One Mile Creek will retain connectivity to habitat continuing along the watercourse to the south of the Project boundary into an area which is not within the impact area of the adjoining, proposed Saraji East project. The low amenity habitat located to the south of the proposed open cut pit will also be intersected by the infrastructure corridor. The Ornamental Snake is considered likely to be able to disperse through the area despite the presence of the Project feature by mobilising over the corridor and using the culverts which will be located along the watercourse crossing. The open cut pit will fragment the low amenity habitat to the south of the pit from the moderate and high-quality habitat in the central portion of the study area. Ornamental Snake mobility is likely to allow the species to disperse across the areas of cleared agricultural land such that these habitat patches are unlikely to be effectively fragmented by the open cut pit.

The surface subsidence within the Ornamental Snake habitat area does not represent a removal of habitat, with the impact presenting as superficial geomorphological changes, which will not have a deleterious affect on soil cracks or gilgai features. The subsidence within identified Ornamental Snake habitat is predicted to be to a maximum depth of 2.9 m and a tilt of typically less than 3% (Gordon Geotechniques 2022). This geomorphological change is unlikely to have a deleterious impact on the gilgai features and cracking soils that define the Ornamental Snake habitat, with indirect impacts to the Ornamental Snake habitat also considered unlikely. The predicted subsidence impacts are described in further detail in Section 10.2 and Section 10.1. Ornamental Snake habitat occurs within riparian vegetation adjacent to One Mile Creek, including in reaches of the Creek that will be subject to stream morphology changes from subsidence. These potential stream morphology affected areas are co-located with areas of predicted ponding, and the assessment of stream morphology change impacts and mitigation measures are detailed in Section 10.3. The vegetation forming Ornamental Snake habitat within the study area was not identified to be groundwater dependent (3D Environmental 2022).

The predicted areas of residual ponding within Ornamental Snake habitat represent a change in habitat with additional ponds arising. The quality and availability of habitat required for foraging, shelter and breeding and mobility will be retained in the residual ponding areas, although the period of inundation of gilgai features may be increased. The areas of residual ponding are predicted to be inundated for a maximum period of several months every few years depending on inflow volumes and soil permeability (WRM 2022), which is considered comparable to the pattern of seasonal inundation as required for habitat for the species. Ornamental Snake diet is predominantly frogs, for which temporary and permanent ponds provide foraging and breeding habitat, the predicted subsidence ponding areas are considered analogous to the temporary ponding areas suitable for the Ornamental Snake prey breeding areas. The impacts of subsidence and predicted ponding it therefore considered to represent a change in Ornamental Snake foraging habitat, and no deleterious impact to suitability for Ornamental Snake foraging.

The extent of flooding in the study area is predicted to increase along the margins of subsided panels however the changes to flood levels and extent are not considered significant (WRM 2022). The impacts of changes to flooding regimes on Ornamental Snake habitat are, therefore, not expected to be significant.

Gas drainage activities in the proposed southern underground mining area will occur with Ornamental Snake habitat. The gas drainage activities are unlikely to create any significant impacts to this species, with access to be largely achieved using existing tracks, and drainage sites will be remediated as mining progresses. The potential for indirect impacts on the Ornamental Snake from noise and vibration, dust, lighting and vehicle strike is considered to be minimal given the measures that will be implemented to manage these impacts.

The identification of impacts to Ornamental Snake habitat in the study area includes consideration of potential impacts from climate change and adjoining projects that have been incorporated into hydrological modelling (WRM 2022). Therefore, it is considered that the assessment has taken into account cumulative sources of impact, and no further cumulative impacts to Ornamental Snake habitat will occur. Further discussion of cumulative impacts is provided in Section 10.12.

Impacts of erosion and subsidence related cracking are assessed in Section 10.2. Given the proposed monitoring and management measures for erosion, it is considered unlikely that erosion will impact Ornamental Snake habitat. The Project also has the potential to increase weed and animal pest populations if they are not appropriately managed. However, as described in Section 11.1.3.7, weed and pest management measures will be implemented for the Project.

An assessment of the significance of the impacts on the Ornamental Snake is provided in Section 11.1.3.9.

Table 11.8: Proposed Project footprint within Ornamental Snake habitat

Habitat amenity	**Extent within study area (ha)**	**Extent of direct disturbance (ha)**		**Extent of subsidence impact (ha)[a]**	**Extent of predicted ponding impact (ha)**
		Stages 1,2,3 clearing (ha)	**Stage 4 clearing (ha)**		
Low	266.0	4.1	143.4	19.9	4.2
Moderate	213.5	1.9	18.3	100.8	10.9
High	1192.5	35.8	3.6	393.8	27.7
Total	**1672.0**	**41.8**	**165.3**	**514.5**	**42.8**

[a] Excludes predicted ponding areas

11.1.3.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Ornamental Snake where practicable. The proposed avoidance and mitigation measures for the Ornamental Snake, including timing, predicted effectiveness, monitoring and adaptive management. These measures and their relevant statutory or policy basis, is provided in Table 11.9.

Table 11.9: Ornamental Snake impact avoidance and mitigation measures

Avoidance/mitigation measures	**Timing**	**Predicted effectiveness**	**Monitoring and adaptive management**	**Statutory or policy basis**
Project infrastructure has been located to minimise direct disturbance to Ornamental Snake habitat.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to Ornamental Snake habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Monitor/audit implementation of vegetation clearance protocol to confirm it is appropriately implemented (e.g. areas have been clearly delineated, prior inspections have been conducted and habitat features have been assessed for potential salvage). Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented.	DoE (2014b), DSEWPaC (2011c), Ponce Reyes *et al.* (2016)
Disturbance areas will be delineated to prevent accidental damage to adjacent Ornamental Snake habitat.	Construction/ operations	Highly effective management technique to manage Project disturbance activities.		
Fauna spotter/catcher will be on-site when clearing activities occur within Ornamental Snake habitat. Fauna spotter/catcher will monitor clearance activities for Ornamental Snakes and any incidence of fauna mortality or injury will be recorded. Injured fauna will be taken to a wildlife carer or veterinarian.	Construction/ operations	Effectiveness is likely to be variable and dependent on whether individual(s) move from their shelter and whether individual(s) can be caught during the clearing activities.	Adaptive measures will be implemented, as necessary. Potential adaptive measures include pre-clearance surveys/trapping of target fauna.	DoE (2014b)
Fauna spotter/catcher will monitor the fauna encountered and the occurrence of Ornamental Snakes within trenches.	Construction	Highly effective method to ensure trapped animals do not perish.	Adaptive measures include increased frequency of inspection or limiting the duration or extent of the disturbance at any one time.	DSEWPaC (2011c)
Select habitat features (e.g. hollows, logs) will be salvaged during clearance activities for habitat enhancement in Ornamental Snake habitat that will not be disturbed by the Project.	Construction/ operations	Effective if salvaged carefully and placed strategically to enhance existing habitat.	Implementation of the vegetation clearance protocol will be monitored/audited. Corrective measures will be implemented as required.	DoE (2014b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Design and undertake subsidence ponding drainage management works to minimise hydrological changes to Ornamental Snake gilgai habitats.	Mine planning/ operations	The hydrological modelling (WRM 2022) indicates the subsidence ponding mitigation works will be effective in minimising the hydrological changes that will occur as a result of mine subsidence.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Audit(s) will be conducted against the Subsidence Management Plan. Corrective measures may include additional works to reduce ponding.	DoE (2015e), DoE (2014b), DSEWPaC (2011c), Ponce Reyes *et al*. (2016)
Implement erosion and sediment control measures.	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for erosion and sedimentation.	Monitoring of the integrity and effectiveness of implemented erosion and sediment controls will be conducted in accordance with the Erosion and Sediment Control Plan that will be prepared for the Project. Adaptive management measures (such as installation of additional erosion controls or increase in frequency of inspections) will be implemented, as required.	DoE (2014b), DSEWPaC (2011c), Ponce Reyes *et al.* (2016)
Implement measures to reduce the risk of the introduction of pollutants (e.g. bunding or containment of hydrocarbon storages, provision of spill kits).	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for leaks and spills or other pollutants being introduced to Ornamental Snake habitat.	Visual inspections will be conducted of containment measures at MIA. Maintenance or implementation of additional controls will be carried out, as required, to maintain integrity and effectiveness. Auditing of management measures and identification of potential system improvements will be conducted.	DoE (2014b), DSEWPaC (2011c), Ponce Reyes *et al*. (2016)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Monitor and manage pest animal populations and implement pest control measures in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	DoE (2014b), DSEWPaC (2011c), Ponce Reyes *et al.* (2016), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoEE (2017)

11.1.3.8 Statutory requirements

A number of conservation, recovery and threat abatement plans are relevant to the Ornamental Snake and have been considered in the development of avoidance, mitigation and management measures (Section 11.1.3.7) and assessment of significant impact for the Ornamental Snake (Section 11.1.3.9):

- The 'Approved Conservation Advice for *Denisonia maculata* (Ornamental Snake)' (DoE 2014b) developed at the time of the EPBC Act listing provides guidance on recovery and threat abatement activities that can be undertaken to ensure the conservation of the species.
- The '*Denisonia maculata*–Ornamental Snake' SPRAT profile provides information about the Ornamental Snake, including relevant regulatory considerations and information in relation to its population and distribution, habitat, movements, feeding and reproduction.
- The SPRAT profile for this species indicates there is no adopted or made Recovery Plan for this species, as the approved conservation advice (DoE 2014b) provides sufficient direction to implement priority actions and mitigate against key threats.
- The 'EPBC Act Draft Referral guidelines for the nationally listed Brigalow Belt reptiles' (DSEWPaC 2011c) includes information on Ornamental Snake habitats, survey considerations, primary threats, impacts and potential mitigation measures. The Draft Referral Guidelines consider 'important habitat' to be a surrogate for 'important populations' of Brigalow Belt reptiles and lists gilgai depressions and mounds as known important habitat for the Ornamental Snake.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019), Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

Threats to the Ornamental Snake include (DAWE 2021a):

- habitat loss through clearing;
- habitat fragmentation;
- habitat degradation through overgrazing by stock, especially cattle, or grazing of gilgais during the wet season that leads to soil compaction and compromising of soil structure;
- alteration of landscape hydrology in and around gilgai environments;
- alteration of water quality through chemical and sediment pollution of wet areas;
- contact with the cane toad;
- predation by feral species; and
- invasive weeds.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Conservation of Nature in the South Pacific (Apia Convention), or other relevant international conventions. The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assess their likelihood of occurrence (Section 11.1.3.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.3.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.3.5);
- identified potential impacts of the Project on the species and its habitats (Sections 10 and 11.1.3.6);
- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.3.7); and

- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) (Section 11.1.3.9).

11.1.3.9 Significant impact assessment

Table 11.10 provides an assessment of the likelihood of significant impacts on the Ornamental Snake in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

The Ornamental Snake population occurring at the study area has been assessed against the definition of 'important population' of a Vulnerable species (DoE 2013a). The study area is located near the centre of the Ornamental Snake range within the Brigalow Belt. Dispersal and genetic exchange is likely to occur between the population occupying the study area and the population occupying the broader region. Therefore, it is considered that the population occupying the study area is not likely to be:

- a key source population for breeding or dispersal;
- a population necessary for maintaining genetic diversity; or
- a population near the limit of the species range.

The high amenity habitat with pronounced gilgai relief identified within the study area corresponds with the definition of known important habitat described in SEWPaC (2011c). Therefore, the population occupying this area of potentially important habitat may be considered an important population.

Table 11.10: Ornamental Snake significant impact assessment

Significance criteria	Assessment of significance
An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The population of Ornamental Snake in the Project area is considered to be an important population. The Project will involve the clearing of 207.1 ha of habitat including 147.5 ha of low amenity habitat. The Project may lead to a decrease in the size of an important population. However, 907.4 ha of habitat will be retained in the study area, and 557.5 ha will be affected by subsidence but is expected to retain or increase its habitat viability.
Reduce the area of occupancy of an important population	The Project will result in the removal of a total of 207.1 ha of habitat. This removal of habitat may reduce the area of occupancy within the study area. Habitat for the species will be retained in the study area through retention of 907.4 ha of habitat that will be unaffected by the Project, as well as the 557.5 ha that will be affected by subsidence but is expected to retain or increase its habitat viability.
Fragment an existing important population into two or more populations	The Project will result in the removal of 207.1 ha of habitat. The removal of habitat for the construction of the infrastructure corridor will impact connectivity of habitat located along One Mile Creek and in the habitat patch to the south of the open cut pit. The open cut pit will fragment a portion of low amenity habitat to the south of the pit from the habitat in the central portion of the study area. However, the connectivity to habitat outside of the study area will be retained. The mobility of the species is expected to allow it to disperse past Project features, including over or under the infrastructure corridor and *via* surrounding cleared areas. Therefore, the population is considered unlikely to be fragmented into two or more populations.

Significance criteria	Assessment of significance
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the Ornamental Snake listed on the Register of Critical Habitat (DAWE 2021Ac). While the habitat is used by a local population of the species, the areas are unlikely to be necessary for the species as a whole for activities such as: • foraging; • breeding; • roosting; • dispersal; • the long-term maintenance of the species; and • maintaining genetic diversity for the reintroduction or recovery of the species. The high amenity habitat identified in the study area is considered likely to be important habitat for the species. This habitat may be considered to represent habitat critical to the survival of the species despite not being listed on the Register of Critical Habitat, and the Project, therefore, has potential to impact this critical habitat.
Disrupt the breeding cycle of an important population	The Project will result in the removal of a total of 207.1 ha of habitat, and these areas of habitat will not support breeding of the species after clearing. The undisturbed areas are expected to continue to provide for breeding. The areas affected by subsidence are expected to maintain habitat viability for breeding, as key habitat requirements are not expected to be degraded by the process of subsidence, including; gilgai depressions and wetland features, soil cracks, debris and leaf litter. The retained habitat throughout the study area is unlikely to be indirectly impacted by the Project. Indirect impacts, such as weeds and pests, noise and vibration, dust, artificial lighting, vehicle strike and bushfire, will be managed as outlined in sections 10.5 to 10.10 and are considered not to have potential to disrupt the breeding cycle of the Ornamental Snake in retained habitat within the study area. The breeding cycle of Ornamental Snake outside the area of habitat to be removed is unlikely to be impacted by the Project.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project requires the removal of 207.1 ha of Ornamental Snake habitat. The removal of this extent of habitat is considered likely to decrease the availability of habitat and cause a decline of the species within the area local to the Project. The habitat retained within the study area is unlikely to undergo any process that is likely to cause the species to decline. The habitat within the subsidence areas will undergo some modification; however, the general habitat requirements of the species will be retained with the addition of increased areas of ponding in wet conditions. Areas of inundated depressions and wetland areas are predicted to be increased within subsidence areas, and therefore, the subsidence areas are considered likely to retain or exceed the availability and quality of habitat present in these areas.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species habitat	The study area is in a modified rural landscape, and invasive species that may be harmful to the Ornamental Snake exist in the broader region. Predatory species, including feral cats, have been recorded in the study area. The Project is unlikely to result in the introduction and establishment of any invasive species that may predate on the Ornamental Snake in the habitat present within the study area. Feral pigs and cane toads have been recorded and are established in the Ornamental Snake habitat within the study area and are the likely cause of degradation of the habitat. The Project is unlikely to result in the introduction or establishment of any other species likely to be harmful to the Ornamental Snake. Monitoring and management of pests, including corrective actions, will be implemented in accordance with a Weed and Pest Management Plan (Section 10.5).
Introduce disease that may cause the species to decline	There are no diseases listed as a threat to the Ornamental Snake. The Project is unlikely to introduce a disease that may cause the species to decline.

Significance criteria	Assessment of significance
Interfere substantially with the recovery of the species	There is no adopted or made Recovery Plan for this species. Priority recovery actions identified by the TSSC (2014) include the identification of populations of high conservation priority, the use of conservation arrangements or management agreements on private land, inclusion in reserve tenure, minimisation of adverse impacts and controlling of introduced pests. The Project is unlikely to substantially interfere with the recovery of the species.
Conclusion	The Project will result in the removal of 207.1 ha of Ornamental Snake habitat. This clearing is identified as likely to reduce the area of habitat availability within the study area and may be critical to the survival of the species in the local area. Therefore, the Project is likely to have a significant impact to the Ornamental Snake. The extent of these impact areas is shown in Figure 11.4

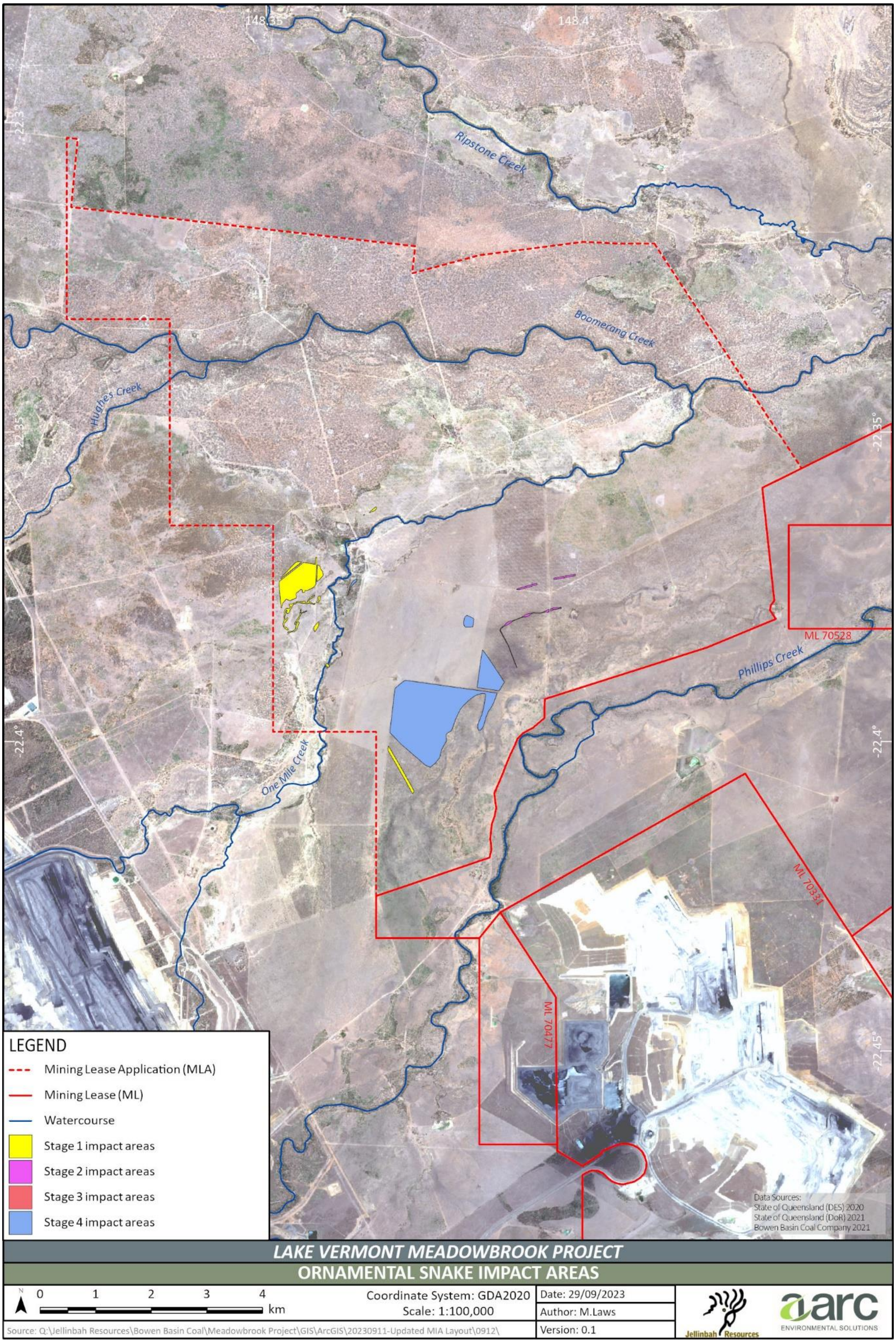


Figure 11.4: Ornamental Snake significant impact areas

11.1.4 White-throated Needletail

11.1.4.1 Description

The White-throated Needletail (*Hirundapus caudacutus*) is listed as Vulnerable under the EPBC Act and NC Act and is a listed migratory and marine species under the EPBC Act.

The White-throated Needletail is a large migratory swift and widespread across eastern and south-eastern Australia during its non-breeding season in September/October (DAWE 2021a, TSSC 2019). In eastern Australia, it has been recorded in all coastal regions of Queensland, extending inland to the western slopes of the Great Divide and occasionally onto adjacent inland plains (DAWE 2021a). The species is considered to be widespread in eastern and south-eastern Australia, from the islands in Torres Strait south to Tasmania. One of two subspecies of White-throated Needletail occurs in Australia although both occur in the northern hemisphere. (DAWE 2021a).

Primarily an aerial species, this species is known to occur across a variety of habitats including wooded areas, open forests, and rainforests (DAWE 2021a). Large tracts of native vegetation, particularly forest, is considered likely to be a key habitat requirement for this species (DoE 2015a). It has been observed flying over farmland, typically over partially cleared pasture or within remnant vegetation at the edge of paddocks where it predominantly forages at cloud level along the edges of low-pressure systems (DAWE 2021a). This species also forages in open habitats or recently disturbed areas (TSSC 2019) feeding on a wide variety of insects (DAWE 2021a), occasionally near ground level. White-throated Needletails seldom alight on the ground or other substrates to catch insects and have very occasionally been seen foraging by launching into the air from trees in pursuit of flying insects or clinging to flowers on eucalypts, searching for insects (DAWE 2021a).

It prefers to roost in forests and woodlands, both among dense foliage in the canopy or in tree hollows, as well as on bark or rock faces, and occasionally roost aerially (DAWE 2021a, DoE 2015a).

11.1.4.2 Desktop analysis

Desktop analysis of relevant databases was conducted to identify records of the White-throated Needletail within the vicinity of the Project (Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia). The desktop assessment also included review of ecological survey and assessments for nearby developments for information/records relating to the White-throated Needletail. Details of the desktop analysis are provided in Section 6.

The White-throated Needletail has been recorded by surveys conducted for the existing Lake Vermont Mine (WBM Oceanics 2003) and by surveys undertaken for the Saraji Mine (Aecom 2021) and Caval Ridge Mine (BAAM 2009).

11.1.4.3 Survey effort

Seasonal fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April) and autumn 2021 (16–25 April) over 45 days in consideration of relevant Commonwealth and Queensland surveys guidelines. The surveys were conducted within the survey window for northern and eastern Australia (DAWE 2021a).

Fourteen systematic survey sites were established during the surveys. All systematic sites were established in habitat considered to provide potential foraging habitat to the White-throated Needletail.

Survey effort for the White-throated Needletail at systematic and supplementary sites included:

- diurnal searches: 75 person hours;
- bird surveys: 83 hours; and
- opportunistic observations.

The survey effort and timing meet the Commonwealth Guideline (DoEE 2019c) and the Queensland Guideline (Eyre 2018).

Further details of the survey timing, effort and methodology is provided in Section 7 and Appendix G.

11.1.4.4 Survey outcomes

An individual White-throated Needletail was recorded during the spring 2019 terrestrial ecology survey within the remnant Poplar Box woodland on alluvial plains (VC 2a) vegetation community (Figure 9.2).

11.1.4.5 Habitat assessment

The White-throated Needletail does not breed in Australia (Higgins 1996). During the non-breeding season in Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1,000 m above the ground (DAWE 2021a). While the species forages above most habitat types, the White-throated Needletail is predominantly recorded above wooded areas (TSSC 2019). The Project area contains areas of wooded and cleared areas which may provide foraging habitat for the species.

11.1.4.6 Impact assessment

Approximately 3371.7 ha of remnant vegetation (woodland habitat) has been identified within the study area (Figure 8.1). A total of 12.2 ha of remnant vegetation is proposed to be cleared for the Project and 96.9 ha is predicted to impacted by predicted potential for ponding. The impacts on White-throated Needletail habitat will add to habitat disturbance that is proposed to occur for other Projects in the region. The clearance of remnant vegetation/habitat for the Project will not fragment habitat for this highly mobile species.

An assessment of the significance of the Project impacts on the White-throated Needletail is provided in Section 11.1.4.9.

11.1.4.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the White-throated Needletail where practicable. The proposed avoidance and mitigation measures for the White-throated Needletail including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis is provided in Table 11.11.

Table 11.11: White-throated Needletail impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Project infrastructure has been located to avoid or minimise direct disturbance to remnant vegetation.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to woodland habitats.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	TSSC (2019), DoE (2015a)
Implement vegetation clearance protocols, including the delineation of vegetation adjoining proposed clearance areas to prevent accidental damage (Section 10.1.2).	Construction/ operations	Highly effective management technique to manage vegetation clearance activities.		

11.1.4.8 Statutory requirements

The following conservation, recovery and threat abatement information has been considered for assessment of the White-throated Needletail:

- The ‘Approved Conservation Advice for *Hirundapus caudacatus* (White-throated Needletail)’ (TSSC 2019), developed at the time of EPBC Act listing and the ‘*Hirundapus caudacutus*–White-throated Needletail’ SPRAT profile provides information about the White-throated Needletail, including its distribution, biology/ecology, threats and conservation actions and priorities.
- The SPRAT profile for this species indicates there is no adopted or made Recovery Plan for this species, as the approved conservation advice (TSSC 2019) provides sufficient direction to implement priority actions and mitigate against key threats and enable recovery.
- The ‘Draft Referral guideline for 14 birds listed as migratory species under the EPBC Act’ (DoE 2015a) provides information on 14 migratory species, including the White-throated Needletail. The referral guideline describes important non-breeding habitat for the White-throated Needletail.
- ‘Australia’s Strategy for Nature 2019–2020’ (Commonwealth of Australia 2019), Australia’s actions for nature including the ‘Threatened Species Strategy 2021–2031’ (Commonwealth of Australia 2021), ‘Australian Weeds Strategy 2017–2027’ (Commonwealth of Australia 2017a) and ‘Australian Pest Animal Strategy 2017–2027’ (Commonwealth of Australia 2017b) outline relevant actions to recover Australia’s threatened plants, animals and ecological communities.

Potential threats to the White-throated Needletail include (DAWE 2021a):

- collision with wind turbines and overhead wires;
- use of insecticides; and
- habitat loss and fragmentation (breeding habitat or non-breeding habitat).

The Project is not inconsistent with the objectives of the EPBC Act or Australia’s obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Conservation of Nature in the South Pacific (Apia Convention), the China–Australia Migratory Bird Agreement (CAMBA), the Japan–Australia Migratory Bird Agreement (JAMBA), the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA), Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) or other relevant international conventions. The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assess its likelihood of occurrence (Section 11.1.4.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.4.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.4.5);
- identified potential impacts of the Project on the species and its habitats (Sections 10 and 11.1.4.6);
- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.4.7); and
- assessed the significance of the impacts in accordance with the Commonwealth ‘Significant Impact Guidelines 1.1: Matters of National Environmental Significance’ (DoE 2013a) (Section 11.1.4.9).

11.1.4.9 Significant impact assessment

Table 11.12 provides an assessment of the likelihood of significant impacts on the White-throated Needletail in accordance with the Commonwealth ‘Significant Impact Guidelines 1.1: Matters of National Environmental Significance’ (DoE 2013a).

Table 11.12: White-throated Needletail significant impact assessment

Significance criteria	Assessment of significance
An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	Although two subspecies of White-throated Needletails breed in separate populations in the Northern Hemisphere, only one occurs in Australia where they do not occur as smaller populations (DAWE 2021a). The clearing of 12.2 ha of remnant vegetation for the Project and potential modification through occasional residual ponding of up to 96.9 ha of remnant vegetation is unlikely to decrease the size of the population given the extent of habitat available to this species across eastern and south-eastern Australia.
Reduce the area of occupancy of an important population	The population of the White-throated Needletail that may use habitat within the study area is considered not to be an important population. The extent of vegetation clearance required for the Project is unlikely to reduce the area of occupancy of this species. Tracts of native vegetation which can provide roosting habitat will remain within the Project area and is widespread in the region. The study area habitat will continue to provide aerial foraging habitat.
Fragment an existing important population into two or more populations	The White-throated Needletail migrates to Australia during the non-breeding season and is widespread across eastern and south-eastern Australia. The Project will not fragment the population into two of more populations.
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the White-throated Needletail listed on the Register of Critical Habitat. Habitat within the Project area does not represent habitat critical to the survival of the White-throated Needletail.
Disrupt the breeding cycle of an important population	The White-throated Needletail does not breed in Australia. The Project will not disrupt the breeding cycle.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Primarily an aerial species, the White-throated Needletail predominantly forages aerially, feeding on a wide variety of insects. They roost in forest and woodlands. While the Project will include some vegetation clearance, it will not reduce the quality or availability of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species habitat	Invasive species are not a serious threat to the White-throated Needletail. The Project is unlikely to result in invasive species that are harmful to the White-throated Needletail.
Introduce disease that may cause the species to decline	Disease is not a known threat to the White-throated Needletail. The Project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	There is no recovery plan for this species. Priority conservation actions identified for this species include working with governments in East Asia to minimise disturbance to breeding habitats and the identification and protection of important habitats in Australia (TSSC 2019). The Project is unlikely to substantially interfere with the recovery of the species.
Conclusion	The area of habitat proposed to be cleared and the importance of the habitat present indicate the Project is unlikely to have a significant impact on the White-throated Needletail.

11.1.5 Squatter Pigeon (Southern subspecies)

11.1.5.1 Description

The Squatter Pigeon (*Geophaps scripta scripta*) is listed as Vulnerable under the EPBC Act and NC Act.

The Squatter Pigeon occurs along the inland slopes of the Great Dividing Range, with a distribution from the Burdekin-Lynd divide in central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Gladstone and south to scattered sites throughout south-eastern Queensland (Cooper *et al.* 2014).

The Squatter Pigeon is known to occur in remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species, with grassy understories within 3 km of a suitable waterbody (DAWE 2021a). Habitat for the species consists of ground covering vegetation rarely not exceeding 33%, and the species requires bare patches of gravelly or dusty soil for foraging. Breeding habitat occurs in areas of similar vegetation on stony rises occurring on sandy or gravelly soils within 1 km of a suitable waterbody, typically associated with Queensland RE land zones 3, 5 or 7 (DAWE 2021a).

The Squatter Pigeon is known to access suitable waterbodies to drink on a daily basis. Waterbodies suitable for the subspecies include:

- permanent or seasonal rivers;
- creeks;
- lakes;
- ponds and waterholes; and
- artificial dams, where there is gently sloping, bare ground on which to approach and stand at the water's edge (DAWE 2021a; Kerswell *et al.* 2020).

The subspecies also prefers to forage and dust-bathe on bare ground under an open canopy of trees (DAWE 2021a). The subspecies is considered unlikely to move far from woodland trees, which provide protection from predatory birds. Where scattered trees still occur, and the distance of cleared land between remnant trees or patches of habitat does not exceed 100 m, individuals may be found foraging in, or moving across modified or degraded environments (DAWE 2021a).

The Squatter Pigeon’s diet consists of seeds, and the species mainly forages on seeds that have fallen to the ground from low vegetation, such as grasses, herbs and shrubs (DAWE 2021a). The Squatter Pigeon scrapes a depression into the ground beneath tussock grass, a bush or a fallen log to create a nest. Females typically lay two eggs that are incubated for 17 days, and once hatched, chicks remain within the nest for 2 to 3 weeks and continue to be dependent upon their parents for around four weeks once leaving the nest (Kerswell *et al.* 2020).

11.1.5.2 Desktop analysis

Desktop analysis of relevant databases has been conducted to identify records of the Squatter Pigeon within the vicinity of the Project (Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia). The desktop assessment also includes reviews of ecological surveys and assessments of nearby developments for information/records relating to the Squatter Pigeon.

The desktop analysis has identified numerous records for the species in the vicinity of the Project, which were identified during previous terrestrial ecology surveys for the Lake Vermont Mine (AARC 2012, AARC 2016) and other nearby developments, including Saraji East Mining Project to the west, Winchester South Project to the north-west and Olive Downs Project to the north.

Details of the desktop analysis are provided in Section 6.

Desktop analysis of Queensland government mapping, including regional ecosystem mapping, essential habitat mapping, land zone mapping and water sources was also conducted to determine the potential vegetation communities and soil types present and the extent of potentially suitable habitat for the Squatter Pigeon.

11.1.5.3 Survey effort

Fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6-19 November), autumn 2020 (23–25 March and 1–8 April), autumn 2021 (16–25 April), winter 2021 (16–20 August June)[4] and spring 2021 (6–10 September 2021)[5] over 50 days in consideration of relevant Commonwealth and Queensland survey guidelines. The surveys extended over both Brigalow Belt Bioregion survey timing windows; spring to early summer and autumn (Eyre *et al.* 2018).

Fourteen systematic survey sites were established during the surveys, with at least two sites established in each habitat type. Survey effort for the Squatter Pigeon included:

- active searching: 75 hours;
- diurnal bird surveys: 83 hours;
- camera trapping: 56 trap nights; and
- incidental recordings obtained from opportunistic observations while travelling within the general study.

Survey timing, methodology and effort met the requirements of the Commonwealth and Queensland guidelines. The Project area is greater than 50 ha, ruling out the need for flushing surveys, which are required under Commonwealth guidelines for small survey areas (<50 ha).

Further details of the survey timing, effort and methodology are provided in Section 7 and Appendix G.

11.1.5.4 Survey outcomes

The Squatter Pigeon has been recorded within the study area during the spring 2019, autumn 2020 and autumn 2021 surveys. In winter 2021, opportunistic observations by 3D Environmental recorded the Squatter Pigeon to the east of the study area near the Isaac River. Squatter Pigeons were recorded at six locations in the study area and the locations at which the Squatter Pigeon has been recorded in the study area are shown on Figure 11.5.

Based on field survey data (i.e., secondary site assessment; Neldner *et al.* [2020]), remnant vegetation and high value regrowth within the study area typically have a ground cover of less than 33%. While some locations include a high percentage of exotic Buffel Grass, native grass cover is common. Ground cover is not heterogeneous, and open areas were often encountered. Furthermore, grazing pressure was altered in April to June 2021 when cattle were removed from the property and this, accompanied by drought breaking rains in the following months, may have resulted in increased ground cover. Under these conditions, the local population may have shifted into surrounding lands where continued grazing ensured ground cover remained suitable. These changing conditions may explain their sporadic presence at the site and that, under different climatic conditions and grazing regime, it could play an important role for the location population.

11.1.5.5 Habitat assessment

Habitat mapping for the Squatter Pigeon within the study area is shown on Figure 11.5 and is based on the habitat descriptions outlined in Table 11.13. The habitat descriptions in Table 11.13 are based on the information contained in DAWE's Species Profiles and Threats (SPRAT) database, including the relevant statutory documents and published research specific to the distribution of habitat for the Squatter Pigeon within the study area.

Potential permanent, semi-permanent and seasonal water sources (watercourses, farm dams and wetlands) within the study area have been inspected by EcoSmart Ecology and AARC to determine their suitability as a water source for Squatter Pigeon breeding and foraging. The habitat assessment involved observations of the

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[4] Opportunistic observations of the Squatter Pigeon by David Stanton (3D Environmental) during the conduct of groundwater dependant ecosystem surveys.

[5] Opportunistic observations of the Squatter Pigeon during the conduct of threatened species habitat assessments (Mark Sanders, EcoSmart Ecology and AARC).

characteristics of the potential water source, the ground cover and other microhabitat features in areas surrounding the water source.

Table 11.13: Squatter Pigeon habitat description and occurrence

Habitat description	Relevant features present within the study area
Potential for breeding	
Remnant or regrowth open forest, woodland, open woodland or scrub, with relatively sparse (<33%) groundcover vegetation, typically an overstorey dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species within 1 km of suitable permanent or semi-permanent water bodies (DAWE 2021a).	Available literature suggests Squatter Pigeons have the potential to nest in areas of suitable habitat within 1 km of a permanent or semi-permanent water source. All areas of remnant and high-value regrowth within the site have been identified as suitable (subject to weather and grazing conditions). Permanent or semi-permanent water bodies identified within the study area include One Mile Creek, all farm dams and a selection of natural wetlands, which were assessed as providing a reliable source of water for breeding under most climatic conditions. Applying the 1 km buffer around these sources suggests breeding opportunity is possible within the areas shown on Figure 11.5. The ephemeral watercourses, Hughes Creek, Boomerang Creek and Phillips Creek, are characterised by sandy substrates. While water can be present in these streams following large rainfall events/flooding, the water quickly disappears within days or, at most, a few weeks. These streams do not provide a semi-permanent or permanent water source for the Squatter Pigeon.
Potential for climatic dependant breeding	
Remnant or regrowth open forest, woodland, open woodland or scrub with relatively sparse (<33%) groundcover vegetation, typically an overstorey dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species within 1 km of suitable seasonal water bodies.	A number of natural wetlands occur within the study area that do not provide a permanent or semi-permanent source of water. However, these natural wetlands may provide a suitable source of water under certain climatic conditions (e.g. in above average wet years). Remnant and high-value regrowth vegetation within 1 km of these natural wetlands may provide breeding habitat for the Squatter Pigeon under certain climatic conditions and have been mapped as 'opportunity for climatic dependant breeding'.
Suitable foraging habitat	
Remnant or regrowth open forest, woodland, open woodland or scrub with relatively sparse (<33%) groundcover vegetation, typically an overstorey dominated by *Eucalyptus, Corymbia, Acacia* or *Callitris* species within 3 km of suitable permanent, semi-permanent, or seasonal water bodies.	The areas mapped as remnant vegetation and high-value regrowth vegetation within the study area provide suitable groundcover for the Squatter Pigeon (subject to climatic conditions and grazing pressure) and have been mapped as suitable habitat where the vegetation occurs within 3 km of suitable permanent, semi-permanent, or seasonal water sources. The suitable water sources include those described above in 'potential for breeding' and 'opportunity for climatic breeding'. The ephemeral streams, Hughes Creek, Boomerang Creek and Phillips Creek, are considered not to provide a suitable seasonal source of water. Grass cover in the cleared agricultural areas is typically much greater than 33% and unsuitable foraging habitat for the Squatter Pigeon. There is some opportunity for Squatter Pigeon to forage in the immediate vicinity of farm dams, where cattle grazing prohibits grass growth, and along property access tracks. However, these areas are considered unlikely to provide extensive foraging opportunities for the species.

Habitat description	Relevant features present within the study area
Dispersal habitat	
Any forest or woodland occurring between patches of foraging or breeding habitat and suitable waterbodies—includes areas of cleared land less than 100 m wide linking areas of suitable breeding or foraging habitat.	Dispersal habitat has been defined to include any remnant and regrowth open forest or woodland occurring between patches of foraging and breeding habitat and areas of cleared land (less than 100 m wide) that link areas of suitable habitat.

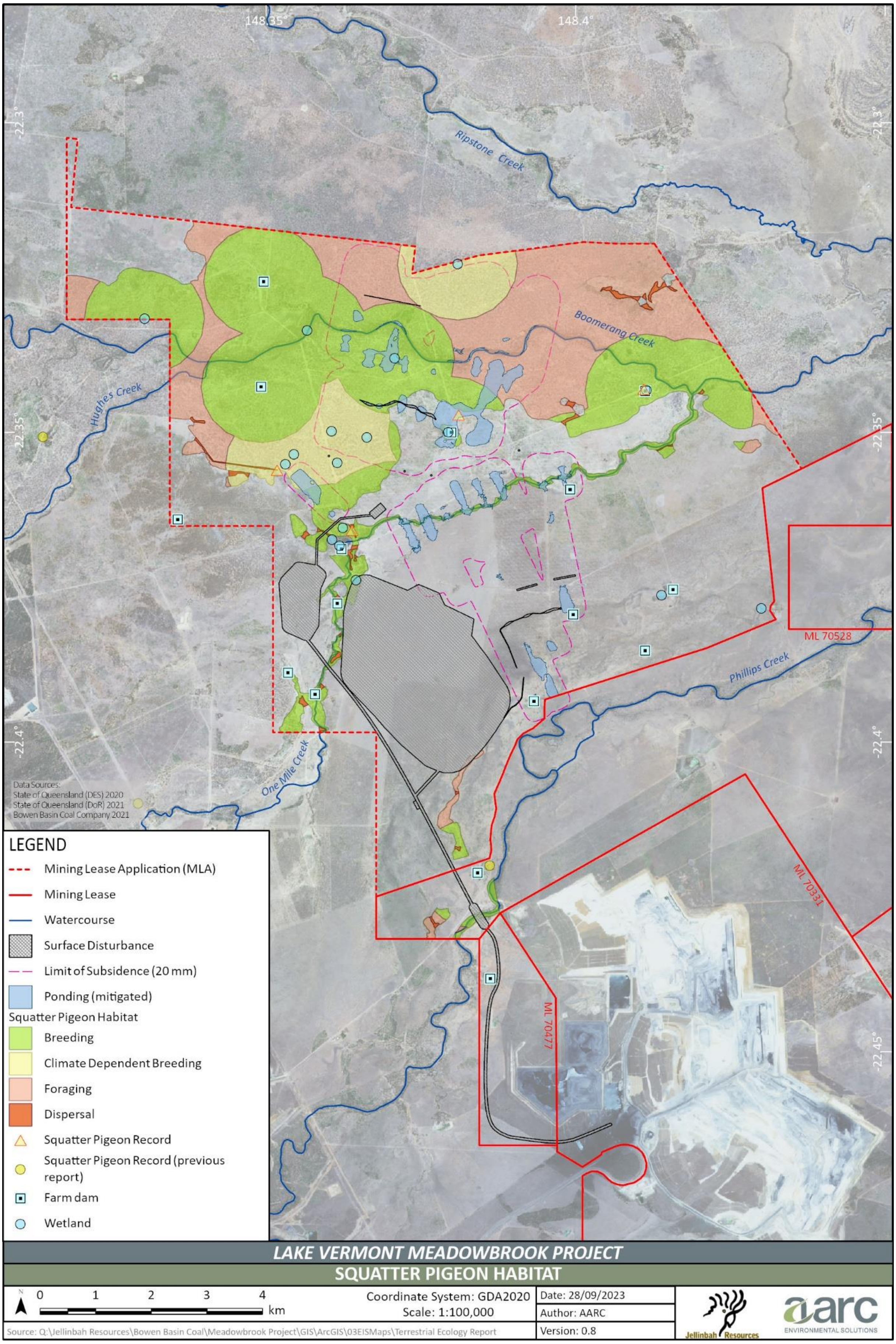

Figure 11.5: *Squatter Pigeon habitat mapping*

11.1.5.6 Impact assessment

A total of 3539.2 ha of Squatter Pigeon habitat has been identified within the study area, including 1869.7 ha of potential breeding habitat, 459.4 ha of potential climate dependent breeding habitat and 1181.1 ha of additional foraging habitat (i.e. additional to the foraging habitat provided by the potential breeding areas) (Table 11.14 and Figure 11.5). A total of 15.8 ha of Squatter Pigeon habitat is proposed to be cleared for the direct surface disturbance of Stages 1, 2, 3 and 4 of the Project, including:

- 12.8 ha of potential breeding habitat;
- 0.3 ha of potential climate dependent breeding habitat;
- 2.7 ha of additional foraging habitat; and
- 29 ha of dispersal habitat.

The Project will result in impacts on Squatter Pigeon habitat, which will add to habitat disturbance that is proposed to occur for other Projects in the region.

The land disturbance associated with the Project (e.g. infrastructure corridor and MIA) will result in some fragmentation of Squatter Pigeon habitat; however, this is unlikely to be significant given the mobility of this species.

A total of 990.3 ha of Squatter Pigeon habitat is within the proposed subsidence footprint and a further 103.6 ha of habitat within the subsidence footprint and predicted to undergo periodic ponding. The potential indirect impacts of subsidence are discussed in Section 10.2. No direct impacts to vegetation are expected to result from subsidence and the Squatter Pigeon habitat characteristics within the subsidence area are expected to be maintained. Soil cracks are predicted to develop in the subsidence area, however given the monitoring and management of potential soil cracks and which will be detailed within the Subsidence Management Plan the quality or availability of Squatter Pigeon habitat within the subsidence footprint is considered unlikely to be impacted.

The expected impacts in areas predicted to undergo periodic ponding are described in Section 10.2.4. Squatter Pigeon habitat in areas of predicted ponding is expected to retain vegetation characteristics required for provide suitable habitat of open forest, woodland, open woodland or scrub with relatively sparse (<33%) groundcover vegetation.

The areas of predicted residual ponding are expected to represent a potential change of habitat, not a removal of habitat. These areas are predicted to experience inundation every few years and retain water for several months. The predicted ponding of water in these areas will create an expansion of the potential climatic-dependent breeding habitat into areas that currently provide foraging habitat but do not support breeding habitat because of their distance to water. The availability of Squatter Pigeon habitat is expected to be retained in predicted ponding areas and the quality of habitat is expected to change through the expansion of breeding and climatic dependent breeding areas.

The extent of flooding in the study area is predicted to increase along the margins of subsided panels; the changes to flood levels and extent are not considered significant (WRM 2022). The impacts of changes to flooding regimes on Squatter Pigeon habitat are, therefore, not expected to be significant. Potential or likely GDEs were identified within the study area however assessed to be unlikely to be significantly impacted by the Project (3D Environmental 2022). Therefore, groundwater impacts are considered unlikely to impact Squatter Pigeon habitat.

The potential for indirect impacts on the Squatter Pigeon from noise and vibration, dust, lighting and vehicle strike are considered to be minimal given the measures that will be implemented to manage these impacts. Impacts of erosion and subsidence related cracking are assessed in Section 10.2 and Section 10.11. Given the proposed monitoring and management measures for erosion, no substantial erosion is expected to occur and it is considered unlikely that erosion will impact Squatter Pigeon habitat. The Project also has the potential to increase weed and animal pest populations if they are not appropriately managed. However, as described in Section 11.1.5.7, weed and pest management measures will be implemented for the Project.

The identification of impacts to Squatter Pigeon habitat in the study area includes consideration of potential impacts from climate change and adjoining projects that have been incorporated into hydrological modelling

(WRM 2022). It is considered that the assessment has, therefore, taken into account cumulative sources of impact, and no further cumulative impacts to Squatter Pigeon habitat will occur. Further discussion of cumulative impacts is provided in Section 10.12.

An assessment of the significance of the impacts on the Squatter Pigeon is provided in Section 11.1.5.9.

Table 11.14: Proposed Project footprint within Squatter Pigeon habitat

Habitat amenity	**Extent within study area (ha)**	**Extent of direct disturbance (ha)**		**Extent of subsidence impact (ha)[a]**	**Extent of predicted ponding impact (ha)**
		Stages 1, 2, 3 clearing (ha)	**Stage 4 clearing (ha)**		
Breeding	1,869.7	5.7	7.1	373.5	62.6
Climate-dependent breeding	459.4	0.3	0.0	273.1	8.9
Foraging	1,181.1	0.5	2.2	343.7	31.5
Dispersal	29.0	<0.1	0	0	0.6
Total	**3,510.2**	**6.5**	**9.3**	**990.3**	**103.6**

[a] Excludes predicted ponding areas

11.1.5.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Squatter Pigeon where practicable. The proposed avoidance and mitigation measures for the Squatter Pigeon include:

- timing;
- predicted effectiveness;
- monitoring; and
- adaptive management.

The relevant statutory or policy basis is provided in Table 11.15.

Table 11.15: Squatter Pigeon impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Project infrastructure will be located to minimise direct disturbance to Squatter Pigeon habitat.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to Squatter Pigeon habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	TSSC (2015b)
Disturbance areas will be delineated to prevent accidental damage to adjacent Squatter Pigeon habitat.	Construction/ operations	Highly effective management technique to manage Project disturbance activities.		
Regularly inspect mine-related surface disturbance areas and Bowen Basin Coal owned land to identify areas requiring weed management measures to be implemented. Implement weed management measures (e.g. mechanical removal and application of approved herbicides).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the spread and occurrence of weeds.	Monitoring and management of weeds in accordance with Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts, or alternative control strategies) will be implemented, as necessary.	TSSC (2015b), Commonwealth of Australia (2017a), Qld Department of Agriculture and Fisheries weed control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of the site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	TSSC (2015b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests if site protocols are followed by personnel.	Regular monitoring of site will be carried out by environmental personnel. Monitoring and auditing of the Waste Management Plan to be updated for the Project. Additional measures (such as provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals	TSSC (2015b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)
Monitor pest animal populations and implementation of pest control measures in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests	Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	TSSC (2015b), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoE (2015b), DoEE (2016b), DEWHA (2008b)
Consult with the Isaac Regional Council and neighbouring mines in relation to weed and pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Audits will be implemented to monitor the consultation outcomes and the management measures will be implemented on site.	TSSC (2015b), Commonwealth of Australia (2017a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Bushfire prevention and management measures will be outlined in the Emergency Response Plan. Inductions of mine site personnel will include fire awareness.	Construction/ operations/ rehabilitation and decommissioning	Effective management procedure to reduce the risk of bushfire.	Any incidence of bushfire will be investigated to determine the requirement for additional controls. Potential adaptive management measures include revision of the Emergency Response Plan and/or a program to increase personnel awareness of bushfire risk (e.g. through tool box talks).	TSSC (2015b)

11.1.5.8 Statutory requirements

A number of conservation, recovery and threat abatement plans are relevant to the Squatter Pigeon and have been considered in assessment of the Squatter Pigeon:

- The 'Conservation Advice for *Geophaps scripta scripta* (Squatter Pigeon [southern])' (TSSC 2015b), developed at the time of EPBC Act listing and '*Geophaps scripta scripta*–Squatter Pigeon (southern)' SPRAT profile provides information about the species, including its distribution, biology/ecology, threats and conservation actions and priorities.
- The SPRAT profile for this species indicates that there is no adopted or made Recovery Plan for this species, as the approved conservation advice (TSSC 2015b) provides sufficient direction to implement priority actions and mitigate against key threats.
- The 'Survey guidelines for Australia's threatened birds' (DEWHA 2010a) includes information on Squatter Pigeon and recommended methods for survey.
- Three threat abatement plans are listed in the SPRAT profile (DAWE 2021a) as being relevant to the Squatter Pigeon, namely:
    1) Department of the Environment (Commonwealth of Australia 2015) Threat abatement plan for predation by feral cats;
    2) Department of the Environment and Energy (2016b) Threat abatement plan for competition and land degradation by rabbits;
    3) Department of the Environment, Water, Heritage and the Arts (DEWHA 2008b) Threat abatement plan for predation by the European red fox.

    A threat abatement plan is a plan made or adopted under section 270B of the EPBC Act which establishes a national framework to guide and coordinate Australia's response to the impacts of a key threatening process.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019), Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

Threats to the Squatter Pigeon (southern) include (DAWE 2021a):

- habitat loss and fragmentation;
- habitat degradation by overgrazing by stock, especially cattle;
- habitat degradation by the establishment of invasive pasture species including Buffel Grass (*Cenchrus ciliaris*); and
- predation by species, including the Fox (*Vulpes vulpes*), Dingo (*Canis familiaris dingo*), and Feral Cat (*Felis catus*).

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or Convention on Conservation of Nature in the South Pacific (Apia Convention). The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assess its likelihood of occurrence (Section 11.1.5.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.5.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.5.5);
- identified potential impacts of the Project on the species and its habitat (Sections 10 and 11.1.5.6);

- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.5.7); and
- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) (Section 11.1.5.9).

11.1.5.9 Significant impact assessment

Table 11.16 provides an assessment of the likelihood of significant impacts on the Squatter Pigeon in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

The Squatter Pigeon population occurring at the study area is not part of the sub-population occurring south of the Carnarvon Ranges, which is an important sub-population (DAWE 2021a). The species occurs regularly north of the Carnarvon Ranges and is considered one population occurring commonly throughout the northern range. The population occurring at the study area is part of this northern population that has connectivity across a large area for dispersal and breeding.

The Squatter Pigeon range extends south to northern NSW, north to Mackay and west to near Longreach. Therefore, the population occurring at the study area is not located near the limit of the species range.

Therefore, the Squatter Pigeon occurring at the study area is neither:

- a key source population for breeding or dispersal;
- a population that is necessary for maintaining genetic diversity; nor
- a population that is near the limit of the species range

The population of Squatter Pigeon that uses the study area is considered unlikely to be an important population according to the criteria of the Significant Impact Guidelines (DoE 2013a).

Table 11.16: Squatter Pigeon significant impact assessment

Significance criteria	**Assessment of significance**
An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The population of Squatter Pigeon that uses habitat within the study area is considered not to be an important population. It is considered that the removal of 15.8 ha of Squatter Pigeon habitat will not lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The population of Squatter Pigeon that uses habitat within the study area is considered not to be an important population. The removal of 15.8 ha of Squatter Pigeon habitat is considered unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	The population of Squatter Pigeon that uses the habitat within the study area is considered not to be an important population. The removal of 15.8 ha of Squatter Pigeon habitat is considered unlikely to fragment an existing important population into two or more populations.

Significance criteria	Assessment of significance
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the Squatter Pigeon listed on the Register of Critical Habitat (DAWE 2021a). The Squatter Pigeon habitat to be impacted by the Project is considered not critical to the survival of the species as, while the habitat is used by a local population of the species, the areas are unlikely to be necessary for the species as a whole for activities such as: • foraging; • breeding; • roosting; • dispersal; • the long-term maintenance of the species; • maintaining genetic diversity; and • for the reintroduction or recovery of the species.
Disrupt the breeding cycle of an important population	The population of Squatter Pigeon that uses habitat within the study area is considered not to be an important population. The removal of 15.8 ha of Squatter Pigeon habitat is considered unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project requires the removal of 15.8 ha of Squatter Pigeon habitat, including 12.8 ha of potential breeding habitat, 0.3 ha of potential climate dependent breeding habitat and 2.7 ha of foraging habitat. The removal of this extent of habitat is unlikely to lead to a long-term decline in the species population given the wider extent of habitat for this species.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species habitat	The study area is located in a modified rural landscape, and invasive species that are harmful to the Squatter Pigeon exist in the broader region. Predatory species, including feral cat and feral fox, have been recorded and are established in the study area and are recognised threats to the Squatter Pigeon. Buffel grass, which can change understory cover, is already established throughout the study area. The Project is unlikely to result in the introduction and establishment of any invasive species that are harmful to the Squatter Pigeon in the habitat present in the study area. Monitoring and management of pests including corrective actions will be implemented in accordance with a Weed and Pest Management Plan (Section 10.5).
Introduce disease that may cause the species to decline, or	No diseases are listed as a threat to the Squatter Pigeon. The Project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	There is no adopted or made Recovery Plan for this species. The approved conservation advice provides direction to implement priority actions for this species and mitigate against key threats (TSSC 2015b). Priority conservation and management actions include the identification of sub-populations of high conservation priority, development of conservation agreements and control of feral herbivores. The Project is unlikely to substantially interfere with the recovery of the species.
Conclusion	The Project is considered unlikely to result in a significant impact to the Squatter Pigeon. The area of habitat to be disturbed by the Project is a very small proportion of the mapped habitat for the species, both within the study area and the wider region. The impacted habitat is considered not to be utilised by an important population. The predicted subsidence will also provide areas of intermittent ponding which may support the expansion of breeding habitat within the study area through the provision of seasonal water sources.

11.1.6 Australian Painted Snipe

11.1.6.1 Description

The Australian Painted Snipe (*Rostratula australis*) is listed as Endangered under the EPBC Act and NC Act. It is also listed as a migratory species and marine species under the EPBC Act.

The Australian Painted Snipe is known to occur within wetlands within all states of Australia (DAWE 2021a). This species is most common in eastern Australia where it has been recorded throughout much of Queensland, New South Wales, Victoria and south-eastern South Australia at scattered locations (DAWE 2021a). The species is widespread and is considered not to have a limited geographic distribution (DSEWPaC 2013a). The species is considered to occur in Australia as a single contiguous breeding population (DAWE 2021a).

Habitat for the Australian Painted Snipe includes a variety of shallow wetlands, including temporary and permanent lakes, swamps and claypans (DAWE 2021a). The Australian Painted Snipe forages at the waters' edge and on mudflats (Garnett and Crowley 2000) and eats vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates (Marchant & Higgins 1993). Nesting nearly always occurs on small islands or wetlands with complex shorelines, shallow water, exposed mud, with patchy to continuous vegetation surrounding the wetland (Rogers *et al.* 2005). Although the species can utilise modified habitats for foraging, they do not breed within areas that lack suitable cover. This species is mainly crepuscular (active at dawn and dusk) and highly cryptic.

The species requires wetland areas and will move to suitable habitat when the habitat becomes unavailable in an area (DAWE 2021a). Dispersive movements have been attributed to local conditions (i.e. moving to flooded areas, moving from drying to permanent wetlands and moving away from areas affected by drought). (DAWE 2021a).

11.1.6.2 Desktop analysis

Desktop analysis of relevant databases has been conducted to determine records of the Australian Painted Snipe within the vicinity of the Project, including Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia occurrence records. The desktop assessment also includes a review of ecological survey and assessments for nearby developments for information/records relating to the Australian Painted Snipe. Details of the desktop analysis are provided in Section 6, Appendix B and Appendix C.

Very few records of this species have been identified in the region despite the extensive environmental impact assessment surveys conducted for mining developments. Within the vicinity of the Project, this species was observed by SKM in an area of flooded *Acacia harpophylla* (Brigalow) woodland within the Saraji East Project site in 2007 (BMA 2021), by Ecological Survey & Management (2013) within the Winchester South Project site within a Brigalow lined waterway (Whitehaven Coal 2021), and by DPM Envirosciences (2018a) in a small wetted gilgai within agricultural grasslands within the Olive Downs Project site. The Australian Painted Snipe has not previously been recorded by surveys conducted for the existing Lake Vermont Mine (Appendix B). The species is considered a vagrant visitor only to the region, likely using wetlands on passage to more suitable foraging and breeding grounds.

Desktop analysis of Queensland government mapping includes a review of wetland mapping and identification of areas that may have the potential to provide habitat for the Australian Painted Snipe.

11.1.6.3 Survey effort

Fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April), autumn 2021 (16–25 April) and spring 2021 (6–10 September) over 50 days in consideration of relevant Commonwealth and Queensland survey guidelines. The surveys extended over both Brigalow Belt Bioregion survey timing windows: spring to early summer and autumn (Eyre *et al.* 2018).

Fourteen systematic survey sites were established during the surveys, with at least two sites established in each habitat type. Survey effort for the Australian Painted Snipe included:

- active searching: 75 hours;
- diurnal bird surveys: 83 hours;
- spotlighting: 47 hours; and
- 0pportunistic observations in suitable habitat.

Survey timing, methodology and effort meet the requirements of the Commonwealth and Queensland guidelines.

11.1.6.4 Survey outcomes

The Australian Painted Snipe was not detected by the seasonal fauna surveys. Most water bodies within the site are considered not suitable, as they lack a complex mosaic of shallow water, open mudflats and clumping vegetation. This includes almost all farm dams. Where habitat is present, it is minor in extent and low in amenity. The species might only occur as a rare vagrant.

11.1.6.5 Habitat assessment

Habitat mapping for the Australian Painted Snipe within the study area is shown on Figure 11.6 and is based on the habitat descriptions outlined in Table 11.17. It should be noted that the extent of the low amenity is likely less than indicated due to thick exotic grass growth in some areas. The habitat descriptions in Table 11.17 are based on the information contained in DAWE's Species Profiles and Threats (SPRAT) database, including relevant statutory documents and published research specific to the distribution of potential habitat for the Australian Painted Snipe within the study area.

Habitat assessment for the Australian Painted Snipe involved inspection of permanent, semi-permanent and seasonal water sources by EcoSmart Ecology and AARC to assess their suitability for Australian Painted Snipe breeding and/or foraging in relation to:

- water body size;
- water retention;
- presence of mudflats; and
- structure of aquatic and fringing vegetation.

Table 11.17: Australian Painted Snipe habitat description

Habitat description	Features present within the study area relevant to habitat category
Breeding habitat	
Wetlands with a complex shoreline with a mosaic of open mud areas, shallow waters (<5cm) and surrounding groundcover vegetation—clumping vegetation, such as tufted grasses, sedges, small woody plants and continuous reed beds or stands of reed-like vegetation (not including tall dense reed beds such as Cumbungi). Nests are placed on small islands.	Not present within the study area; wetlands within the study area are minor in extent and lack the complex microhabitat features required for this species breeding.
Intermittent foraging habitat	
Shallow permanent or ephemeral freshwater or brackish wetlands and other inundated/waterlogged areas with a variable ground cover (e.g. grasses, shrubs and rushes).	Site habitat assessments indicate the wetland and gilgai habitats within the study area provide the most suitable marginal (low amenity), intermittent foraging habitat for the Australian Painted Snipe. This includes one natural palustrine wetland and two modified wetlands (palustrine and lacustrine). Less suitable marginal (low amenity) habitat is provided by wetted gilgai habitat is only available for a short period after rainfall when the gilgai are full. Inspections of farm dams within the study area indicate they do not provide suitable foraging habitat for the Australian Painted Snipe.

While there is potential for transient Australian Painted Snipes to utilise the intermittent foraging habitat in the study area under suitable climatic conditions, the low amenity value of the foraging habitat suggests there is a low likelihood of this species occurring during the life of the mine.

11.1.6.6 Impact assessment

A total of 1242.2 ha of Australian Painted Snipe intermittent foraging habitat has been identified within the study area including 14.2 ha of the most suitable habitat (palustrine and lacustrine wetland areas) and 1228 ha of low amenity foraging habitat (Figure 11.6). A total of 34.2 ha of Australian Painted Snipe habitat is proposed to be disturbed by Stage 1 of the Project and 4.2 ha is proposed to be disturbed by Stage 4 (Table 11.18). The Project will result in impacts on Australian Painted Snipe which, while low in habitat amenity, will add to habitat disturbance that is proposed to occur for other Projects in the region.

The areas of residual ponding occur over a 29.5 ha portion of the identified Australian Painted Snipe habitat. These areas are expected to represent a change of habitat; the ponded areas are likely to hold water for a maximum period of several months every few years depending on inflow volumes and soil permeability (WRM 2022), which is likely longer than the habitat currently holds water. This would potentially provide an increase of habitat suitability in these areas. The residual ponding areas also extend outside of the mapped Australian Painted Snipe foraging habitat, and the ponding in these areas may allow these previously unsuitable areas to provide some low amenity foraging habitat to the Australian Painted Snipe.

The extent of flooding in the study area is predicted to increase along the margins of subsided panels; however, the changes to flood levels and extent are considered not significant (WRM 2022). The impacts of changes to flooding regimes on Australian Painted Snipe habitat are, therefore, not expected to be significant.

The potential for indirect impacts to the Australian Painted Snipe from noise and vibration, dust, lighting and vehicle strike is considered to be minimal given the measures that will be implemented to manage these impacts and the low likelihood of its occurrence given more suitable habitats exist in the surrounds and in the wider region. The Project also has the potential to increase weed and animal pest populations if they are not appropriately managed. However, as described in Section 11.1.6.7, weed and pest management measures will be implemented for the Project.

An assessment of the significance of the impacts on the Australian Painted Snipe is provided in Section 11.1.6.9.

Table 11.18: Proposed disturbance of Australian Painted Snipe habitat

Habitat amenity	**Extent within study area (ha)**	**Extent of direct disturbance (ha)**	
		Stages 1,2,3 clearing (ha)	**Stage 4 clearing (ha)**
Most suitable marginal (low amenity)	14.2	0.3	0.0
Marginal (low amenity)	1228.0	33.9	4.2
Total	**1242.2**	**34.2**	**4.2**

11.1.6.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Australian Painted Snipe where practicable. The proposed avoidance and mitigation measures for the Australian Painted Snipe including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis is provided in Table 11.19.

Table 11.19: Australian Painted Snipe impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Project infrastructure has been located to minimise direct disturbance to Australian Painted Snipe habitat.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to Australian Painted Snipe habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	TSSC (2013b); DSEWPaC (2013a), Ponce Reyes *et al.* (2016)
Disturbance areas will be delineated to prevent accidental damage to adjacent Australian Painted Snipe habitat.	Construction/ operations	Highly effective management technique to manage Project disturbance activities.		
Design and undertake subsidence drainage management works to minimise hydrological changes to gilgai and wetland habitats that provide potential foraging habitat for the Australian Painted Snipe.	Mine planning/operations	The hydrological modelling (WRM 2022) indicates the subsidence mitigation works will be effective in minimising the hydrological changes that will occur as a result of mine subsidence to gilgai and wetland habitats.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Audit(s) will be conducted, and follow-up corrective measures (e.g. additional drainage works) will be implemented, as required.	DoE (2015e), TSSC (2013b); DSEWPaC (2013a), Ponce Reyes *et al.* (2016)
Implement erosion and sediment control measures.	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for erosion and sedimentation.	Monitoring will be conducted of the integrity and effectiveness of implemented erosion and sediment controls in accordance with the Erosion and Sediment Control Plan to be prepared for the Project. Adaptive management measures (such as installation of additional erosion controls or increase in frequency of inspections) will be implemented, as required.	TSSC (2013b); DSEWPaC (2013a), Ponce Reyes *et al.* (2016)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Implement measures to reduce the risk of the introduction of pollutants (e.g. bunding or containment of hydrocarbon storages, provision of spill kits).	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for leaks and spills or other pollutants being introduced to Australian Painted Snipe habitat.	Visual inspections will be conducted of containment measures at MIA. Maintenance or implementation of additional controls will be carried out as required to maintain integrity and effectiveness. Management measures will be audited to identify potential system improvements.	TSSC (2013b); DSEWPaC (2013a), Ponce Reyes *et al*. (2016)
Regularly inspect mine-related surface disturbance areas and Bowen Basin Coal owned land to identify areas requiring weed management measures to be implemented. Implement weed management measures (e.g. mechanical removal and application of approved herbicides).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the spread and occurrence of weeds.	Monitor and manage weeds in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts, or alternative control strategies) will be implemented, as necessary.	TSSC (2013b), Commonwealth of Australia (2017a), Qld Department of Agriculture and Fisheries weed control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	TSSC (2013b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests if site protocols are followed by personnel.	Regular monitoring of site will be carried out by environmental personnel. The Waste Management Plan will be monitored and audited to suit the required conditions of the Project. Additional measures (such as the provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals	TSSC (2013b), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)
Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be prepared for the Project.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	TSSC (2013b), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoE (2015b), DEWHA (2008b)
Consult with the Isaac Regional Council and neighbouring mines in relation to weed and pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Audits will be implemented to monitor the consultation outcomes and the management measures implemented on site.	TSSC (2013b), Commonwealth of Australia (2017a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)

11.1.6.8 Statutory requirements

The following conservation, recovery and threat abatement information has been considered for assessment of the Australian Painted Snipe:

- The 'Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe)' (DSEWPaC 2013a), 'Commonwealth Listing Advice on *Rostratula australis* (Australian Painted Snipe' (TSSC 2013b) and '*Rostratula australias*–Australian Painted Snipe' SPRAT profile provides information in relation to its population and distribution, habitat, movements and feeding and guidance on threat abatement and recovery actions that can be undertaken for the species.
- The SPRAT profile for this species indicates there is no adopted or made Recovery Plan for this species; however, a Recovery Plan is required. A 'Draft National Recovery Plan for the Australian Painted Snipe–*Rostratula australis*' (DoEE 2019d) provides information on current threats and recovery actions.
- The 'Survey guidelines for Australia's threatened birds' (DEWHA 2010a) includes information on the Australian Painted Snipe and recommended methods for survey.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019), Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021), 'Australian Weeds Strategy 2017–2027' (Commonwealth of Australia 2017a) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

Threats to the Australian Painted Snipe include (DAWE 2021a, DoEE 2019d):

- loss and degradation of wetland habitat due to:
  - drainage of wetlands and diversion of water to agriculture and reservoirs;
  - deterioration of water quality;
  - grazing and associated trampling of wetland vegetation by cattle and/or sheep;
  - the replacement of endemic wetland vegetation by invasive weeds;
  - climate variability and change; and
  - degradation of habitat by invasive herbivores, such as the Feral Pig, Goat and Deer;
- predation by feral species, such as the European Red Fox and Feral Cat;
- inappropriate fire regimes; and
- low genetic diversity.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Conservation of Nature in the South Pacific (Apia Convention), the China–Australia Migratory Bird Agreement (CAMBA), the Japan–Australia Migratory Bird Agreement (JAMBA), the Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA) or Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assess its likelihood of occurrence (Section 11.1.6.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.6.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.6.5);
- identified potential impacts of the Project on the species and its habitats (Sections 10 and 11.1.6.6);

- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.1.7); and
- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) (Section 11.1.6.9).

11.1.6.9 Significant impact assessment

Table 11.20 provides an assessment of the likelihood of significant impacts on the Australian Painted Snipe in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

Table 11.20: Australian Painted Snipe significant impact assessment

Significance criteria	**Assessment of significance**
An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000). As the Project will not disturb breeding habitat, it is unlikely to disrupt the breeding cycle of the Australian Painted Snipe. The extent of Project disturbance to low amenity intermittent foraging habitat is unlikely to lead to a long-term decrease in the size of the population given the extent of foraging habitat available in the wider region. The Project is highly unlikely to decrease the size of a population.
Reduce the area of occupancy of the species	The Australian Painted Snipe has not been recorded by the Project surveys. While the Project will disturb potential intermittent foraging habitat for the Australian Painted Snipe, it is unlikely to reduce the area of occupancy of the species given similar (and higher amenity) wetland and floodplain habitats occur within the local area and wider region.
Fragment an existing population into two or more populations	The Australian Painted Snipe has been recorded at wetlands in all states of Australia. However, it is most common in eastern Australia where it has been recorded throughout much of Queensland, New South Wales, Victoria and south-eastern South Australia at scattered locations (DoEE 2019c and DoEE 2019d). Connectivity of habitat will not be compromised by the Project for this mobile species. The Project will not fragment the population into two of more populations.
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the Australian Painted Snipe listed on the Register of Critical Habitat (DAWE 2021a). The habitat to be disturbed by the Project is considered not critical to the survival of the species, as it is unlikely to be necessary for activities such as foraging, breeding, roosting, dispersal, long-term maintenance of the species, maintaining genetic diversity or recovery of the species.
Disrupt the breeding cycle of a population	The Project will not disturb breeding habitat for the Australian Painted Snipe and is unlikely to disrupt the breeding cycle of the population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No potential breeding habitat will be disturbed by the Project. Up to 38.4 ha of potential intermittent marginal foraging habitat for the Australian Painted Snipe may be directly disturbed by the Project. However, this is unlikely to cause the species to decline given the availability of foraging resources in the local and wider area. As described in Section 10.3.2, changes to the flooding regime within the study area and surrounds are predicted to be minor and are unlikely to affect the availability of habitat for this species. Potential indirect impacts associated with the Project, such as weeds and pest animals will be managed so they do not degrade retained habitat within the study area. The Project is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Significance criteria	Assessment of significance
Result in invasive species that are harmful to a Critically Endangered or Endangered species becoming established in the Endangered or Critically Endangered species' habitat	Land within the study area is currently used for low intensity cattle grazing. Grazing and associated trampling of wetland vegetation by cattle is recognised as a potential threat to this species' habitat. Predation by feral species, such as the European Red Fox and Feral Cat, is also a recognised threat; both have been recorded in the study area. Invasive herbivores, including the Feral Pig and Red Deer, have also been recorded in the study area. The Project is unlikely to increase these threats or result in invasive species becoming established in the species' habitat.
Introduce disease that may cause the species to decline	Disease is not a known threat to this species. There are no indications of disease threatening the population of the Australian Painted Snipe. The Project is unlikely to introduce a disease that may cause the species to decline.
Interfere with the recovery of the species	While there is currently no adopted Recovery Plan for this species, the 'Draft National Recovery Plan for the Australian Painted Snipe –*Rostratula australis*' (DoEE 2019d) outlines recovery objectives and strategies to improve the conservation status of the species. The five key strategies identified to achieve the Draft Recovery Plan objectives are: 1) Manage and protect known Australian Painted Snipe breeding habitats at the landscape scale. 2) Develop and apply techniques to measure changes in population trajectory in order to measure the success of recovery actions. 3) Reduce or eliminate threats at breeding and non-breeding habitats. 4) Improve knowledge of the habitat requirements, biology and behaviour of Australian Painted Snipe. 5) Engage community stakeholders to improve awareness of the conservation of Australian Painted Snipe. 6) Coordinate, review and report on recovery process. The Project is unlikely to interfere with the recovery of the species.
Conclusion	The Project is considered unlikely to significantly impact the Australian Painted Snipe.

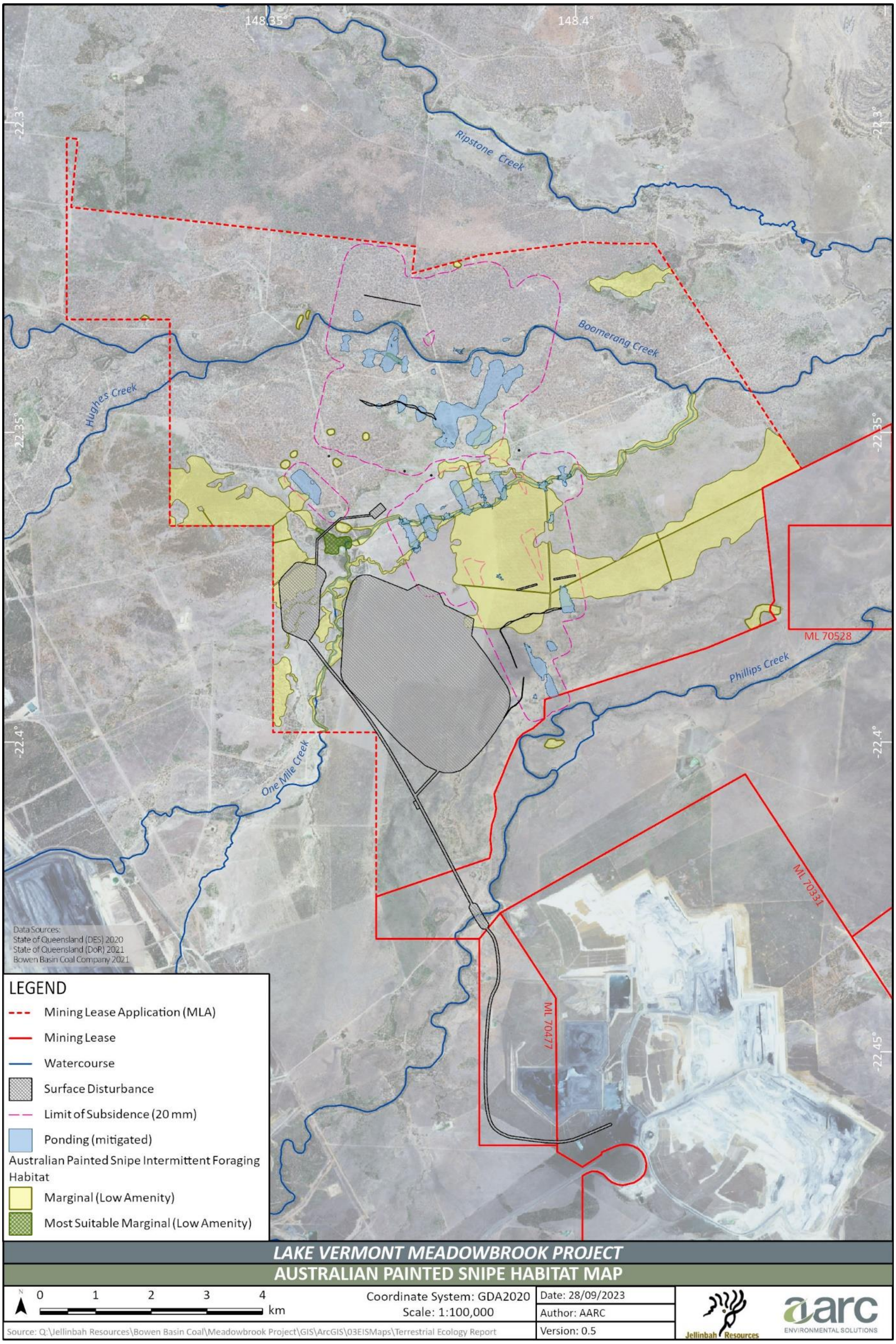

Figure 11.6: Australian Painted Snipe habitat mapping

11.1.7 Koala

11.1.7.1 Description

The Koala (*Phascolarctos cinereus*) was listed as Vulnerable under the NC Act and the EPBC Act at the time of the controlled action decision for the Project. Since this time, it is acknowledged that the listing status for the Koala has been upgraded to Endangered under the NC Act and the EPBC Act. While the updated conservation advice for this species has been considered, ecological surveys and impact assessment have been undertaken using the criteria that applied at the time of the controlled action decision (not applied retrospectively).

The Koala is known to occur in temperate to tropical forest, woodland and semi-arid communities, in areas that contain known Koala food trees, or shrubland with emergent food trees (DoE 2014a). The koala is a leaf-eating specialist that feeds primarily during dawn, dusk or at night (DoE 2014a). Diet is restricted mainly to *Eucalyptus* species; however, it may also consume foliage of related genera, including *Corymbia, Angophora* and *Lophostemon*. The Koala is also known to supplement its diet with other genera at times, including *Leptospermum* and *Melaleuca* (DoE 2014a).

Koalas tend to move little under most conditions, changing trees only a few times each day (Ellis *et al.* 2009). Dispersing individuals, mostly young males, may occasionally cover distances of several kilometres over land with little vegetation (DAWE 2021a).

Shelter trees play an essential role in thermoregulation and are likely to be selected based on height, canopy cover and elevation (i.e. trees occurring in gullies are preferable) (Crowther *et al.* 2013). A growing body of evidence suggests that shelter trees are equally important as food trees and should be weighted as such when assessing habitat suitability (Crowther *et al.* 2013).

Preferred food and shelter trees are naturally abundant on fertile clay soils, and the highest densities of Koalas are likely to occur along creek lines (DoEE 2019c, TSSC 2012a, DSEWPaC 2012a). A potential Koala habitat tree is considered to be a tree of the *Corymbia, Melaleuca, Lophostemon, Eucalyptus* genera that is edible by koalas or *Angophora* genus with a trunk diameter greater than 10 cm at 1.3 m above ground (State of Queensland 2020).

This species has established home ranges within revegetated eucalypt woodlands (TSSC 2012a). Areas of relatively lower quality habitat that enable movement between higher quality areas also constitutes important habitat for the Koala (DEWHA 2009).

11.1.7.2 Desktop analysis

Desktop analysis has been conducted of relevant databases to identify records of the Koala within the vicinity of the Project (Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia).

The desktop assessment includes reviews of an ecological survey and assessments of nearby developments for information/record purposes relating to the Koala. Numerous records of the species in the vicinity of the Project were identified.

The Koala was recorded in surveys and assessments for nearby developments, including Saraji East Mining Project to the west, Winchester South Project to the north-west and Olive Downs Project to the north. Details of the desktop analysis are provided in Section 6, Appendix B and Appendix C

Desktop analysis of Queensland government mapping including regional ecosystem mapping has also been conducted to determine the extent of potentially suitable habitat for the Koala.

11.1.7.3 Survey effort

Fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April), autumn 2021 (16–25 April) and spring 2021 (6–10 September) over 50 days in consideration of relevant Commonwealth and Queensland surveys guidelines. The spring 2019 survey was conducted during the recommended direct observation period (TSSC 2012a).

Fourteen systematic survey sites were established during the surveys; all habitat types surveyed systematically are considered to provide potential Koala habitat.

Survey effort for the Koala at systematic and targeted sites included:

- diurnal searches for Koalas and scats: 75 person hours;
- call playback: 11 person hours;
- spotlighting: 58.6 person hours; and
- camera trapping: 56 trap nights.

Survey timing, effort and methodology are consistent with the Commonwealth and Queensland guidelines, and the survey methods used are included in the recommendations of both guidelines.

The habitat assessment survey comprises 20 transects 100 m x 50 m to assess the availability of suitable Myrtaceae 'eucalypt' trees (species of *Eucalyptus, Angophora* and *Corymbia*) within remnant vegetation and high-value regrowth vegetation within the study area. Myrtaceae eucalypts with a diameter at breast height (DBH) of >10 cm were counted along each transect.

Further details of the survey timing, effort and methodology are provided in Section 7 and Appendix G.

11.1.7.4 Survey outcomes

The Koala is present within the study area. Six Koala individuals and three scats were recorded during the autumn 2019, spring 2019 fauna surveys and the spring 2021 habitat assessment survey. The species has been observed at systematic trap sites in Eucalypt Dry Woodlands and freshwater wetland habitats and incidentally in remnant vegetation as shown in Figure 11.7.

11.1.7.5 Habitat assessment

Habitat mapping for the Koala within the study area is shown in Figure 11.7 and is based on the habitat descriptions provided in Table 11.21 that were derived from field habitat assessments conducted by EcoSmart Ecology and AARC. The habitat description in Table 11.21 is based on the information contained in DAWE's Species Profiles and Threats (SPRAT) database, including the relevant statutory documents and published research specific to the distribution of habitat for the Koala within the study area.

With the exception of RE 11.3.1, transect data indicates remnant vegetation within the study area (with the minor exceptions noted in Table 11.21) provided abundant Myrtaceae eucalypts (Table 11.22). In many REs, this includes a high density of trees preferentially used for foraging (*E. tereticornis, E. melanophloia* and *E. populnea* (Kerswell *et al.* 2020). Exceptions include RE 11.3.1, 11.3.9, 11.5.8b, 11.5.8c and 11.5.12, which had lower preferred tree densities (<15/ha). Based on these results, some areas of vegetation within the site are likely to support lower Koala densities and can be assessed as having 'marginal' habitat amenity (as per the definition in Kerswell *et al.* 2020).

While all areas of vegetation with dense preferred feed trees have the potential to support comparatively high Koala numbers, given the vegetation structure and occurrence within the landscape, RE 11.3.25 may play a particularly important ecological role for the local population. Koalas show a preference for tree species on more fertile soils with higher leaf nutrient status and possibly high leaf moisture, especially during times of drought or heat stress (Clifton *et al.* 2007; Ellis *et al.* 2010; Davies *et al.* 2014; DAWE 2021b). Koalas are also susceptible to extreme temperatures (DAWE 2021b) and will select trees which provide better thermal regulation (Lunney *et al.* 2014; Briscoe *et al.* 2015). Such trees are often located in gullies and/or have thicker canopies (Crowther *et al.* 2013). It is likely vegetation within RE 11.3.25 fulfills these roles, as it is within close proximity to creek lines (increasing the likelihood of high leaf moisture) and has a comparatively tall, dense canopy. Furthermore, this vegetation is linear, following major creek lines (Boomerang and Phillips Creeks) and may, therefore, also play an important dispersal/movement role.

Vegetation Community VC 1d [Brigalow high-value regrowth) and the adjacent patch of RE 11.4.8 contains few Eucalypts/habitat trees and are considered unsuitable for the Koala. While Eucalypt regrowth can be suitable for the Koala, the cleared agricultural areas within the study area contains low Brigalow regrowth, which is unsuitable for the Koala.

Table 11.21: Koala habitat description and occurrence

Habitat Description	Relevant features present within the study area
Suitable habitat	
Koala habitat is any forest or woodland that contains known koala food tree species or shrubland with emergent food trees (TSSC 2012a). A Koala food tree includes species from the *Eucalyptus*, *Corymbia, Angophora, Lophostemon* and *Melaleuca* genera (DoE 2014a). In inland areas, Koalas are also known to inhabit *Acacia* woodlands (with emergent food trees) in both riparian and non-riparian environments. Non-food trees such as Brigalow (*Acacia harpophylla)* and Sally wattle (*Acacia salicina*) have been utilised by this species for daytime roosting (Ellis *et al.* 2002). A potential Koala habitat tree is considered to be a tree with a trunk diameter greater than 10 cm at 1.3m above ground (State of Queensland 2020).	Within the study area, areas mapped as remnant vegetation communities with food tree species density greater that 20 per ha are considered to provide potential suitable habitat for the Koala. The communities include: • Eucalypt grassy woodlands (VC 2a [RE 11.3.2], VC 2b [RE 11.3.3], VC 2c [RE 11.3.4] and VC 2e [RE 11.5.3]); • Eucalypt open forest to woodlands fringing drainage lines (VC 3a [RE 11.3.25]); and • Eucalypt freshwater wetlands (VC 4a [RE 11.3.27b], VC 4b [RE 11.3.27f], VC 4c [RE 11.5.17, noting the palustrine wetlands themselves have not been mapped]). A patch of RE 11.3.2 located to the south of Boomerang Creek in the far east of the study area is small in extent and separated (~200 m) from nearby habitats. While Koalas can move over open areas of this distance, it seems unlikely the area will be utilised with regularity considering nearby available habitat. It has, therefore, been mapped here as 'marginal' habitat.
Marginal habitat	
Koala habitat with sub-suitable food tree species density. A potential Koala habitat tree is considered to be a tree with a trunk diameter greater than 10 cm at 1.3 m above ground (State of Queensland 2020).	Within the study area, areas mapped as remnant vegetation communities with food tree species density lower than 20 per ha are considered to provide potential marginal habitat for the Koala. The communities include: • Brigalow woodlands on clay soils (VC 1a [RE 11.3.1], VC 1b [RE 11.4.8], and VC 1c [RE 11.4.9]); and • Poplar Gum and Clarkson Bloodwood woodland on alluvial plains (VC 2d [RE 11.3.9], VC 2h [RE 11.5.12]).
Important ecological function habitat	
Koala habitat that may provide: • refugial habitat features, such as food trees on more fertile soils with higher leaf nutrient status, higher leaf moisture or with thicker canopies; these characteristics are especially important during periods of drought or heat stress; • connective function between otherwise discontinuous areas of suitable habitat.	Within the study area, areas mapped as Eucalypt grassy woodlands (VC 3a [RE 11.3.25]) have been identified as potential important ecological function habitat.

Table 11.22: Estimated tree density per hectare for dominant RE's within the study area

RE	Number of sites	Estimated Eucalypt* density/ha	Important food species density/ha#
11.3.1	2	24	8
11.3.2	3	82	79
11.3.9	2	101	11
11.3.25/27	5	85	52
11.3.4	1	62	54
11.5.3	5	86	79
11.5.8	2	65	12

* including all *Eucalypt, Angophora* and *Corymbia* species

\# for the assessed important food tree species included *E. tereticornis, E. melanophloia* and *E. populnea*

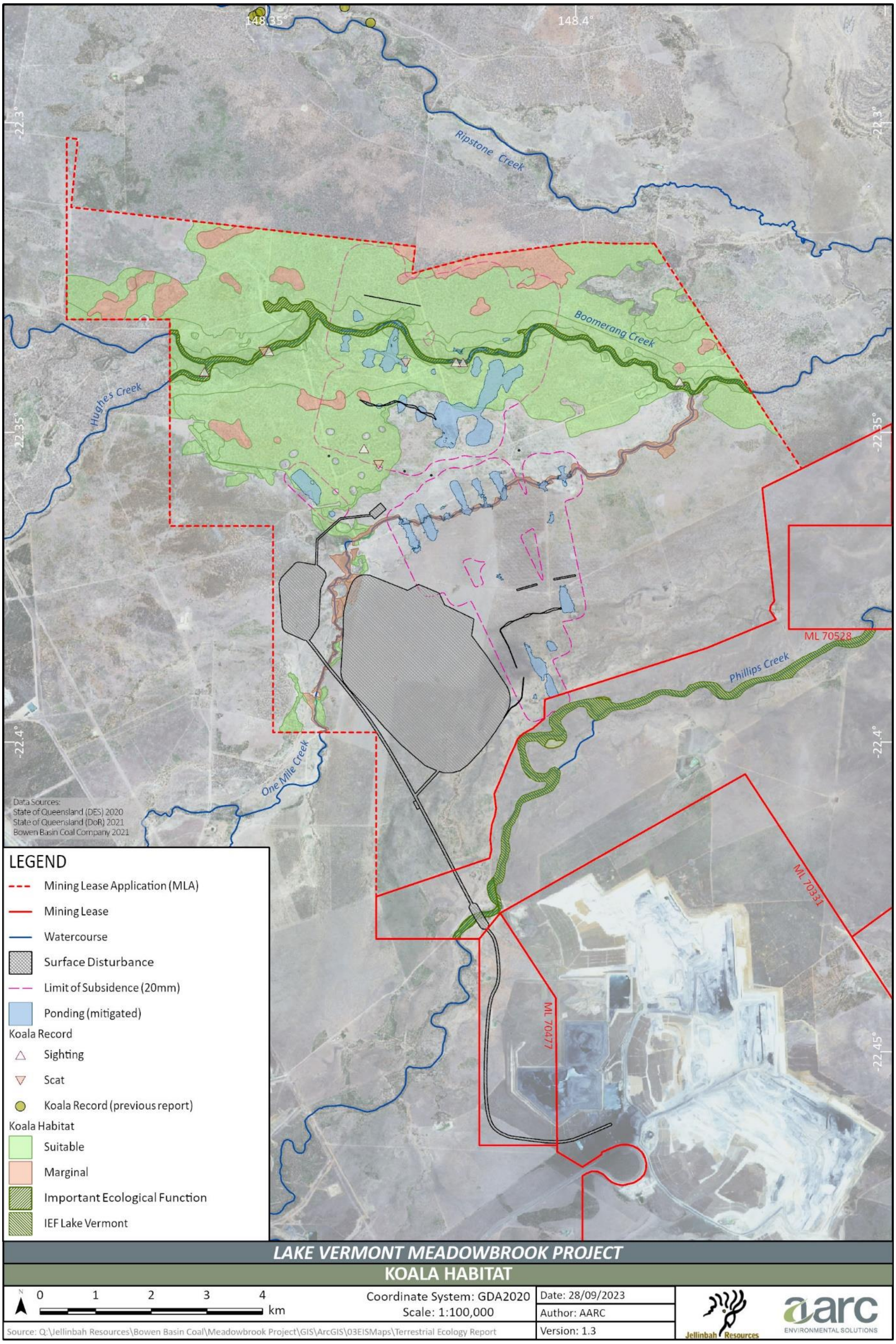

Figure 11.7: Koala habitat mapping

11.1.7.6 Impact assessment

Approximately 3319.5 ha of Koala habitat has been identified within the study area (Table 11.23 and Figure 11.7) of which approximately 12.2 ha of Koala habitat is proposed to be cleared for the Project, and 96.9 ha is predicted to be impacted by residual ponding. The areas of residual ponding are predicted to be inundated for a maximum period of several months every few years depending on inflow volumes and soil permeability (WRM 2022). This inundation is expected to negatively impact the Koala's staple forage tree species and is, therefore, considered to constitute the removal of the habitat. Further detail of ponding impacts to vegetation is provided in Section 10.2.4. Koala habitat occurs within riparian vegetation adjacent to Boomerang Creek and One Mile Creek, including in reaches that will be subject to stream morphology changes from subsidence. These potential stream morphology affected areas are co-located with areas of predicted ponding, and the assessment of stream morphology change impacts and mitigation measures are detailed in Section 10.3.

The subsidence footprint outside of the residual ponding areas is predicted to retain its Koala habitat suitability. Open woodland vegetation subject to comparable surface subsidence conditions has retained its vegetation condition post-subsidence (Section 10.2). Therefore, the predicted impacts are not likely to substantially impact the Koala forage and breeding trees, and the vegetation that provides Koala habitat within the subsidence footprint is expected to maintain its habitat quality post-subsidence. Canopy trees within the subsidence footprint will be avoided while surface activities for gas drainage are conducted, so gas drainage activities are, therefore, considered unlikely to impact Koala habitat.

The Project will result in impacts on Koala habitat, which will add to habitat disturbance that is proposed to occur for other Projects in the region.

The vegetation clearance associated with the infrastructure corridor will fragment the riparian corridors of One Mile Creek and Phillips Creek.

The extent of flooding in the study area is predicted to increase along the margins of subsided panels. The changes to flood levels and extent are considered not significant (WRM 2022). The impacts of changes to flooding regimes on Koala habitat are, therefore, not expected to be significant. Potential or likely GDEs were identified within the study area, however all areas assessed to be unlikely to be significantly impacted by the Project (3D Environmental 2022). Therefore, groundwater impacts are considered unlikely to impact Koala habitat.

The potential for indirect impacts to the Koala from noise and vibration, dust, lighting and vehicle strike is considered to be minimal given the measures that will be implemented to manage these impacts. Subsidence impacts related to cracking and erosion are assessed in Section 10.2 and Section 10.11. Given the proposed monitoring and management measures for erosion, no substantial erosion is expected to occur and it is considered unlikely that erosion will impact Koala habitat. The Project also has the potential to increase animal pest populations if they are not appropriately managed. However, as described in Section 11.1.7.7, pest management measures will be implemented for the Project.

The proposed impact is equivalent to 3 % of the Koala habitat in the study area. The impacts are predominantly due to hydrological change affecting the resilience of Koala habitat, and the modelling for these changes has incorporated the cumulative effects of nearby projects and climate change (WRM 2022). The impacts identified to Koala habitat are unlikely to contribute to cumulative impacts in the subregion. Further discussion of cumulative impacts is provided in Section 10.12.

An assessment of the significance of the impacts on the Koala is provided in Section 11.1.7.9.

Table 11.23: Proposed disturbance of Koala habitat

Habitat amenity	Extent within study area (ha)	Extent of direct disturbance (ha)		Extent of indirect disturbance (ha)
		All stage 1,2,3 direct clearing	**Stage 4 – open cut pit**	**Predicted periodic ponding**
Suitable (important ecological function)	2963.0	4.6 (1.6)	<0.1 (0.0)	88.7 (5.2)
Marginal	356.6	0.6	7.0	8.2
Total	**3319.6**	**5.2**	**7.1**	**96.9**

11.1.7.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Koala where practicable. The proposed avoidance and mitigation measures for the Koala, including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis, are provided in Table 11.24.

Table 11.24: Koala impact avoidance and mitigation measures

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Project infrastructure has been located to minimise direct disturbance to Koala habitat.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to Koala habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	DSEWPaC (2012), DoE (2014a), DAWE (2021e), DES (2019b)
Implement vegetation clearance protocols, including the delineation of vegetation adjoining proposed clearance areas to prevent accidental damage (Section 10.1.2).	Construction/ operations	Highly effective management technique to manage vegetation clearance activities.		
Fauna spotter/catcher will be on-site when clearing activities occur within Koala habitat. Fauna spotter/catcher will monitor clearance activities for the Koala and any incidence of fauna mortality or injury will be recorded. Injured fauna will be taken to a wildlife carer or veterinarian.	Construction/ operations	Highly effective management technique—vegetation clearance activities can be timed to avoid the clearance of trees until vacated by Koalas (should they be present).	Adaptive measures will be implemented, as necessary. Potential adaptive measures will include pre-clearance surveys and progressive clearing around known habitat trees.	DSEWPaC (2012), DoE (2014a),
Speed limits will be imposed to reduce the risk of vehicle strike.	Construction/ operations/ rehabilitation and decommissioning	Highly effective management technique to minimise the potential for vehicle strike.	Monitor incidence of vehicle strike. Adaptive management measures will include signage and/or reduction in speed limits at selected locations identified as having a higher risk of vehicle strike.	DSEWPaC (2012), DoE (2014a), DAWE (2021b), DES (2019b)
Safe driving procedures will be incorporated into site inductions to increase awareness of the risk of vehicle strike.	Construction/ operations/ rehabilitation and decommissioning	Highly effective management technique to minimise the potential for vehicle strike.	Monitor incidence of vehicle strike. Adaptive management measures will include an increase in measures (frequency or methods) or signage to increase awareness	DSEWPaC (2012), DoE (2014a), DAWE (2021b), DES (2019b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna (e.g. feral dogs).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests such as feral dogs.	Regular monitoring of site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	DSEWPaC (2012), DoE (2014a), DAWE (2021b), Commonwealth of Australia (2017b)
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests, including feral dogs if site protocols are followed by personnel.	Regular monitoring of the site will be carried out by environmental personnel. The Waste Management Plan will be monitored and audited, as necessary, to suit the required conditions of the Project. Additional measures (such as the provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals.	DSEWPaC (2012), DoE (2014a), Commonwealth of Australia (2017b)
Monitor and manage pest animal populations and implementation of pest control measures in accordance with Weed and Pest Management Plan (Section 10.5) to be prepared for the Project.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	DSEWPaC (2012), DoE (2014a), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Consult with the Isaac Regional Council and neighbouring mines in relation to pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Audits will be carried out to monitor the consultation outcomes and the management measures implemented on-site.	DSEWPaC (2012), DoE (2014a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)
Minimise effects of artificial lighting.	Mine planning/ construction	Effective management measure to minimise effects of artificial lighting.	Mine planning for MIA and the infrastructure corridor will include lighting designs (placement, configuration and direction) to minimise light spill.	DAWE (2020), AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting' (Standards Australia 2019), DES (2019b)
Bushfire prevention and management measures will be outlined in the Emergency Response Plan. Inductions of mine site personnel will include fire awareness.	Construction/ operations/ rehabilitation and decommissioning	Effective management procedure to reduce the risk of bushfire.	Any incidence of bushfire will be investigated to determine the requirement for additional controls. Potential adaptive management measures include revision of the Emergency Response Plan and/or a program to increase personnel awareness of bushfire risk (e.g. through tool box talks).	DSEWPaC (2012), DoE (2014a), DAWE (2021b)
Design and undertake subsidence ponding drainage management works to minimise hydrological changes to Koala habitats.	Mine planning/ operations	The hydrological modelling (WRM 2022) indicates the subsidence ponding mitigation works will be effective in minimising the hydrological changes that will occur as a result of mine subsidence.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Audit(s) will be conducted against the Subsidence Management Plan. Corrective measures may include additional works to reduce ponding.	DoE (2015e), DAWE (2021b), DSEWPaC (2011b)

11.1.7.8 Statutory requirements

Conservation and recovery plans relevant to the Koala have been considered in this assessment as follows:

- The 'Listing advice for *Phascolarctos cinereus* (Koala)' (TSSC 2012a), which outlines the reason for the conservation assessment of the Koala, and the 'Approved Conservation Advice for *Phascolartos cinerus* (combined populations in Queensland, New South Wales and the Australian Capital Territory)' (DSEWPaC 2012a), developed at the time of EPBC Act listing, provides information about the species, including its distribution and habitat, threats and priority management actions.
- The '*Phascolarctos cinereus* combined populations of Qld, NSW and the ACT–Koala' SPRAT profile provides information about the Koala, including relevant regulatory considerations and information in relation to its population and distribution, habitat, life cycle, feeding, movement patterns, threats, abatement and recovery.
- The SPRAT profile for this species indicates there is no adopted or made Recovery Plan for this species; however, a Recovery Plan is required. The 'Draft National Recovery Plan for the Koala (combined populations in Queensland, New South Wales and the Australian Capital Territory)' (DAWE 2021b) provides information, including cultural significance, ecology, current threats, guidance on recovery and further conservation of the species.
- The 'Draft National Recovery Plan for the Koala' considers habitat critical to the survival of a species to be the area that the species relies on to halt decline and promote the recovery of the species that can be unambiguously identified. Under the EPBC Act, the following factors and any other relevant factors may be considered when identifying habitat that is critical to the survival of a species:
    - *a) whether the habitat is used during periods of stress (examples flood, drought or fire);*
    - *b) whether the habitat is used to meet essential life cycle requirements (examples: foraging, breeding, nesting, roosting, social behaviour patterns or seed dispersal processes);*
    - *c) the extent to which the habitat is used by important populations;*
    - *d) whether the habitat is necessary to maintain genetic diversity and long-term evolutionary development;*
    - *e) whether the habitat is necessary for use as corridors to allow the species to move freely between sites used to meet essential life cycle requirements;*
    - *f) whether the habitat is necessary to ensure the long-term future of the species or ecological community through reintroduction or re-colonisation;*
    - *g) any other way in which habitat may be critical to the survival of a listed threatened species or a listed threatened ecological community.*
- The 'EPBC Act referral guidelines for the Vulnerable koala' (DoE 2014a) includes information on Koala habitat, modelled distribution, geographic context, threats, interim recovery objectives and survey methods. The Draft Referral Guideline includes a Koala Habitat Assessment Tool to assist in determining habitat quality and whether the habitat constitutes critical habitat.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019), Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

The SPRAT profile for this species indicates no threat abatement plan has been identified as being relevant for this species. However, threats to the Koala include (DAWE 2021a):

- habitat loss and habitat fragmentation;
- vehicle strike;
- predation by domestic or feral dogs;

- climate change induced impacts including drought, fire and heatwaves; and
- disease.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or Convention on Conservation of Nature in the South Pacific (Apia Convention). The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assessed its likelihood of occurrence (Section 11.1.7.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area considering Commonwealth and Queensland survey guidelines (Section 11.1.7.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.7.5);
- identified potential impacts of the Project on the species and its habitats (Sections 10 and 11.1.7.6);
- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.7.7); and
- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) (Section 11.1.7.9).

11.1.7.9 Significant impact assessment

Table 11.25 provides an assessment of the likelihood of significant impacts on the Koala in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

The Koala population occurring at the study area has been assessed against the definition of 'important population' of a Vulnerable species (DoE 2013a). The population has been determined to be part of a large population that is distributed throughout the broader region and maintains connectivity for breeding and dispersal throughout this area. Breeding is considered to occur amongst the population in the broader region; therefore, the population occurring in the study area is not likely to be necessary for maintaining species genetic diversity. The Koala range extends throughout the coast and inland areas of eastern Australia, and the study area is not near the limits of the species range.

It is unlikely the Koala population in the study area is necessary for the species' long-term survival and recovery and, therefore, is not an important population as per the Significant Impact Guidelines for a Vulnerable listed species (refer Section 11.1.7.1). However, considering the species' recent EPBC Act listing change to Endangered, it is considered justified to determine all populations as important for the purpose of impact assessment.

Table 11.25: Koala significant impact assessment

Significance criteria	Assessment of significance
An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The population of Koala that uses the habitat within the study area can be considered an important population. The removal of 12.3 ha of habitat and potential ponding impact of 96.9 ha on the habitat may lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The population of Koala that uses the habitat within the study area can be considered an important population. The removal of 12.3 ha habitat and potential ponding impact of 96.9 ha on habitat may reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	The population of Koala that uses the habitat within the study area can be considered an important population. The removal of 12.3 ha habitat and potential ponding impact of 96.9 ha on habitat is considered unlikely to fragment an existing important population into two or more populations. The remaining vegetation will retain connectivity to the broader region of Koala habitat.
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the Koala listed on the Register of Critical Habitat (DAWE 2021c). However, the Koala habitat in the study area is considered likely to meet the EPBC Act Referral Guidelines (DoE 2014a) definition of habitat critical to the Koala. Approximately 109.2 ha of Koala habitat will be disturbed by the Project through direct clearing and impact by ponding from subsidence. This action is considered likely to adversely affect habitat critical to the survival of the species. Approximately 2232.8 ha will remain undisturbed by clearing or subsidence within the study area for the local population. A further 977.6 ha of habitat will be retained within the subsidence footprint, which is predicted not to be substantially impacted and expected to continue to provide its current habitat function.
Disrupt the breeding cycle of an important population	The population of Koala that uses the habitat within the study area may be considered an important population. The removal of 12.3 ha of habitat and potential ponding impact of 96.9 ha on habitat is considered unlikely to disrupt the breeding cycle of an important population. The Koala habitat retained is expected to remain suitable for breeding for the species. Indirect impacts will be managed such that the breeding cycle will not be disrupted of the population.

Significance criteria	Assessment of significance
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project requires the removal of 12.3 ha of habitat, which will result in geomorphological changes creating ponding impacts on 96.9 ha of habitat. This includes 93.3 ha of suitable habitat and 15.8 ha of marginal habitat. The removal of this extent of habitat is unlikely to lead to a long-term decline in the species population given the availability of habitat for the species in the broader region. The study area is connected to areas of remnant vegetation habitat along the northern, north-east and north-west boundaries, including connectivity to the Isaac River in the east of the study area, which represents an area of habitat to support mobility for the species throughout the broader region. The retained habitat throughout the study area is unlikely to be indirectly impacted by the Project. Indirect impacts, such as weeds and pests, noise and vibration, dust, artificial lighting, vehicle strike and bushfire, will be managed as outlined in sections 10.5 to 10.10 and are considered not to have potential to impact the availability or quality of habitat to the extent that the Koala is likely to decline. The GDE Assessment (3D Environmental 2022) has identified that the risk of impact to GDEs (which form a portion of Koala habitat in the Project area) is 'low to insignificant'. The impact of groundwater drawdown is, therefore, unlikely to impact the availability or quality of habitat to the extent that the Koala is likely to decline.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species habitat	The study area is located in a modified rural landscape, and invasive species that are harmful to the Koala exist in the broader region. While predatory species, including wild dogs, are recorded to be established in the study area, the Project is unlikely to result in the introduction and establishment of any invasive species that are harmful to the Koala within the study area. Monitoring and management of pests, including corrective actions, will be implemented in accordance with a Weed and Pest Management Plan (Section 10.5).
Introduce disease that may cause the species to decline, or	Koala populations are affected by three known viral diseases which are widespread throughout the wild population. These diseases are likely to be present in the population in the study area; however, the proposed Project is unlikely to cause the introduction of these diseases or other diseases to the study area. The Koala population in the study area will retain connectivity to the surrounding Koala habitat and will, therefore, remain exposed to infections from the broader region.
Interfere substantially with the recovery of the species	The Project will result in the clearing of 12.3 ha and impact on 96.9 ha of potential ponding in Koala habitat. The Draft Recovery Plan for the Koala (DAWE 2021b) identifies that direct threats to the Koala include climate change, land-use changes and natural system modifications, while ecological threatening processes include habitat loss and fragmentation, habitat degradation and genetic effects. There is currently no habitat for the Koala listed on the Register of Critical Habitat (DAWE 2021c). However, the Koala habitat in the study area is considered likely to meet the EPBC Act Referral Guidelines (DoE 2014a) definition of habitat critical to the Koala. Therefore, the impact of the Project on the Koala habitat in the study area may amount to impacts equivalent to the direct threats identified in the Draft Recovery Plan for the Koala, and the Project may interfere with the recovery of the species.
Conclusion	The Project will result in the clearing or disturbance of 109.2 ha of Koala habitat. This habitat is identified as likely to be critical habitat and, therefore, the Project is likely to have a significant impact to the Koala. The extent of these impact areas is shown in Figure 11.8

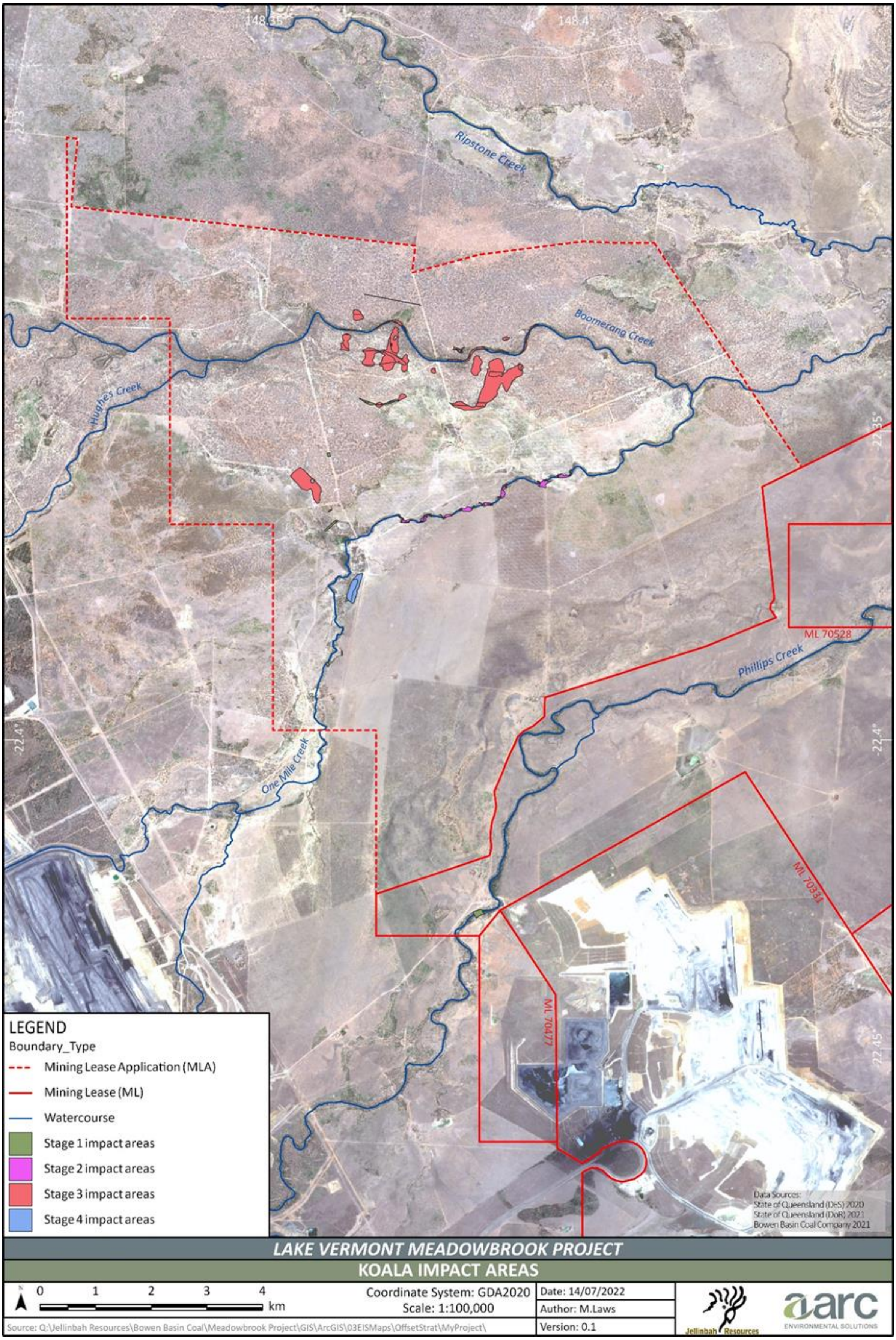

Figure 11.8: Koala significant impact areas

11.1.8 Greater Glider

11.1.8.1 Description

The Greater Glider (*Petauroides volans*) was listed as Vulnerable under the NC Act and the EPBC Act at the time of the controlled action decision for the Project. Since this time, it is acknowledged that the listing status for the Greater Glider has been upgraded to Endangered under the NC Act and the EPBC Act. While the updated conservation advice for this species has been considered, ecological surveys and impact assessment have been undertaken using the criteria that applied at the time of the controlled action decision (not applied retrospectively).

The taxonomy of this species may be subject to revision in the near future (McGregor *et al.* 2020); however, this assessment is applicable to the Greater Glider (*Petauroides volans sensu lato*) as referred to on the DAWE Species Profiles and Threats database (DAWE 2021a). The species is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria, with an elevational range from sea level to 1,200 m above sea level.

The Greater Glider is an arboreal, nocturnal marsupial known to occur in Eucalypt dominated habitats ranging from low, open forests on the coast to tall forests in the ranges and low woodland westwards of the Dividing Range (TSSC 2016b, DCCEEW 2022). It is primarily folivorous, with a diet mostly comprising Eucalypt leaves and occasionally flowers. Preferred habitat consists of taller, montane, moist Eucalypt forests with relatively old trees and abundant hollows. It also favours forests with a diversity of Eucalypt species due to seasonal variation in its preferred tree species (TSSC 2016b, DCCEEW 2022). During the day, this species shelters in tree hollows, with a particular selection for large hollows in large old trees (TSSC 2016b, DCCEEW 2022) and requires at least two hollow bearing trees for every 2 ha of suitable forest habitat (Kerswell *et al.* 2020).

The species is absent from cleared areas and has little dispersal ability to move between fragments through cleared areas. Greater Gliders have been recorded in habitat patches <10 ha however, modelling suggests that in QLD the species requires native forest patches of at least 160 km^2 to maintain viable populations, and low reproductive output and susceptibility to disturbance ensures low viability in small remnants (TSSC 2016b, DCCEEW 2022).

11.1.8.2 Desktop analysis

Desktop analysis has been conducted of relevant databases to identify records of the Greater Glider within the vicinity of the Project (Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia occurrence records). The desktop assessment also includes reviews of an ecological survey and assessments of nearby developments for information/records relating to the Greater Glider.

The desktop analysis identified numerous records for the species in the vicinity of the Project. The Greater Glider is recorded in surveys and assessments for nearby developments, including Saraji East Mining Project to the west, Winchester South Project to the north-west and Olive Downs Project to the north. Details of the desktop analysis are provided in Section 6, Appendix B and Appendix C.

Desktop analysis of Queensland government mapping, including regional ecosystem mapping, has also been conducted to determine the extent of potentially suitable habitat for the Greater Glider.

11.1.8.3 Survey effort

Fauna surveys of the study area have been conducted in autumn 2019 (11–21 March), spring 2019 (6–19 November), autumn 2020 (23–25 March and 1–8 April), autumn 2021 (16–25 April) and spring 2021 (6–10 September) over 50 days in consideration of relevant Commonwealth and Queensland survey guidelines. All surveys fell within the Brigalow Belt Bioregion recommended survey timing (Eyre *et al*. 2018).

Fourteen systematic survey sites were established during the surveys. Four systematic sites were established in Eucalypt dry woodlands on inland depositional plains (sites MF01, MF05, MF09, MF13) and two systematic sites on Poplar Gum and *Corymbia* spp. woodlands on alluvial plains (sites MF10 and MF14).

For habitat assessment, amenity surveys have been conducted along transects of 100 m x 50 m within areas of potentially suitable vegetation. The canopy cover of Myrtaceae eucalypt species (*Eucalyptus, Angophora* and *Corymbia*) was recorded using the intercept method (Neldner *et al.* 2020), and the number of trees with suitable hollows (diameter >20 cm, alive or dead) was recorded. Spotlighting along a 500 m transect was undertaken at a subset of these sites to record the number of observed Greater Glider individuals.

Survey effort for the Greater Glider at systematic and supplementary sites included:

- active searches: 75 person hours;
- spotlighting: 58.6 person hours; and
- call playback: 11 person hours.

The survey timing, methodology and effort are consistent with the Commonwealth Guidelines. Stag watch surveys were not applied, as spotlighting and call playback at potential den tree areas sufficiently surveyed these areas.

Further details of the survey timing, effort and methodology are provided in Section 7 and Appendix G.

11.1.8.4 Survey outcomes

The Greater Glider has been recorded at the Project area in woodland and riparian habitats during the autumn 2019, spring 2019, autumn 2020 and spring 2021 surveys. Targeted spotlighting for the Greater Glider conducted during the site habitat assessments also recorded the species. There were 24 records of Greater Gliders within the study area and the locations of Greater Glider records are shown on Figure 11.9.

The habitat assessment transect and spotlight data has been used to assess habitat amenity for the Greater Glider within the study area (Table 11.26)[6]. High counts of tree hollows and *Eucalyptus* spp. canopy cover are associated with higher Greater Glider abundance (DCCEEW 2022), and these characteristics have been used as indicators of Greater Glider habitat amenity. Transects have not been conducted within RE 11.3.3, 11.4.8 or 11.4.9 due to their small extent within the study area and have been assessed for habitat amenity on the basis of other survey experience conducted within these REs.

Table 11.26: Greater Glider habitat amenity assessment criteria

Habitat amenity	Hollows per ha	*Eucalyptus* spp. canopy cover	Greater Glider transect abundance per km
High	>10	>40 %	>3
Moderate	>10	<40 %	1
Low	2-9	<40 %	0.25
Unsuitable	<2	Not applicable	NA

11.1.8.5 Habitat assessment

Habitat mapping for the Greater Glider within the study area is shown in Figure 11.9 and is informed by the assessment of the habitat available at the Project area, information contained in DAWE's Species Profiles and Threats (SPRAT) database, including the relevant statutory documents and published research.

[6] Assessment of habitat amenity for the Greater Glider is only applicable to the study area and is not an assessment of habitats throughout the species range or within the region.

The habitat requirements of the Greater Glider are described in Section 11.1.8.1. The key habitat features are:

- presence of suitable fodder trees (Eucalyptus species);
- presence and abundance of hollow-bearing trees with suitably-sized and aged hollows; and
- sufficient canopy cover of Eucalyptus species.

The results of the habitat amenity surveys conducted by EcoSmart Ecology and AARC are:

- Three REs assessed as providing high habitat amenity—RE 11.3.25/RE11.3.27, 11.3.3, 11.3.4.
- Three REs assessed as providing moderate habitat amenity—RE 11.3.9, 11.5.8c, 11.5.3 (with the exception noted below).
- Four REs assessed as providing low habitat amenity—RE 11.3.2 (with the exception noted below), 11.3.1 (with the exception noted below), 11.4.8 (with the exception noted below) and 11.4.9.
- REs or specific areas considered unsuitable for the Greater Glider are:
  - RE 11.5.17 (palustrine wetland component containing no Eucalypts);
  - the high-value regrowth Brigalow vegetation in the north-east of the study area and the small patch of RE 11.4.8 situated adjacent to the high-value regrowth Brigalow vegetation (both of which do not contain enough hollows or Eucalypts for the Greater Glider);
  - riparian vegetation (RE 11.3.1) along the western section of One Mile Creek due to the low density of Eucalyptus species, low number of hollow-bearing trees, its more open canopy and narrow linear nature;
  - a portion of RE 11.5.3 in the south near Phillips Creek, as it is small in extent and isolated from other suitable habitat; and
  - a portion of RE 11.3.2 to the south of Boomerang Creek near the eastern boundary of the study area (identified to be too small and isolated to provide suitable habitat).

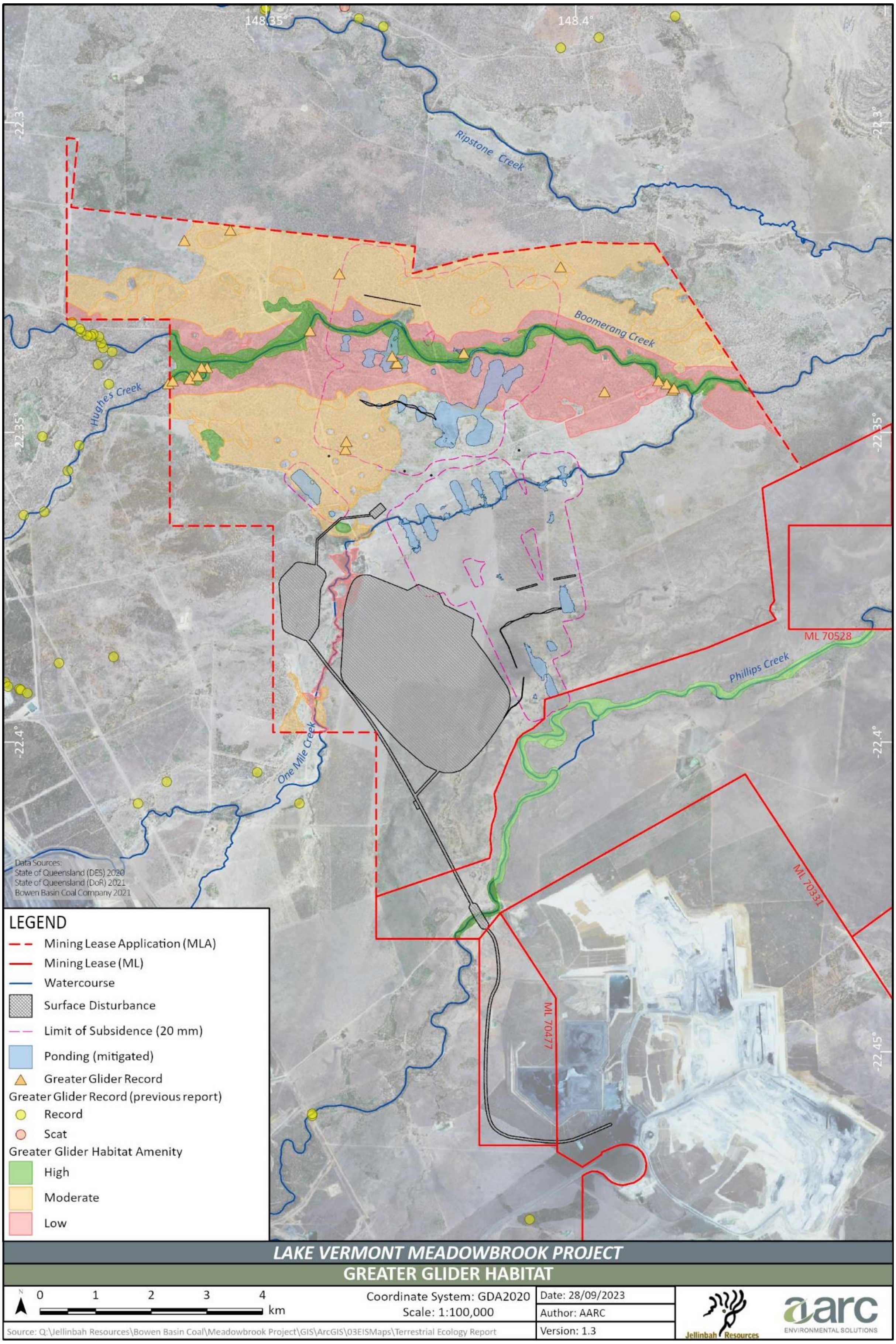

Figure 11.9: Greater Glider habitat mapping

11.1.8.6 Impact assessment

Approximately 3194.4 ha of Greater Glider habitat have been identified within the study area, including 332.2 ha of high amenity, 1874.0 ha of moderate amenity and 988.1 ha of low amenity habitat (Figure 11.9 and Table 11.27). A total of 11.9 ha of Greater Glider habitat is proposed to be directly disturbed through clearing for the Project and 88.7 ha indirectly impacted by predicted periodic ponding. The areas of residual ponding are predicted to be inundated for a maximum period of several months every few years depending on inflow volumes and soil permeability (WRM 2022). This is expected to be sufficient to disturb the Greater Gliders' staple forage tree species and is, therefore, considered sufficient disturbance to cause the removal of the habitat. Further detail of ponding impacts to vegetation is provided in Section 10.2. Greater Glider habitat occurs within riparian vegetation adjacent to Boomerang Creek and One Mile Creek, including in reaches that will be subject to stream morphology changes from subsidence. The potential stream morphology affected areas are co-located with areas of predicted ponding, and the assessment of stream morphology change impacts and mitigation measures are detailed in Section 10.3.

The subsidence footprint outside of the residual ponding areas is predicted to retain its Greater Glider habitat suitability. Open woodland vegetation subject to comparable surface subsidence conditions at other underground mining projects in the Bowen Basin has retained its vegetation condition post-subsidence (Section 10.2). Therefore, the predicted impacts are not likely to substantially impact the Greater Glider foraging and breeding trees, and the vegetation that provides Greater Glider habitat within the subsidence footprint is expected to maintain its habitat quality post-subsidence. Canopy trees within the subsidence footprint will be avoided while surface activities for gas drainage are conducted. Therefore, the gas drainage activities within the subsidence footprint are not expected to amount to a significant impact on Greater Glider habitat.

The Project will result in impacts on Greater Glider habitat, which will add to habitat disturbance that is proposed to occur for other Projects in the region.

The direct disturbance associated with the Project (e.g. infrastructure corridor and MIA) will result in some fragmentation of Greater Glider low and moderate amenity habitat.

The extent of flooding in the study area is predicted to increase along the margins of subsided panels; however, the changes to flood levels and extent are considered not significant (WRM 2022). The impacts of changes to flooding regimes on Greater Glider habitat are, therefore, not expected to be significant. Potential or likely GDEs were identified within the study area, however all areas were assessed to be unlikely to be significantly impacted by the Project (3D Environmental 2022). Therefore, groundwater impacts are considered unlikely to impact Koala habitat.

The potential for indirect impacts to the Greater Glider from noise and vibration, dust, lighting and vehicle strike is considered to be minimal given the measures that will be implemented to manage these impacts. Impacts of subsidence related cracking and erosion are assessed in Section 10.11 and will be subject to management and monitoring under a Subsidence Management Plan. Given the proposed monitoring and management measures for erosion, no substantial erosion is expected to occur and it is considered unlikely that erosion will impact Greater Glider habitat. The Project also has the potential to increase animal pest populations if they are not appropriately managed. However, as described in Section 10.5, pest management measures will be implemented for the Project.

The proposed impact is equivalent to 3% of the Greater Glider habitat in the study area. The impacts are predominantly due to hydrological change affecting the resilience of Greater Glider habitat, and the modelling for these changes has incorporated the cumulative effects of nearby projects and climate change (WRM 2022). The impacts identified on Greater Glider habitat are unlikely to contribute to cumulative impacts on the subregion. Further discussion of cumulative impacts is provided in Section 10.12.

An assessment of the significance of the impacts on the Greater Glider is provided in Section 11.1.8.9.

Table 11.27: Proposed disturbance of Greater Glider habitat

Habitat amenity	Extent within study area (ha)	Extent of direct disturbance (ha)		Extent of indirect disturbance (ha)
		Stages 1,2,3 clearing	Stage 4 clearing	Stage 2 and 3 residual ponding
High	332.2	1.6	0.0	12.6
Moderate	1874.0	2.9	0.0	17.8
Low	988.1	0.3	7.0	58.3
Total	**3194.3**	**4.8**	**7.0**	**88.7**

11.1.8.7 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to the Greater Glider where practicable. The proposed avoidance and mitigation measures for the Greater Glider, including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis is provided in Table 11.28.

Table 11.28: Greater Glider impact avoidance and mitigation measures

Avoidance/mitigation measures	**Timing**	**Predicted effectiveness**	**Monitoring and adaptive management**	**Statutory or policy basis**
Project infrastructure has been located to minimise direct disturbance to Greater Glider habitat.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to Greater Glider habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	TSSC (2016b), DCCEEW (2022)
Implement vegetation clearance protocols, including the delineation of vegetation adjoining proposed clearance areas to prevent accidental damage (Section 10.1.2).	Construction/ operations	Highly effective management technique to manage vegetation clearance activities.		
Fauna spotter/ catcher will be on -site when clearing activities occur within Greater Glider habitat. Fauna spotter/catcher will monitor clearance activities for the Greater Glider, and any incidence of fauna mortality or injury will be recorded. Injured fauna will be taken to a wildlife carer or veterinarian.	Construction/ operations	Potentially effective.	Adaptive measures will be implemented, as necessary. Potential adaptive measures will include pre-clearance surveys and progressive clearing around known habitat trees.	TSSC (2016b), DCCEEW (2022)
Minimise effects of artificial lighting.	Mine planning/ construction	Effective management measure to minimise effects of artificial lighting.	Mine planning for MIA and the infrastructure corridor will include lighting designs (placement, configuration and direction) to minimise light spill.	DAWE (2020), AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting' (Standards Australia 2019)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Bushfire prevention and management measures will be outlined in the Emergency Response Plan. Inductions of mine site personnel will include fire awareness.	Construction/ operations/ rehabilitation and decommissioning	Effective management procedure to reduce the risk of bushfire.	Any incidence of bushfire will be investigated to determine the requirement for additional controls. Potential adaptive management measures include revision of the Emergency Response Plan and/or a program to increase personnel awareness of bushfire risk (e.g. through tool box talks).	TSSC (2016b), DCCEEW (2022)
Design and undertake subsidence ponding drainage management works to minimise hydrological changes to Greater Glider habitats.	Mine planning/ operations	The hydrological modelling (WRM 2022) indicates the subsidence ponding mitigation works will be effective in minimising the hydrological changes that will occur as a result of mine subsidence.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Audit(s) will be conducted against the Subsidence Management Plan. Corrective measures may include additional works to reduce ponding.	DoE (2015e), TSSC (2016b), DCCEEW (2022), DSEWPaC (2011b)

11.1.8.8 Statutory requirements

Conservation information relevant to the Greater Glider has been considered in this assessment as follows:

- The 'Conservation Advice for *Petauroides volans* (greater glider (southern and central))' (DCCEEW 2022) outlines the reasons for the conservation assessment of the species with regard to the 2022 up listing of the species and provides information about the Greater Glider, including information in relation to its distribution, biology/ecology, threats and conservation and management actions.
- The Conservation Advice for *Petauroides volans* (greater glider) (TSSC 2016b) outlines the conservation assessment of the species according to the listing relevant to the assessment and approval process for the species.
- The '*Petauroides volans*–Greater Glider' SPRAT profile provides information about the relevant regulatory considerations and links to information available in relation to its listing under the EPBC Act. The SPRAT profile indicates there is no adopted or made Recovery Plan for this species; however, a Recovery Plan is required.
- 'Australia's Strategy for Nature 2019–2020' (Commonwealth of Australia 2019), Australia's actions for nature including the 'Threatened Species Strategy 2021–2031' (Commonwealth of Australia 2021) and 'Australian Pest Animal Strategy 2017–2027' (Commonwealth of Australia 2017b) outline relevant actions to recover Australia's threatened plants, animals and ecological communities.

Threats to the Greater Glider include (TSSC 2016b, DCCEEW 2022):

- inappropriate fire regimes;
- habitat clearing and fragmentation;
- timber harvesting;
- barbed wire fencing (entanglement);
- increased temperatures and changes to rainfall patterns;
- hyper-predation by owls;
- competition from Sulphur-crested Cockatoos;
- predation by Feral Cats; and
- predation by European Red Foxes.

The Project is not inconsistent with the objectives of the EPBC Act or Australia's obligations under the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) or Convention on Conservation of Nature in the South Pacific (Apia Convention). The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify records for the species and assess its likelihood of occurrence (Section 11.1.8.2, Appendix B and Appendix E);
- undertaken field surveys to target the species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.8.3 and Appendix G);
- identified potential habitat for the species within the study area (Section 11.1.8.5);
- identified potential impacts of the Project on the species and its habitats (Sections 10 and 11.1.8.6);
- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on the species and its habitat (Sections 10 and 11.1.8.7); and
- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) (Section 11.1.8.9).

11.1.8.9 Significant impact assessment

Table 11.29 provides an assessment of the likelihood of significant impacts on the Greater Glider in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

The Greater Glider population occurring at the study area has been assessed against the definition of 'important population' of a Vulnerable species (DoE 2013a). The population is determined to be part of a large population, which is distributed throughout the broader region and maintains connectivity for breeding and dispersal throughout this area. Breeding is considered to occur amongst the population of the broader region and, therefore, the population occurring in the study area is not likely to be necessary for maintaining species genetic diversity. The Greater Glider range extends throughout the coast and inland areas of eastern Australia, and the study area is not near the limits of the species range.

It is unlikely the Greater Glider population of the study area is necessary for the species' long-term survival and recovery and, therefore, is not an important population as per the Significant Impact Guidelines for a Vulnerable listed species (refer Section 11.1.8.1). However, considering the species' recent EPBC Act listing change to Endangered, it is considered justified to determine all populations as important for the purpose of impact assessment.

Table 11.29: Greater Glider significant impact assessment

Significance criteria	Assessment of significance
An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of an important population of a species	The population of Greater Glider using the study area can be considered an important population. The impacts to all Greater Glider habitat amenity categories includes the removal of 11.9 ha of habitat and potential ponding impact on 88.7 ha of habitat is considered unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The population of Greater Glider using the study area can be considered an important population. The impacts to all Greater Glider habitat amenity categories include the removal of 11.9 ha of habitat and potential ponding impact on 88.7 ha of habitat is considered unlikely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	The population of Greater Glider using the study area can be considered an important population. The impacts to all Greater Glider habitat amenity categories include the removal of 11.9 ha of habitat and potential ponding impact on 88.7 ha of habitat is considered unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	There is currently no habitat for the Greater Glider listed on the Register of Critical Habitat (DAWE 2021c). However, a according to the latest approved conservation advice (DCCEEW 2022), all suitable habitat identified within the study area is considered habitat critical to the survival of the species due to being a large contiguous area of eucalypt forest with mature hollow-bearing treesand forage species canopy cover. As such, impacts on all identified habitat for the Greater Glider within the study area is considered likely to adversely affect habitat critical to the survival of the species. The Project involves clearing and direct impacts on approximately 100.6 ha of Greater Glider habitat.
Disrupt the breeding cycle of an important population	The population of Greater Glider using the study area can be considered to be an important population. The impacts to all Greater Glider habitat amenity categories includes the removal of 11.9 ha of habitat and potential ponding impact on 88.7 ha of habitat is considered unlikely to disrupt the breeding cycle of an important population

Significance criteria	Assessment of significance
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Project requires the removal of 11.9 ha of habitat and will result in geomorphological changes causing potential ponding impacts on 88.7 ha of habitat. The removal of this extent of habitat is unlikely to lead to a long-term decline in the species population given the wide extent of habitat for this species. The study area is connected to areas of remnant vegetation habitat along the northern, north-east and north-west boundaries. The study area will maintain connectivity to corridors of high amenity riparian eucalypt woodland vegetation, including vegetation adjoining the Isaac River, which represents areas of habitat to support mobility for the species throughout the broader region. The retained habitat throughout the study area is unlikely to be indirectly impacted by the Project. Indirect impacts, such as weeds and pests, noise and vibration, dust, artificial lighting, vehicle strike and bushfire, will be managed, as outlined in sections 10.5 to 10.10 and are considered not to have potential to impact the availability or quality of habitat to the extent that the Greater Glider is likely to decline. The Groundwater Dependent Ecosystem Assessment (3D Environmental 2022) identified that the risk of impact on GDEs (which form a portion of Greater Glider habitat in the Project area) is 'low to insignificant'. The impact on groundwater drawdown is, therefore, unlikely to impact the availability or quality of habitat to the extent that the Greater Glider is likely to decline.
Result in invasive species that are harmful to a Vulnerable species becoming established in the Vulnerable species habitat	The study area is in a modified rural landscape, and invasive species exist in the broader region. Invasive species (Feral Cats and European Red Foxes) and native species (owls and Sulphur Crested Cockatoos) are recognised as a threat to the Greater Glider (DCCEEW 2022). Feral Cat and European Red Fox were recorded in surveys. Given the proposed monitoring and management of pests including corrective actions in accordance with a Weed and Pest Management Plan (Section 10.5), the Project is unlikely to result in the increase of invasive species likely to be harmful to the Greater Glider. The confidence in the threat posed by native species threats is considered low and are these threats are considered applicable for small parts of the Greater Glider range (DCCEEW 2022). The numbers of native owls or Sulphur-crested Cockatoos are considered unlikely to be a threat to the Greater Glider in the study area and the Project is unlikely to impact these threats.
Introduce disease that may cause the species to decline	There are no diseases of the Greater Glider listed as a threat to the species (DCCEEW 2022). The Project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	There is no adopted or made Recovery Plan for this species; however, a Recovery plan is considered to be required (DCCEEW 2022). Priority conservation actions identified by Conservation Advice (DCCEEW 2022) include: • management of habitat loss, disturbance and modification (including fire) including protection of unburnt habitat, revision of prescribed burning prescriptions, protection of habitat trees, avoidance of habitat fragmentation and avoidance of the use of barbed wire; • protection of climate change refuge habitat and improve micro-climate conditions in at risk areas; • manage invasive species threats; and • investigate the feasibility of reintroductions to areas the species was extirpated. The Project is unlikely to substantially interfere with the recovery of the species. The removal of 11.9 ha of habitat and potential ponding impact on 88.7 ha of habitat is considered not to substantially interfere with the recovery of the species.

Significance criteria	Assessment of significance
Conclusion	The Project will result in the clearing or disturbance of 100.6 ha of Greater Glider habitat, including 14.2 ha of high amenity habitat, 20.7 moderate amenity habitat and 65.6 ha of low amenity habitat. All Greater Glider habitat identified within the study area is considered likely to be critical to the survival of the species, and the clearing and ponding impact on 100.6 ha of habitat is considered to be a significant impact. The extent of these impact areas is shown in Figure 11.10.

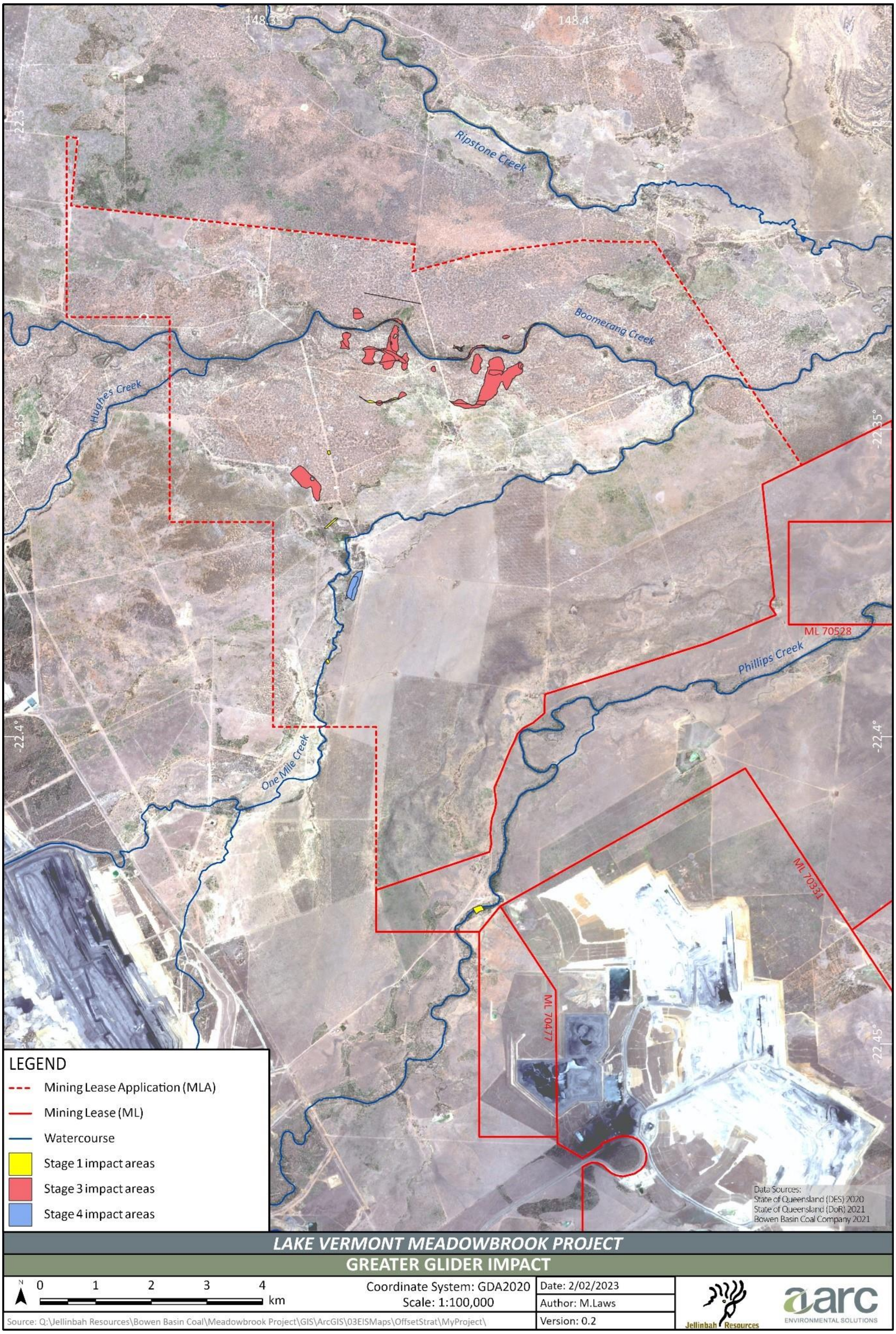

Figure 11.10: Greater Glider significant impact areas

11.1.9 Migratory Species

11.1.9.1 Desktop analysis and Description

Desktop analysis has been conducted of relevant databases to determine records of migratory species within the vicinity of the Project, including Wildlife Online, Queensland Museum, Wildnet and Atlas of Living Australia occurrence records. The desktop assessment also includes reviews of an ecological survey and assessments of nearby developments for information/records relating to migratory species.

Sixteen species listed as migratory under the EPBC Act have been identified by the desktop assessment as having known records within the wider region (50 km search area) (Table 6.2 in Section 6.2.1.3). While not having known records within 50 km of the study area, an additional four species listed in the TOR for the Project (Oriental Cuckoo, Yellow Wagtail, Curlew Sandpiper[7] and Pectoral Sandpiper), have also been considered in the survey and assessment of migratory species.

A description of each migratory species, including its distribution, habitat and ecology and assessment of likelihood of occurrence, is provided in Appendix E (or Appendix G for migratory species also listed as threatened under the EPBC Act).

Thirteen migratory species have been identified as having the potential to occur within the study area:

1) Fork-tailed Swift;
2) Gull-billed Tern;
3) Caspian Tern;
4) Black-faced Monarch;
5) Satin Flycatcher;
6) Rufous Fantail;
7) Common Sandpiper;
8) Sharp-tailed Sandpiper;
9) Red-necked Stint;
10) Latham’s Snipe;
11) Greenshank;
12) Marsh Sandpiper; and
13) Glossy Ibis.

Migratory species considered to have a higher likelihood of occurring within the study area are the:

- Fork-tailed Swift;
- Satin Flycatcher;
- Caspian Tern;
- Latham’s Snipe; and
- Glossy Ibis.

Five migratory species are considered unlikely to occur in the study area (Osprey, Oriental Cuckoo, Spectacled Monarch, Yellow Wagtail and Pectoral Sandpiper), the species have still been targeted by the field surveys as described in Appendix H.

[7] The Curlew Sandpiper is also listed as threatened under the EPBC Act and has been considered in the assessment of threatened species.

11.1.9.2 Survey effort

Seasonal fauna surveys have been undertaken in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September 2021) consistent with Commonwealth and Queensland survey guidelines.

0 describes the survey effort undertaken and how the survey effort compares to relevant Commonwealth and State guidelines and best practice survey guidelines for each migratory species. In summary, survey methods and effort generally complied with survey guidelines and included, but was not limited to:

- 14 systematic survey sites;
- 75 person hours of active searching;
- 83 person hours of diurnal bird surveys;
- opportunistic observations; and
- survey and inspection of farm dams and wetlands.

While other survey methods have been employed during the terrestrial ecology surveys, those mentioned above are the most relevant for the detection of the migratory birds potentially occurring within the study area.

11.1.9.3 Survey outcomes

Two migratory species listed under the EPBC Act have been recorded within the study area during the field surveys: the White-throated Needletail and the Caspian Tern (Figure 9.2).

The survey outcomes and assessment for the White-throated Needletail are provided in Section 11.1.4. One Crested Tern was recorded opportunistically during the autumn 2021 field survey at a lacustrine wetland (farm dam) within the cleared agricultural area (Figure 9.2).

11.1.9.4 Habitat assessment

The wetland areas, farm dams and/or inundated paddocks within the study area provide potential foraging habitat for occasional migratory species that utilise wetland habitats, particularly when climatic conditions are suitable. These include species such as the:

- Gull-billed Tern;
- Caspian Tern;
- Common Sandpiper;
- Sharp-tailed Sandpiper;
- Marsh Sandpiper;
- Red-necked Stint;
- Latham's Snipe; and the
- Greenshank and Glossy Ibis.

The wetland and gilgai habitats mapped as providing potential intermittent foraging habitat for the Australian Painted Snipe (Figure 11.6) within the study area provide potential habitat for the migratory wetland species. As discussed in Section 11.1.6.5 for the Australian Painted Snipe, wetted gilgai habitat is only available for a short period after rainfall when the gilgai are full. While inspections of farm dams within the study area indicate they do not provide suitable foraging habitat for the Australian Painted Snipe, they may provide potential foraging habitat for migratory wetland bird species. The location of farm dams within the study area is shown on Figure 11.5.

Remnant vegetation within the study area provides potential habitat for occasional migratory species such as the:

- Fork-tailed Swift;
- Black-faced Monarch; and the
- Satin Flycatcher and the Rufous Fantail.

The areas of remnant vegetation within the study area providing potential or known habitat for the Koala (Figure 11.7) provides potential habitat for the migratory woodland bird species.

The study area does not provide potential breeding habitat for migratory species, with many being non-breeding visitors to Australia.

11.1.9.5 Impact assessment

As described in Section 11.1.9.4, wetland areas, farm dams and/or inundated paddocks within the study area provide potential intermittent foraging habitat for occasional migratory species that utilise wetland habitats. Approximately 38.4 ha of this habitat will be cleared by the Project. A further 29.5 ha of this habitat will be impacted by residual ponding, which represents a change in this habitat rather than a removal of this habitat. A total of 213.9 ha is modelled to undergo increased ponding as a result of changed hydrology due to surface subsidence (WRM 2022). These areas are likely to result in increased suitability for migratory species that use wetland habitats. Remnant vegetation within the study provides potential habitat for occasional migratory species that utilise woodland habitats. A total of 12.2 ha of remnant vegetation is proposed to be cleared for the Project, and a further 96.9 ha of remnant vegetation is predicted to be substantially impacted by residual ponding. The impacts to migratory species' habitat will add to habitat disturbance that is proposed to occur for other Projects in the region. The Project will not fragment habitat for mobile migratory species.

The extent of flooding is predicted to increase along the margins of subsided panels; however, the changes to flood levels are considered not significant (WRM 2022). Therefore, the impact of changes to flooding regimes on migratory species are not expected to be significant.

An assessment of the significance of the Project impacts on migratory species is provided in Section 11.1.9.8.

11.1.9.6 Avoidance, mitigation and management

The Project has been designed to avoid and mitigate impacts to migratory species where practicable. The proposed avoidance and mitigation measures for migratory species, including timing, predicted effectiveness, monitoring, adaptive management and the relevant statutory or policy basis is provided in Table 11.30.

Table 11.30: Migratory Species impact avoidance and mitigation measures

Avoidance/mitigation measures	**Timing**	**Predicted effectiveness**	**Monitoring and adaptive management**	**Statutory or policy basis**
Project infrastructure has been located to minimise direct disturbance to remnant vegetation and wetland habitats.	Mine planning/ construction/ operations	Highly effective—minimises the extent of impacts to migratory woodland species habitat.	Monitor disturbance/vegetation clearance areas against approved disturbance limits. Should clearing exceed approved limits, incident reporting would be initiated with a corrective action plan will be proposed (including proposed timing) and implemented. The corrective actions will be informed by the nature and extent of the exceedance.	DoE (2015a), DAWE (2021)
Disturbance areas will be delineated to prevent accidental damage to adjacent remnant vegetation/habitat.	Construction/ operations	Highly effective management technique to manage Project disturbance activities.		
Design and undertake subsidence drainage management works to minimise hydrological changes to gilgai and wetland habitats.	Mine planning/ operations	The hydrological modelling (WRM 2022) indicates the subsidence mitigation works will be effective in minimising the hydrological changes that will occur as a result of mine subsidence to gilgai and wetland habitats.	Subsidence effects and implemented mitigation and rehabilitation measures will be monitored in accordance with the Subsidence Management Plan (Section 10.2) to be prepared for the Project. Audit(s) will be conducted and follow up corrective measures (e.g. additional drainage works) will be implemented as required.	DoE (2015e), DoE (2015a), DAWE (2021)
Implement erosion and sediment control measures.	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for erosion and sedimentation.	Monitoring will be conducted of the integrity and effectiveness of implemented erosion and sediment controls in accordance with the Erosion and Sediment Control Plan that will be prepared for the Project. Adaptive management measures (such as installation of additional erosion controls or increase in frequency of inspections) will be implemented, as required. .	DoE (2015a), DAWE (2021)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Implement measures to reduce the risk of the introduction of pollutants (e.g. bunding or containment of hydrocarbon storages, provision of spill kits).	Construction/ operations/ rehabilitation and decommissioning	Highly effective management measure to minimise the potential for leaks and spills or other pollutants being introduced to migratory species habitat.	Visual inspections will be conducted of containment measures at MIA. Maintenance or implementation of additional controls, as required, will be carried out to maintain integrity and effectiveness. Audits of management measures and identification and implementation of potential system improvements will be undertaken.	DoE (2015a), DAWE (2021)
Regularly inspect mine-related surface disturbance areas and Bowen Basin Coal owned land to identify areas requiring weed management measures to be implemented. Implement weed management measures (e.g. mechanical removal and application of approved herbicides).	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the spread and occurrence of weeds.	Monitor and manage weeds in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts, or alternative control strategies) will be implemented, as necessary.	DoE (2015a), DAWE (2021), Commonwealth of Australia (2017a), Qld Department of Agriculture and Fisheries weed control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020)
Maintain a clean, rubbish-free environment to discourage scavenging and reduce the potential for colonisation of these areas by introduced fauna.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Regular monitoring of site will be carried out by environmental personnel. Raise awareness through personnel inductions. Additional measures (such as tool box talks or staff newsletters) will be implemented if inspections indicate a clean, rubbish-free environment is not being maintained.	DoE (2015a), DAWE (2021), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)

Avoidance/mitigation measures	Timing	Predicted effectiveness	Monitoring and adaptive management	Statutory or policy basis
Store domestic waste in appropriate receptacles and locations.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests if site protocols are followed by personnel.	Regular monitoring of site will be carried out by environmental personnel. Monitoring and auditing of the Waste Management Plan will be updated for the Project. Additional measures (such as provision of additional receptacles or change in location of receptacles) will be implemented if current storage practices encourage feral animals	DoE (2015a), DAWE (2021), Commonwealth of Australia (2017b), DoE (2015b), DEWHA (2008b)
Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be prepared for the Project.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Corrective actions (such as increasing the frequency or extent of control efforts or alternative control strategies) will be implemented, as necessary.	DoE (2015a), DAWE (2021), Commonwealth of Australia (2017b), Qld Department of Agriculture and Fisheries pest control strategies (https://www.daf.qld.gov.au), Isaac Regional Council (2020), DoE (2015b), DEWHA (2008b)
Consult with the Isaac Regional Council and neighbouring mines in relation to weed and pest management activities.	Construction/ operations/ rehabilitation and decommissioning	Effective management measure to manage the occurrence and abundance of feral pests.	Monitor and manage pests in accordance with the Weed and Pest Management Plan (Section 10.5) to be updated for the Project. Audits will be implemented to monitor the consultation outcomes and the management measures implemented on site.	DoE (2015a), DAWE (2021), Commonwealth of Australia (2017a), Commonwealth of Australia (2017b), Isaac Regional Council (2020)

11.1.9.7 Statutory requirements

As described in Section 5.1.2, Australia is party to various international conventions and agreements to protect migratory species. These include the:

- China–Australia Migratory Bird Agreement (CAMBA);
- Japan–Australia Migratory Bird Agreement (JAMBA);
- Republic of Korea–Australia Migratory Bird Agreement (ROKAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Each of these agreements provides for the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships (DAWE 2020). Bird species listed within the appendices/annexes of these agreements/conventions, are subsequently listed as migratory species under the EPBC Act.

The EPBC Act provides the domestic legal framework for implementing Australia's obligations under a number of international conventions related to the environment, including but not limited to, the Bonn Convention. The EPBC Act also includes provisions relating to migratory bird conservation bilateral agreements, including CAMBA, JAMBA and ROKAMBA.

Threats to migratory species include (DoE 2015a, DAWE 2021a):

- loss, modification or fragmentation of habitat;
- invasive species that are harmful to the migratory species;
- actions that result in mortality (e.g. collisions with wind turbines, windows, light houses); and
- human activities at international breeding sites.

The Project will not be inconsistent with Australia's obligations under the Bonn Convention, CAMBA, JAMBA, ROKAMBA or an international agreement approved under subsection 209(4) of the EPBC Act. The terrestrial ecology assessment has:

- conducted a thorough desktop assessment to identify migratory species with the potential to be impacted by the Project (Section 11.1.9.1 and Appendix B);
- identified the habitat and lifecycle requirements of migratory species and considered their likelihood of occurrence (Section 11.1.9.1 and Appendix E);
- undertaken field surveys to target migratory species within the study area in consideration of Commonwealth and Queensland survey guidelines (Section 11.1.9.2 and 0);
- identified potential habitat for migratory species within the study area;
- identified potential impacts of the Project on migratory species and their habitats (Sections 10 and 11.1.9.5);
- developed avoidance, mitigation and management measures to avoid or minimise potential impacts on migratory species and their habitat (Sections 10 and 11.1.9.6); and
- assessed the significance of the impacts in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a), which has indicated the Project will not result in a significant impact to migratory species (Section 11.1.9.8).

11.1.9.8 Significant impact assessment

Table 11.31 provides an assessment of the likelihood of significant impacts on migratory species that have the potential to occur in the study area in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a).

An area of 'important habitat' for a migratory species is (DoE 2013a):

a) habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or

b) habitat that is of critical importance to the species at particular life-cycle stages, and/or

c) habitat utilised by a migratory species which is at the limit of the species range, and/or

d) habitat within an area where the species is declining.

The potential habitat available to migratory species in the study area is unlikely to provide important habitat for any migratory species.

Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important (DAWE 2021a). Wetland habitat is considered *internationally important* if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird or a total abundance of at least 20,000 waterbirds. *Nationally important habitat* for migratory shorebirds regularly supports 0.1% of the flyway population of a single species of migratory shorebird, or 2,000 migratory shorebirds or 15 migratory shorebird species.

The 'Revision of the East Asian-Australasian Flyway Population Estimates for 37 Listed Migratory Shorebird Species' (Hansen *et al.* 2016) provides population estimates for 37 migratory shorebirds to help define 'important habitat' for these species. As an example, important habitat for Latham's Snipe is described as areas that have previously been identified as internationally important for the species or areas that support at least 18 individuals of the species (Hansen *et al.* 2016). The 'Referral Guideline for 14 birds Listed as Migratory (DoE 2015a)' also outlines ecologically significant proportions of 14 migratory species, including the Fork-tailed Swift, Rufous Fantail, Black-faced Monarch and Satin Flycatcher.

As described in Section 11.1.9.3, one Crested Tern has been recorded at one time during surveys conducted over several seasons. Similarly, extensive field surveys conducted for nearby studies and in the wider region also recorded migratory species in low numbers. The area is unlikely to support an ecologically significant proportion of the population of a migratory species.

Table 11.31: Migratory species significant impact assessment

Significance criteria	**Assessment of significance**
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	
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	The study area is unlikely to represent an area of important habitat for any migratory species, including the Crested Tern. The Project will not substantially modify, destroy or isolate an area of important habitat for a migratory species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	The study area is unlikely to represent an area of important habitat for a migratory species. Predation by feral species, such as the European Red Fox and Feral Cat is a recognised threat to species such as Latham's Snipe; both pests have been recorded in the study area. The Project is unlikely to increase these threats or result in invasive species becoming established in potential habitat for migratory species.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Project is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of a population of a migratory species.
Conclusion	The Project will not result in a significant impact to migratory species listed under the EPBC Act.

11.2 Matters of State Environmental Significance

Sections 11.2.1 to 11.2.4 provide an assessment of impacts on matters of state environmental significance in accordance with the 'Queensland Environmental Offsets Policy Significant Residual Impact Guideline' (DEHP 2014) (Significant Residual Impact Guideline). As the EO Act does not apply to impacts on EPBC Act MNES that are being assessed by the Commonwealth Government, the matters addressed in this section only include matters of state environmental significance that are not already addressed in Section 11.1:

- regulated vegetation;
- connectivity areas; and
- protected wildlife habitat (Short-beaked Echidna).

The impact assessments consider the potential impacts of the Project and the avoidance, mitigation and management measures described in Section 10.

The impacts to wetlands and watercourses are assessed separately within the surface water assessment and groundwater assessment of the Project.

11.2.1 Regulated Vegetation

Regulated vegetation is a 'prescribed regional ecosystem' that:

- is an Endangered or Of Concern regional ecosystem, as defined under the VM Act; or
- intersects with an area shown on the vegetation management wetlands map, as defined under the VM Act; or
- is located within the defined distance from the defining banks of a watercourse identified on the vegetation management watercourse map, as defined under the VM Act.

11.2.1.1 Endangered and Of Concern Regional Ecosystems

Under the EO Act 2014, offsets are required for significant residual impacts on remnant Of Concern and Endangered REs defined under the VM Act.

The field-verified vegetation map (Figure 8.1) identified the following remnant REs under the VM Act within the study area:

- four Endangered (RE 11.3.1, 11.4.8, 11.4.9 and 11.5.17); and
- three Of Concern (RE 11.3.2, 11.3.3 and 11.3.4).

The extent of the Endangered and of concern REs are presented in Figure 11.11.

The Significant Residual Impact Guideline provides thresholds for clearing that is considered to represent a significant residual impact based on the structural category of the regional ecosystem.

A significant impact will occur if the Project will result in clearing of an Endangered or Of Concern RE in an:

- area greater than 5 ha where in a grassland (structural category) regional ecosystem; or
- area greater than 2 ha where in a sparse (structural category) regional ecosystem; or
- area greater than 0.5 ha where in a dense to mid-dense (structural category) regional ecosystem.

Table 11.32 describes the structural category of each Endangered and Of Concern RE and the proposed extent of disturbance to each RE.

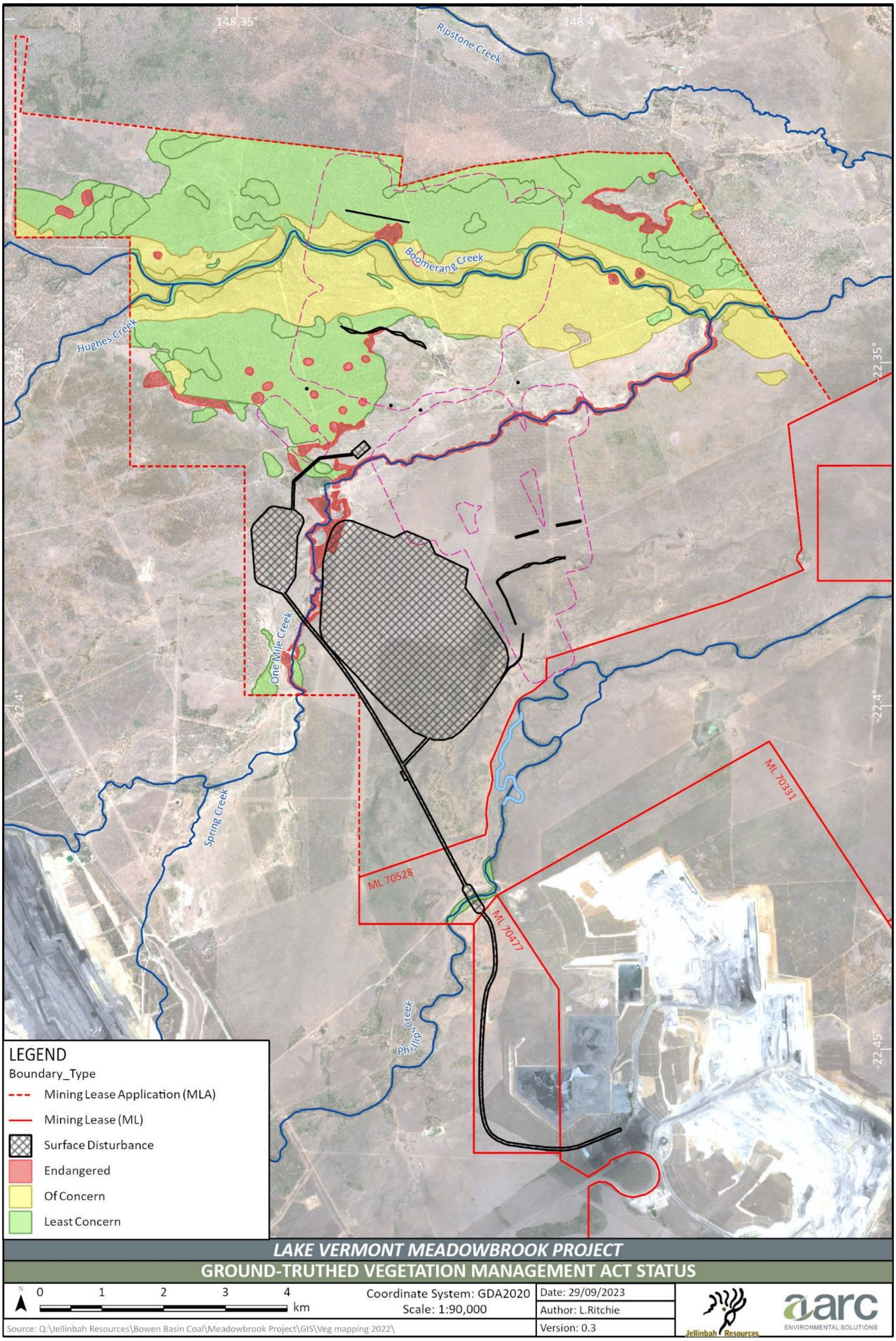

Figure 11.11: Ground-truthed Vegetation Management Act status

Table 11.32: Endangered and Of Concern Regional Ecosystems assessment summary

Regional Ecosystem	Extent within study area (ha)	Structural category	Assessment criteria	Assessment against criteria	Stage 1,2,3 direct disturbance (ha)	Stage 4 (ha)	Predicted periodic ponding (ha)
Endangered RE							
11.3.1	106.2	Mid-dense	Clearing exceeds 0.5 ha	Yes, the Project will result in the removal of 12.1 ha of this community, 4.8 ha of which does not represent the Brigalow TEC[1]	0.3 (0.0 not TEC)	3.6 (3.6 not TEC)	8.2 (1.2 not TEC)
11.4.8	51.4	Sparse	Clearing exceeds 2 ha	Yes, the Project will result in the removal of 3.9 ha of this community, 3.3 ha of which does not represent the Brigalow TEC[1]	0.3 (0.0 not TEC)	3.5 (3.3 not TEC)	0.1 (0.0 not TEC)
11.4.9	19.4	Sparse	Clearing exceeds 2 ha	No, the Project will not clear vegetation within this vegetation community.	0.0	0.0	0.0
11.5.17	21.3	Sparse	Clearing exceeds 2 ha	No, the Project will not clear vegetation within this vegetation community.	0.0	0.0	0.0
Of Concern RE							
11.3.2	960.2	Sparse	Clearing exceeds 2 ha	Yes, the Project will result in the removal of 58.3 ha of this community, all of which represents the Poplar Box TEC[1].	0.0	0.0	58.3 (13.9 not TEC)
11.3.3	12.2	Sparse	Clearing exceeds 2 ha	No, the Project will not clear vegetation within this vegetation community.	0.0	0.0	0.0
11.3.4	178.0	Sparse	Clearing exceeds 2 ha	Yes, the Project will result in the removal of 4.9 ha of this community.	0.0	0.0	4.9

[1] The ‘Queensland Environmental Offsets Policy (Version 1.9)’ (DES 2021b) states that the State Government can only impose an offset condition in relation to a prescribed activity if the same matter has not been subject to assessment under the EPBC Act.

Areas of vegetation within the subsidence footprint, but outside of predicted residual ponding areas are not expected to be deleteriously impacted (refer Section 10.2.4). Subsidence impacts related cracking and erosion are assessed in Section 10.2.3, and Section 10.11. Given the proposed monitoring and management measures for erosion, no substantial erosion is expected to occur and it is considered unlikely that erosion will impact regulated vegetation.

Offsets will be required for the significant residual impacts on Endangered REs for the 4.8 ha of RE 11.3.1 and 3.3 ha of RE 11.4.8, which are not subject to offset conditions for the Brigalow TEC.

Offsets will be required for the significant residual impact on Of Concern REs for the 4.9 ha of RE 11.3.4 and 13.9 ha of RE 11.3.2.

11.2.1.2 Clearing in the portion of a RE that lies within a VM Act mapped wetland

Offsets are required under the EO Act for significant residual impacts on remnant REs that lie within a mapped vegetation management wetland or are within 50 m of the defining bank of a VM Act wetland. For an activity to have a significant residual impact on a RE that is within a mapped wetland, the same thresholds described for Regional and Of Concern REs must be exceeded (i.e. clearing of greater than 0.5 ha in mid-dense REs and clearing of greater than 2 ha in sparse REs).

A total of four VM Act wetlands will be impacted by the Project. The mapped VM Act wetlands within the study area and surrounds are shown on Figure 3.1 and the impacted wetlands are presented in Table 11.33.

One VM Act wetland is partially within the ETL disturbance footprint area. The area of disturbance is 0.01 ha within the wetland and 0.48 ha within 50 m of the wetland defined bank. The wetland vegetation is RE 11.3.27f, no vegetation structure category is assigned for this RE (DES 2021a). However, the impact to this RE does not exceed the threshold for any of the structure categories.

Three VM Act wetlands are within the Stage 3 subsidence area. The hydraulic modelling for the surface water assessment (WRM 2022) has identified three existing periodic ponding areas that largely align with the mapped VM Act wetlands. The modelling has also identified that these three ponding areas will be impacted by the predicted surface subsidence. For the purpose of this assessment, the impacts on these ponding areas are considered analogous to the expected impacts on the associated mapped VM Act wetlands. The vegetation of the three impacted wetlands is RE 11.5.17, which a is sparse vegetation category.

- One VM Act wetland of 1.8 ha is within the underground mining Stage 3 predicted periodic ponding footprint. The predicted increase in ponding represents a change in habitat that may increase the frequency and duration of ponding in the wetland. This is expected to result in a change that is detrimental to the vegetation fringing in the current wetland and is considered to be a significant impact.
- One VM Act wetland of 3.5 ha will be partially impacted by subsidence from Stage 3 underground mining. The area of the wetland that will receive periodic inundation is predicted to be reduced as a result of the predicted surface subsidence. The lack of periodic inundation is expected to be detrimental to the vegetation of the wetland, and it is considered that the portion of the wetland that will receive reduced inundation (0.8ha) will be significantly impacted.
- One VM Act wetland of 2.1 ha will be entirely impacted by subsidence from Stage 3 underground mining. A longwall pillar will be located under the wetland, and the wetland is predicted not to receive periodic inundation as a result of the expected surface subsidence. This change is considered to be a significant impact.

A total of 4.7 ha of VM Act wetlands of RE 11.5.17 are predicted to be impacted by the Project. This exceeds the thresholds relevant to the vegetation structure categories. Therefore, a significant residual impact is expected to occur to 4.7 ha, and offsets will be required.

Table 11.33: VM Act wetland impacts

Wetland	VM Act wetland extent (ha)	RE	Structure category	Area impacted (ha)	Nature of impact
Wetland located 200 m to the north of One Mile Creek near the proposed ETL.	3.7	11.3.27	None assigned	0.01	Direct clearing for ETL.
Wetland located 400 m to the south of Boomerang Creek within proposed subsidence area and residual ponding area.	1.8	11.5.17	Sparse	1.8	Modelled to have extent completely inundated by periodic ponding.
Wetland located between Boomerang Creek and One Mile Creek and within the proposed subsidence area.	3.5	11.5.17	Sparse	0.8	Modelled to have inundated area reduced.
Wetland located between Boomerang Creek and One Mile Creek and within the proposed subsidence area.	2.1	11.5.17	Sparse	2.1	Modelled to no longer be periodically inundated.

11.2.1.3 Regional Ecosystems within a defined distance of a VM Act watercourse

The Queensland Government vegetation management watercourse map shows watercourses defined under the VM Act that are used to regulate vegetation clearing in proximity of watercourses (DEHP 2014). Boomerang Creek, Hughes Creek, One Mile Creek and Phillips Creek are defined watercourses under the VM Act (Figure 6.4) within the study area.

Offsets may also be required under the EO Act for significant residual impacts on remnant REs located within 5 m of the defining banks of a VM Act watercourse. For an activity to have a significant residual impact, the same thresholds described for Regional and Of Concern REs must be exceeded (i.e. clearing of greater than 0.5 ha in mid-dense REs and clearing of greater than 2 ha in sparse REs).

Appendix 3 of the 'Queensland Environmental Offsets Policy', lists the defined distance of REs for measuring significance of impacts to watercourse vegetation. For 1st and 2nd order streams, the defined distance is 25 m from the defining banks. For 3rd and 4th order streams, the defined distance is 50 m from the defining banks. For 5th order streams, the defined distance is 100 m from the defining banks.

Remnant vegetation of REs within the defined distance of VM Act watercourses in the study area that will be cleared or impacted by predicted periodic ponding for areas that exceed the threshold include:

- 8.0 ha of RE 11.3.1; and
- 6.1 ha of RE 11.3.25.

Offsets will be required for these impacts to vegetation within the defined distance of a watercourse.

11.2.2 Connectivity Areas

In accordance with the Significant Residual Impact Guideline, the Landscape Fragmentation and Connectivity Tool has been used to assess the significance of impact on connectivity areas.

An impact on connectivity areas is determined to be significant if:

- the change in the core remnant ecosystem extent at the local scale (post impact) is greater than a threshold determined by the level of fragmentation at the regional scale; or

- any core area that is greater than or equal to 1 ha is lost or reduced to patch fragments (core to non-core).

The assessment has determined that the Project change in the core remnant ecosystem extent at the local scale is below the threshold of regional fragmentation. The assessment has also determined that the number of core remnant areas occurring on the site will not be reduced by the Project. The assessment has concluded that any impact on connectivity areas is not significant. The Landscape Fragmentation and Connectivity Tool output is provided in Appendix K.

11.2.3 Wetlands and Watercourses

Assessment of impacts on wetlands and watercourses has been conducted within the aquatic ecology assessment.

11.2.4 Protected Wildlife Habitat

11.2.4.1 Essential Habitat

Essential habitat is shown on the regulated vegetation management map under the VM Act and is areas that contain at least three essential habitat factors for protected wildlife or areas in which the protected wildlife is located. Essential habitat is mapped within the study area for the Ornamental Snake (refer to Appendix C). This species is listed as both a MNES and MSES and impacts on this species are addressed in Section 11.1.

11.2.4.2 Habitat for an Endangered, Vulnerable or Special Least Concern Animal

Protected wildlife habitat includes an area of habitat for an Endangered, Vulnerable or Special Least Concern animals (DEHP 2014).

Five fauna species listed as Endangered or Vulnerable under the NC Act have been identified during field surveys:

1) Ornamental Snake
2) Squatter Pigeon (Southern)
3) White-throated Needletail
4) Koala; and
5) Greater Glider.

All these species are also listed as threatened under the EPBC Act and have been assessed in accordance with the Commonwealth 'Significant Impact Guidelines 1.1: Matters of National Environmental Significance' (DoE 2013a) in Section 11.1.

Two Special Least Concern (migratory) species listed under the NC Act have been recorded by the surveys:

- White-throated Needletail (also listed as Vulnerable); and
- Crested Tern (*Thalasseus bergii*).

These species are also listed as migratory under the EPBC Act and have been assessed in Section 11.1.9, along with other Special Least Concern (migratory) species that are likely to have the potential to occur within the study area.

The Short-beaked Echidna (*Tachyglossus aculeatus*), which is listed as a non-migratory Special Least Concern species under the NC Act has also been recorded during the surveys. An assessment of the likelihood of significant impacts on the Short-beaked Echidna is provided below.

Short-beaked Echidna

The Short-beaked Echidna is found in almost all Australian environments and is present in all Australian states (Van Dyck and Strahan 2008). This species is known from a variety of habitat types, including open forests, grasslands and heavily vegetated woodlands. Distributions in arid regions are generally sparse. The Short-beaked Echidna has no particular habitat requirements outside of the supply of ants and termites for its diet (Van Dyck and Strahan 2008). This species generally seeks shelter under thick bushes, in hollow logs, in debris and has been known to occasionally shelter in rabbit or wombat burrows (Van Dyck and Strahan 2008).

The Short-beaked echidna is a solitary species, with overlapping home ranges and no fixed nesting sites (Van Dyck and Strahan 2008). In arid regions, the species is known to forage at night to avoid high temperatures (Van Dyck and Strahan 2008). In temperate regions, the pattern of activities varies depending on temperatures, but the species typically foraging around dusk and dawn (Van Dyck and Strahan 2008). Habitat loss poses a threat to the Echidna, and the retention of habitat, such as fallen logs, branches, tree stumps, leaf litter and debris, is beneficial to this species (NSW National Parks and Wildlife Service 1999). The Short-beaked Echidna is thought to have few natural enemies; however, it may be killed by cars, dogs, foxes, cats and occasionally goannas (Australian Museum 2021).

The Short-beaked Echidna has been recorded opportunistically within cleared agricultural land within the study area during the autumn 2021 and spring 2021 surveys. The locations at which the species has been recorded in the study area is shown on Figure 9.2. While the Short-beaked Echidna is known to use cleared and disturbed habitats, remnant habitats in the study area are likely to be preferred (over 3,440 ha in the study area). The Project will result in the clearing/disturbance of approximately 12.2 ha of remnant vegetation and 797.7 ha of cleared agricultural areas and high value regrowth. Areas of indirect disturbance, such as predicted ponding and predicted subsidence, are not expected to constitute a disturbance with magnitude or intensity sufficient to impact the habitat utility for the echidna. Subsidence areas, including the areas which may undergo intermittent ponding, are expected to retain vegetation sufficient to provide Short-beaked Echidna habitat (refer Section 10.2.4).

Table 11.34 provides an assessment of the likelihood of significant impacts on the Short-beaked Echidna in accordance with the Significant Residual Impact Guideline.

Table 11.34: Short-beaked Echidna significant impact assessment

Significance criteria	Assessment of significance
An action is likely to have a significant impact on a special Least Concern (non-migratory) animal wildlife habitat if it is likely that it will result in:	
A long-term decrease in the size of a local population	Approximately 12.2 ha of remnant vegetation and 797.7 ha of cleared agricultural land is proposed to be cleared by the Project. The Short-beaked Echidna utilises a wide range of habitats, which are widespread in the study area and wider region. The extent of habitat disturbance proposed is unlikely to lead to a long-term decrease in the size of a local population given the extent of habitat that remains available in the local area and wider region.
A reduced extent of occurrence of the species	While the Project will disturb potential habitat for the Short-beaked Echidna, it is unlikely to reduce the extent of occurrence of this species. The Project is not near the edge of the known distribution of the Short-beaked Echidna.
Fragmentation of an existing population	The Short-beaked Echidna is a mobile species able to move across cleared or disturbed land. Connectivity of habitats is unlikely to be significantly affected by the proposed vegetation clearance and disturbance associated with the Project. The Project is unlikely to fragment an existing population into two of more populations.
Genetically distinct populations forming as a result of habitat isolation	The Project is unlikely to isolate or fragment an existing population of the Short-beaked Echidna and is, therefore, unlikely to result in genetically distinct populations forming.
Disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	The Short-beaked Echidna is a mobile species that uses a diverse range of habitats. While direct impacts on Short-beaked Echidna generic foraging habitat and potentially breeding/nesting habitat will occur within proposed Project disturbance areas, similar and higher quality habitat occurs on adjacent and nearby lands within the study area. The habitat within the proposed disturbance areas is unlikely to be of any specific significance to the local population.
Conclusion	The Project is unlikely to result in a significant impact to the Short-beaked Echidna.

12 Environmental offset requirements

12.1.1 Summary of MNES offset requirements

The assessments of significance for MNES are provided in Section 11.1. They indicate that the Project is unlikely to result in a significant impact on the White-throated Needletail, Australian Painted Snipe, Squatter Pigeon and migratory birds. The assessments of significance indicate that the Project is likely to have a significant impact on the following MNES, and offsets will be required in accordance with the '*Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy' (DSEWPaC 2012b):

- Brigalow TEC (7.9 ha);
- Poplar Box TEC (44.4 ha);
- Ornamental Snake (207.1 ha);
- Koala (109.2 ha); and
- Greater Glider (100.6 ha).

A Biodiversity Offset Strategy will be prepared for the Project under the EPBC Act. The strategy will include habitat quality information for the proposed disturbance areas, habitat quality information for the proposed offset sites on Bowen Basin Coal owned land adjacent to the Project and outline the proposed provision of offsets for impacted matters.

12.1.2 Summary of MSES offset requirements

The assessments of significance for MSES (that are not assessed under the EPBC Act) are provided in Section 11.2. The impacts to MSES and associated offset requirements for the Project are summarised in Table 12.1. In summary, offsets will be required for the Project for significant residual impacts on regulated vegetation (Endangered and Of Concern REs), REs within mapped vegetation management wetlands and REs within the defined distance of a vegetation management watercourse in accordance with the EO Act and Queensland Environmental Offsets Policy.

It is noted that the authorised impacts to prescribed environmental matters for Lake Vermont Mine include:

- regulated vegetation for REs within a defined distance of a relevant watercourse for;
    - RE 11.3.25 within defined distance of a relevant watercourse;
    - RE 11.3.27 within defined distance of a relevant wetland; and
- protected wildlife habitat for the Squatter Pigeon.

Therefore, under the Queensland Environmental Offsets Policy, for the purposes of the impacts to these matters, all impacts identified are considered cumulative to the approved authorised impact and require offsets. This includes direct impacts to Squatter Pigeon habitat assessed to not meet the significance assessment criteria of the Significant Impact Guideline (DoE 2013a) in Section 11.1.5.6.

For all prescribed environmental matters, the size and scale of an offset is that which is necessary to achieve a conservation outcome.

In accordance with the Queensland Environmental Offsets Policy, for a land-based offset:

- for Endangered regional ecosystems, the offset site must be of the same broad vegetation group as the impacted regional ecosystem, of the same regional ecosystem status and within the same bioregion; and
- an offset site for connectivity must be a non-remnant ecosystem and be in the same subregion as the impact area.

For Endangered regional ecosystems, the offset requirement is set at a multiplier of four and for connectivity impacts, the offset requirement is set at a multiplier of one.

A Biodiversity Offset Strategy will be prepared for the Project under the EPBC Act that presents the offset requirements for the MSES (not already offset under the EPBC Act) and proposed provision of offsets for impacted matters.

Table 12.1: Summary of Impacts to MSES

Matter of State Environmental Significance			**Extent of disturbance (ha)**	**Offset required**
Regulated vegetation	Endangered REs	RE 11.3.1	12.1[1] (4.8 ha of which is assessed as not Brigalow TEC under the EPBC Act).	Yes, for the 4.8 ha of RE 11.3.1 not assessed as Brigalow TEC under the EPBC Act.
		RE 11.4.8	3.9[2] (3.3 ha of which is assessed as not Brigalow TEC under the EPBC Act).	Yes, for the 3.3 ha of RE 11.4.8 not assessed as Brigalow TEC under the EPBC Act.
		RE 11.4.9	No clearing of this vegetation community.	No.
		RE 11.5.17	No clearing of this vegetation community.	No.
	Of Concern REs	RE 11.3.2	58.3[3] (44.4 of which represents the Poplar Box TEC assessed under the EPBC Act).	Yes, for the 13.9 ha of RE 11.3.2 not assessed as Poplar Box TEC under the EPBC Act
		RE 11.3.3	No clearing of this vegetation community.	No.
		RE 11.3.4	4.9	Yes, for 4.9 ha.
	REs within mapped vegetation management wetlands		Significant hydrological change impacts to three wetland areas of RE 11.5.17.	Yes, for 4.7 ha of RE 11.5.17 wetland areas.
	REs within the defined distance of a vegetation management watercourse	RE 11.3.1	8.0	Yes, for 8.0 ha (and assessed as Brigalow TEC under the EPBC Act).
		RE 11.3.25	6.1	Yes, for 6.1 ha.
Connectivity areas			No significant impact.	No.
Wetlands and watercourses			No direct disturbance (wetlands). Not applicable (watercourses).	No.
	Essential habitat	Ornamental Snake	Refer to Section 11.1.3 of this report, significance assessment for the Ornamental Snake under the EPBC Act.	

Matter of State Environmental Significance			**Extent of disturbance (ha)**	**Offset required**
Protected Wildlife Habitat	Flora survey trigger map high risk area		Not applicable.	
	Area containing plants that are Endangered or Vulnerable wildlife		Not applicable.	No.
	Habitat for Endangered, Vulnerable or Special Least Concern Animal	Ornamental Snake	Refer to Section 11.1.3 of this report, significance assessment under the EPBC Act.	
		White-throated Needletail	Refer to Section 11.1.4 of this report, significance assessment under the EPBC Act.	
		Squatter Pigeon	Direct impacts considered to be significant as cumulative to authorise impacts for Lake Vermont Mine under Queensland Environmental Offsets Policy despite significance assessment under EPBC Act (refer to section 11.1.5)	
		Australian Painted Snipe	Refer to Section 11.1.6 of this report, significance assessment under the EPBC Act.	
		Koala	Refer to Section 11.1.7 of this report, significance assessment under the EPBC Act.	
		Greater Glider	Refer to Section 11.1.8 of this report, significance assessment under the EPBC Act.	
		Short-beaked Echidna	809.9 ha (including 12.2 ha remnant vegetation and 797.7 ha of cleared agricultural land).	No.
Designated Precinct in a Strategic Environmental Area			Not applicable.	No.
Protected Areas			Not applicable.	No.
Highly protected zones of State marine parks			Not applicable.	No.
Fish habitat areas			Not applicable.	No.
Waterway providing for fish passage			Refer to AARC (2021) Lake Vermont Mine Aquatic Ecology Assessment.	
Marine plants			Not applicable.	No.
Legally secured offset areas			Not applicable.	No.

13 References

3D Environmental 2022, Lake Vermont Meadowbrook Project*, Groundwater Dependent Ecosystem Assessment*, prepared by 83d Environmental for Bowen Basin Coal Pty Ltd.

AARC Environmental Solutions Pty Ltd (AARC) 2021, Lake Vermont Meadowbrook Project, *Aquatic Ecology Assessment*, for the Lake Vermont Meadowbrook Project, prepared for Bowen Basin Coal Pty Ltd.

AARC Environmental Solutions Pty Ltd (AARC), 2022, Lake Vermont Meadowbrook Project Soil and Land Suitability Assessment, Prepared for Bowen Basin Coal Pty Ltd by AARC Environmental Solutions Pty Ltd, 2022

Accad, A, Kelley, JAR, Richter, D, Neldner, VJ, and Li, J 2021, *Remnant Regional Ecosystem Vegetation in Queensland*, Analysis 1997-2019. Queensland Department of Environment and Science, Brisbane.

Aecom 2021, Saraji East Mining Lease Project, *Terrestrial Ecology Technical Report*, prepared by Aecom Australia Pty Ltd for BM Alliance Coal Operations Pty Ltd (BMA).

Atlas of Living Australia (ALA) 2018-2020, *Occurrence Records Search*, Atlas of Living Australia, viewed 2018-2020, <https://biocache.ala.org.au/search#tab_spatialSearch>.

Australasian Resource Consultants Pty Ltd (AARC) 2012, Lake Vermont Western Extension, *Terrestrial Flora and Fauna Assessment Report*, prepared for Lake Vermont Resources.

Australasian Resource Consultants Pty Ltd (AARC) 2016, Lake Vermont Northern Extension*, Flora and Fauna Report*, for the Lake Vermont Coal Mine Northern Extension, prepared for Bowen Basin Coal Pty Ltd.

Australasian Virtual Herbarium (AVH) 2019, *Macropteranthes leiocaulis occurrence records*, Australasian Virtual Herbarium < https://avh.ala.org.au/occurrences/search?taxa=Macropteranthes+leiocaulis>

Australian Biological Resources Study (ABRS) 2020, *Australian Faunal Directory*, Australian Biological Resources Study, Canberra, <https://biodiversity.org.au/afd/home>

Australian Museum 2021, *Short-beaked Echidna*, Australian Museum < https://australian.museum/learn/animals/mammals/short-beaked-echidna/>

Australian National Botanical Gardens (ANBG) 2019, *Macropteranthes leiocaulis*, Australian National Botanical Gardens < https://www.anbg.gov.au/cpbr/cd-keys/RFK7/key/RFK7/Media/Html/entities/Macropteranthes_leiocaulis.pdf>

Australian Plant Census (APC) 2020, *Vascular Plants Australian Plant Name Index (APNI)*, Centre for Australian National Biodiversity Research, Council of Heads of Australasian Herbaria, <https://biodiversity.org.au/nsl/services/APNI>.

Biodiversity Assessment and Management Pty Ltd (BAAM) 2009, *Caval Ridge Coal Mine Project Ecological Assessment*, Appendix K of the Caval Ridge Coal Mine Project Environmental Impact Statement, prepared for URS Australia.

BirdLife Australia 2019a, *The Atlas of Australian Birds: Gull-billed Tern*, < http://www.birdlife.org.au/bird-profile/gull-billed-tern>

BirdLife Australia 2019b, *The Atlas of Australian Birds: Spectacled Monarch* < http://www.birdlife.org.au/bird-profile/gull-billed-tern>

BM Alliance Coal Operations Pty Ltd (BMA) 2021, Saraji East Mining Lease Project, *Environmental Impact Statement*, prepared for BM Alliance Coal Operations Pty Ltd (BMA).

Briscoe, NJ, Krockenberger, A, Handasyde, KA & Kearney, MR 2015, '*Bergmann meets Scholander: geographical variation in body size and insulation in the Koala is related to climate*', Journal of Biogeography, vol. 42, no. 4, pp. 791–802.

Bureau of Meteorology (BoM) 2018-2020, *Groundwater Dependent Ecosystems Atlas*, Commonwealth of Australia, Canberra, <http://www.bom.gov.au/water/groundwater/gde/map.shtml>.

Bureau of Meteorology (BoM) 2020a, *Fitzroy Basin Map*, Commonwealth of Australia, Canberra, viewed: June 2020, <http://www.bom.gov.au/qld/flood/brochures/fitzroy/map.shtml>.

Bureau of Meteorology (BoM) 2020b, *Weather Station Directory: Moranbah Airport*, Commonwealth of Australia, Canberra, viewed: September 2020, <http://www.bom.gov.au/climate/data/stations/>

Bureau of Meteorology (BoM) 2020c, *Weather Station Directory: Clermont Airport*, Commonwealth of Australia, Canberra, viewed: September 2020, <http://www.bom.gov.au/climate/data/stations/>.

Bureau of Meteorology (BoM) 2020d, *Daily rainfall: Booroondarra*, Commonwealth of Australia, Canberra, viewed: September 2020, <http://www.bom.gov.au/jsp/ncc/cdio/wData/wdata?p_nccObsCode=136&p_display_type=dailyDataFile&p_stn_num=035109&p_startYear=>.

Butler, DW 2007, *Recovery plan for the "Brigalow (Acacia harpophylla dominant and co-dominant)" endangered ecological community (draft of 1 May 2007)*, Report to the Department of the Environment and Water Resources, Canberra, Queensland National Parks and Wildlife Service, Brisbane.

Churchill S 2008, *Australian Bats*, Reed New Holland, Sydney.

Clifton, ID, Ellis, W, Melzer, A & Tucker, G 2007, *Water turnover and the northern range of the Koala (Phascolarctos cinereus)*, Australian Mammalogy, vol. 29, no. 1, pp. 85–88.

Cogger, HG, Cameron, EE, Sadlier, RA & Eggler, P 1993, *The Action Plan for Australian Reptiles*, Canberra, ACT: Australian Nature Conservation Agency.

Commonwealth of Australia, 2015, Threat abatement Plan for predation by feral cats, Commonwealth of Australia, 2015.

Commonwealth of Australia 2017a, *Australian Weeds Strategy 2017-2021*, Department of Agriculture and Water Resources, Canberra.

Commonwealth of Australia 2017b, *Australian Pest Animal Strategy 2017-2021*, Department of Agriculture and Water Resources, Canberra.

Commonwealth of Australia 2019, *Australia's Strategy for Nature 2019-2030*, Prepared by the interjurisdictional Biodiversity Working Group for the Meeting of Environment Ministers, Commonwealth of Australia Canberra.

Commonwealth of Australia 2021, *Threatened Species Strategy 2021-2031*, Department of Agriculture, Water and the Environment, Commonwealth of Australia, Canberra, ISBN 978-1-76003-397-2

Cooper, RM, McAllan, IAW and Curtis, BR 2014, *The Atlas of the Birds of NSW and the ACT*, Mini-Publishing, Gordon, New South Wales.

Crisp, MD 1991, *Contributions towards a revision of Daviesia (Fabaceae: Mirbelieae), II. The D. latifolia group Australian Systematic Botany*, vol. 4, no. 2, pp. 229–298.Cropper S 1993, Management of endangered plants, CSIRO Publications, Melbourne.

Crowther, MD, Lunney, J, Lemon, E, Stalenberg, R, Wheeler, G, Madani, K, Ross and M, Ellis 2013, *Climate-mediated habitat selection in an arboreal folivore*, Ecography, vol. 36, pp. 01-008.

Cumberland Ecology 2015, *Terrestrial Ecology Assessment Report*, prepared for the Eastern Leases Project, Report prepared for the Eastern Leases Project, Epping, Sydney.

Davies, N, Gramotnev, G, Seabrook, L, McAlpine, C, Baxter, G, Lunney, D & Bradley, A 2014, *Climate driven changes in diet composition and physiological stress in an arboreal folivore at the semi-arid edge of its distribution*, Biological Conservation, vol. 172, pp. 80–88.

Department of Agriculture, Water and the Environment (DAWE) 2020, *Migratory Birds*, Commonwealth of Australia, Department of Agriculture, Water and the Environment, Canberra, <https://www.environment.gov.au/biodiversity/migratory-species/migratory-birds#International_cooperation>.

Department of Agricultural Water and the Environment (DAWE) 2018 -2021, *EPBC Act Protected Matters Report*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of Agriculture, Water and the Environment (DAWE) 2021a, *Species Profile and Threats Database*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra. <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Department of Agriculture, Water and the Environment (DAWE) 2021b, *Draft National Recovery Plan for the Koala Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory))*, Department of Agriculture, Water and the Environment, Canberra.

Department of Agriculture, Water and the Environment (DAWE) 2021c, Species Profile and Threats Database: Register of Critical Habitat. Department of Agriculture, Water and the Environment, Australian Government, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/publicregisterofcriticalhabitat

Department of Climate Change, Energy, the Environment and Water 2022 (DCCEEW 2022), Conservation advice for *Petauroides volans* (greater glider (southern and central)), Canberra. < https://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-05072022.pdf>

Department of Environment and Heritage Protection (DEHP) 2014, *Queensland Environmental Offsets Policy*, Significant Residual Impact Guideline, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Resource Management (DERM) 2011, *National recovery plan for the large-eared pied bat Chalinolobus dwyeri,* Report prepared by DERM to the Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Department of Environment and Resource Management (DERM) 2012, *National recovery plan for the red goshawk Erythrotriorchis radiatus. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra*, Queensland Department of Environment and Resource Management Brisbane

Department of Environment and Science (DES) 2018, *A Biodiversity Planning Assessment for the Brigalow Belt Bioregion*, Version 2.1, Brisbane: Department of Environment and Science, Queensland Government.

Department of Environment and Science (DES) 2018-2021a, Department of Environment and Science Environmental Report: *Matters of State Environmental Significance*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2018-2021b, Department of Environment and Science Environmental Report: *Regional Ecosystems Biodiversity Status*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2018-2021c, *Protected Plants Flora Survey Trigger Map*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2018-2021d, *Modelled Potential Habitat Mapping*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2018-2021e, Department of Environment and Science Environmental Report: Terrestrial *Biodiversity and Aquatic Conservation Values*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2018-2021f, *WildNet Wildlife Records* - Published - Queensland, Department of Environment and Science, Accessed 9 November 2021. <http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={40D75ED6-3959-41EB-A5C8-E563FA5B66CA}>

Department of Environment and Science (DES) 2019a, *Flora Survey Guidelines - Protected Plants (V2.01)*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2019b, *Koala-sensitive Design Guideline*, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2021a, Regional Ecosystem Description Database Version 12, State of Queensland, Department of Environment and Science, Brisbane, <https://apps.des.qld.gov.au/regional-ecosystems/>

Department of Environment and Science (DES) 2022, *Queensland Environmental Offsets Policy (Version 1.12)*, Conservation Policy and Planning, State of Queensland, Department of Environment and Science, Brisbane.

Department of Environment and Science (DES) 2021c, *Biodiversity status of 2017 remnant regional ecosystems - Queensland,* State of Queensland, Department of Environment and Science, Brisbane, accessed on 1 March 2021. <http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={8FDF54D2-654C-4822-8295-1D8E8E772373}>

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008a, *Rangelands 2008 Taking the Pulse: Brigalow Belt North*, Commonwealth of Australia, National Land and Water Resources Audit, Department of the Environment, Water, Heritage and the Arts, Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008b, *Threat abatement plan for predation by the European red fox*, Department of the Environment, Water, Heritage and the Arts, Canberra.

Department of the Environment, Water, Heritage, and the Arts (DEWHA) 2008c, *Approved Conservation Advice for Delma torquata (Collared Delma),* Department of the Environment, Water, Heritage and the Arts,

Department of the Environment, Water, Heritage, and the Arts (DEWHA) 2008d, *Approved Conservation Advice for Neochmia ruficauda ruficauda (Star Finch (eastern))*, Department of the Environment, Water, Heritage and the Arts,

Department of the Environment, Water, Heritage, and the Arts (DEWHA) 2008e*, Approved Conservation Advice for Lerista allanae (Allan's Lerista),* Department of the Environment, Water, Heritage and the Arts,

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2009, *National Koala Conservation and Management Strategy 2009–2014*, Department of Agriculture, Water and the Environment, Commonwealth of Australia, Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010a, *Survey guidelines for Australia's threatened birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra,

Department of the Environment Water, Heritage and the Arts (DEWHA) 2010b, *Survey guidelines for Australia's threatened bats; Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of Natural Resources (DoR) 2018-2021a, *Vegetation Management Report*, State of Queensland, Department of Natural Resources, Mines and Energy, Brisbane.

Department of Natural Resources (DoR) 2018-2021b, *Groundwater dependent ecosystems areas – Queensland*, State of Queensland, Department of Natural Resources, Mines and Energy, Brisbane.

Department of the Environment (DoE) 2013a, *Matters of National Significance Significant Impact Guidelines 1.1*, Commonwealth of Australia.

Department of the Environment (DoE) 2013b, *Approved Conservation Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community*, Canberra: Department of the Environment, Canberra.

Department of the Environment (DoE) 2014a, *EPBC Act Referral Guidelines for the vulnerable koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra,

Department of the Environment (DoE) 2014b, *Approved Conservation Advice for Denisonia maculata (Ornamental Snake)*, Department of the Environment.

Department of the Environment (DoE) 2014c, *Approved Conservation Advice for Aristida annua (a tufted grass).* Canberra: Department of the Environment.

Department of the Environment (DoE) 2014d, *Approved Conservation Advice for Egernia rugosa (Yakka Skink),* Department of the Environment.

Department of the Environment (DoE) 2014e, *Approved Conservation Advice for Furina dunmallii (Dunmall's Snake)*, Department of the Environment.

Department of the Environment (DoE) 2015a, *Draft referral guideline for 14 migratory birds listed under the EPBC Act*, Commonwealth of Australia.

Department of the Environment (DoE) 2015b, *Threat abatement plan for predation by feral cats*, Commonwealth of Australia.

Department of the Environment (DoE) 2015c, *Conservation Advice Grantiella picta painted honeyeater*. Department of the Environment.

Department of the Environment (DoE) 2015d, *Conservation Advice Calidris ferruginea curlew sandpiper*, Department of the Environment.

Department of the Environment (DoE) 2015e, *Monitoring and management of subsidence induced by longwall coal mining activity,* Department of the Environment.

Department of the Environment (DoE) 2016*, EPBC Act referral guideline for the endangered northern quoll Dasyurus hallucatus EPBC Act Policy Statement*, Department of the Environment,

Department of the Environment and Energy (DoEE) 2016a, *Interim Biogeographic Regionalisation for Australia, (IBRA) Version 7*, Map produced by ERIN, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2016b, *Threat abatement plan for competition and land degradation by rabbits*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017 Threat Abatement Plan for Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs. Department of the Environment and Energy (DoEE) 2018-2019, *EPBC Act Protected Matters Report,* Commonwealth of Australia, Department of the Environment and Energy, Canberra.

Department of the Environment and Energy (DoEE) 2019a, *Notification of Referral Decision and Designated Proponent – controlled action Lake Vermont Meadowbrook Coal Mine Project*, Queensland (EPBC 2019/8485), Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2019b, *Conservation Advice (including listing advice) for the Poplar Box Grassy Woodlands on Alluvial Plains*, Commonwealth of Australia, Department of the Environment and Energy, Canberra.

Department of the Environment and Energy (DoEE) 2019c, *Species Profile and Threats Database*, Canberra. <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

Department of the Environment and Energy (DoEE) 2019d, *Draft national Recovery Plan for the Australian Painted Snipe Rostratula australis*, Department of the Environment and Energy, Canberra.

Department of the Environment and Energy (DoEE) 2020, *National Light Pollution Guidelines for Wildlife*, Commonwealth of Australia, Department of Environment and Energy.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011a, *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011b, *Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under* *the Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011c, *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*, Commonwealth of Australia, Department of Agricultural Water and the Environment, Canberra,

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a, Approved Conservation Advice for Phascolarctos cinereus (combined populations of Queensland, New South Wales, and the Australian Capital Territory) (koala Northern Designatable Unit), Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012b, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, Commonwealth of Australia, Department of Agriculture, Water and the Environment, Canberra,

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013a, *Approved Conservation Advice for Rostratula australis (Australian painted snipe)*. Canberra, Department of Sustainability, Environment, Water, Population and Communities.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013b, *Approved Conservation Advice for Dichanthium queenslandicum (king blue-grass)*. Canberra, ACT, Department of Sustainability, Environment, Water, Population and Communities, DPM EnviroSciences Pty Ltd 2018a, Olive Downs Coking Coal Project, *Terrestrial Fauna Assessment*, Appendix B of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

DPM EnviroScience's Pty Ltd 2018a, Olive Downs Coking Coal Project, Terrestrial Fauna Assessment, Appendix B of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

DPM EnviroScience's Pty Ltd 2018b, Olive Downs Coking Coal Project*, Terrestrial Flora Assessment*, Appendix A of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

DPM EnviroScience's Pty Ltd 2018c, Olive Downs Coking Coal Project, *Aquatic Ecology Assessment*, Appendix C of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

e2m 2021, Winchester South Project, *Terrestrial Ecology Assessment,* Appendix D of the Winchester South Project Environmental Impact Statement, prepared for Whitehaven Coal Pty Ltd.

Ecological Survey & Management 2013, *Terrestrial Flora and Fauna Baseline Report*, Winchester South Project, prepared for Whitehaven Coal Pty Ltd.

Ecological Survey & Management 2020a, Isaac Downs, *Terrestrial Ecology Impact Assessment,* Appendix 10 of the Isaac Downs Impact Statement, prepared for Stanmore IP Coal Pty Ltd.

Ecological Survey & Management 2020b, Isaac Plains East Extension, *Terrestrial Ecology Impact Assessment*, Appendix 11 of the Isaac Plains East Extension Impact Statement, prepared for Stanmore IP Coal Pty Ltd.

Eco Logical Australia, 2015, Impact of Mine Subsidence on Threatened Ecological Communities, Prepared for the Australian Coal Association Research Program, ACARP Project C22019, Published 01/06/2015

Ellis, WAH, Melzer, A, Carrick FN and Hasegawa 2002, *Tree use, diet and home range of the koala (Phascolarctos cinereus) at Blair Athol*, central Queensland, CSIRO Publishing, Wildlife Research, vol 29, pp. 303-311.

Ellis, WAH, Melzer, A and Bercovitch, FB 2009, *Spatiotemporal dynamics of habitat use by koalas: the checkerboard model*, Behavioural Ecology and Sociobiology, vol. 63, pp. 1181-1188.

Ellis, W, Melzer, A, Clifton, I and Carrick, F 2010, *Climate change and the Koala Phascolarctos cinereus: water and energy*, Australian Zoologist, vol. 35, pp. 369-377.

Engeny 2020, *Subsidence Monitoring Report - Grosvenor Mine*, prepared by Engeny Water Management Consultants for Anglo American, 2020.

Engeny 2021. *Riverine Subsidence Monitoring Report - Moranbah North Mine*. Unpublished report Prepared by Engeny Water Management Consultants for Anglo American

Eyre, TJ, Ferguson, DJ, Hourigan, CL, Smith, GC, Mathieson, MT, Kelly, AL, Venz, MF, Hogan, LD & Rowland, J 2018, *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland Version 3.0*, Department of Science, Information Technology, Innovation and the Arts, State of Queensland.

Ferguson, D and Mathieson, M 2014, *Yakka skink, Egernia rugosa: Targeted species survey guidelines*, Department of Environment and Science, Brisbane.

Garnett, ST & Crowley, GM 2000, *The Action Plan for Australian Birds 2000*. Canberra, ACT: Environment Australia and Birds Australia.

Goff, FG, Dawson, GA and Rochow, JJ 1982, *Site examination for threatened and endangered plant species*, Environmental Management, vol. 6, pp. 307-316.

Gordon Geotechniques, 2022, *Subsidence Prediction Report for The Meadowbrook Underground Project, Prepared by Gordon Geotechniques Pty Ltd for Lake Vermont Resources Pty Ltd, March 2022.*

Hansen, BD, Fuller, RA, Watkins, D, Rogers, DI, Clemens, RS, Newman, M, Woehler, EJ and Weller, DR 2016, *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species*. Unpublished report for the Department of the Environment, BirdLife Australia, Melbourne.

Higgins, PJ & Davies, SJJF 1996, *Handbook of Australian, New Zealand and Antarctic Birds, Volume Three - Snipe to Pigeons*, Oxford University Press, Melbourne.

Hill, BM and Ward, SJ 2010, *National Recovery Plan For the Northern Quoll Dasyurus hallucatus*, Department of Natural Resources, Environment, The Arts and Sport, Darwin.

Hourigan, C 2011a, Ghost bat, *Macroderma gigas: Targeted species survey guidelines*, Queensland Herbarium, Department of Environment and Science, Brisbane.

Hourigan, C 2011b, *Coastal sheathtail bat, Taphozous australis: Targeted species survey guidelines*, Queensland Herbarium, Department of Environment and Science, Brisbane.

Hourigan, C 2012, *Glossy black-cockatoo, Calyptorhynchus lathami, Targeted species survey guidelines*, Queensland Herbarium, State of Queensland, Department of Environment and Science, Brisbane.

Isaac Regional Council 2020, *Isaac Region Biosecurity Plan 2020-2023*, Isaac Regional Council.

JBT Consulting 2022, Meadowbrook Project Groundwater Impact Assessment, Prepared by JBT Consulting for Jellinbah Resources, May 2022.

Jones, DN, Bernede, L, Bond, ARF, Dexter, C and Strong, CL 2016, *Dust as a contributor to the road-effect zone: a case study from a minor forest road in Australia*, Australasian Journal of Environmental Management, vol. 23, pp.67–80.

Katestone 2022, Lake Vermont Meadowbrook Project, *Air Quality and Greenhouse Gas Assessment*, prepared for Bowen Basin Coal.

Kerswell, A, Kaveney, T, Evans, C, & Appleby, L 2020, *Central Queensland Threatened Species Habitat Descriptions*, prepared for BHP Billiton Mitsubishi Alliance.

Lechner, A, M, Baumgartl, T, Matthew, P, & Glenn, V, 2016, The impact of underground longwall mining on prime agricultural land: a review and research agenda, Land Degradation & Development, 27(6), 1650-1663.

Lunney, D, Stalenberg, E, Santika, T & Rhodes, JR 2014, *Extinction in Eden: identifying the role of climate change in the decline of the Koala in south-eastern NSW*, Wildlife Research, vol. 41, no. 1, pp. 22–34.

Marchant, S & Higgins, PJ eds. 1993, *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2 - Raptors to Lapwings.* Melbourne, Victoria: Oxford University Press.

McDonald, KR, JA Covacevich, GJ Ingram & PJ Couper 1991, *The status of frogs and reptiles*. In: Ingram, G.J. & R.J. Raven, eds. *An Atlas of Queensland's Frogs, Reptiles, Birds and Mammals*, pp. 338-345. Brisbane: Queensland Museum.

McGregor, DC, Padovan, A, Georges, A, Krockenberger, A, Yoon, HJ, Youngentob, KN 2020, *Genetic evidence supports three previously described species of greater glider, Petauroides volans, P. minor, and P. armillatus*, Scientific Reports, vol.10, no.1, 1-11.

National Reserves System Section (NRS) 2000*, Revision of the Interim Biogeographic Regionalisation For Australia (IBRA) and Development of Version 5.1 Summary Report*, Commonwealth of Australia, Environment Australia, Canberra.

Neldner VJ ,Butler, DW and Guymer, GP 2017, *Queensland's Regional Ecosystems: Building and maintaining a biodiversity inventory, planning framework and information system for Queensland, State of Queensland*, Queensland Herbarium and Department of Science, Information Technology and Innovation, Brisbane.

Neldner VJ, Wilson BA, Dillewaard HA, Ryan TS & Butler DW 2019, *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland. Version 5.0*, (Updated April 2019), Queensland Herbarium, Queensland Department of Science, Information Technology and Innovation, State of Queensland.

Neldner, VJ, Wilson, BA, Dillewaard, HA, Ryan, TS, Butler, DW, McDonald, WJF, Addicott, EP and Appelman, CN 2020, *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland*. Version 5.1. Updated March 2020. Queensland Herbarium, Queensland Department of Environment and Science, Brisbane.

New South Wales National Parks and Wildlife Service 1999*, Echidna's Voluntary Conservation on Private and Public Land Note 3 - 1999*, New South Wales Government.

Parliament of the Commonwealth of Australia (PCA) 1999, response to Recommendations – Commonwealth Environment Powers, Report to the Senate Environment, Communications, Information Technology and the Arts Reference Committee on Commonwealth Environment Powers, May 1999.

Implementing Australia's International Obligations – Report on Commonwealth Environment Powers – Government Response

Ponce Reyes, R, Firn, J, Nicol, S, Chadès, I, Stratford, DS, Martin, TG, Whitten, S, Carwardine, J 2016, *Priority Threat Management for Imperilled Species of the Queensland Brigalow Belt* , CSIRO, Brisbane.

Queensland Government 2018-2021a*, Environmentally Sensitive Areas: Mining Activities Mapping*, State of Queensland, Brisbane.

Queensland Government 2018-2021b, *Wildlife Online Extract*, State of Queensland, Department of Environment and Science, Brisbane, viewed 2018-2021.

Queensland Government 2018, Mined Land Rehabilitation Policy, Department of Environment and Heritage Protection, and Department of Natural Resources and Mines, and Queensland Treasury, Queensland Government, Brisbane.

Queensland Government, 2019, *Species Profile Search,* Queensland Government, <https://apps.des.qld.gov.au/species-search/>

Queensland Wetlands Program, State of Queensland Department of Environment and Resource Management Australian Government Department of Sustainability, Environment, Water, Population and Communities (Queensland Wetlands Program) 2018-2020, *Wetland Maps Report*, State of Queensland, Department of Environment and Science, Brisbane.

Rogers, DI. Hance, S, Paton, C, Tzaros, P, Griffioen, M, Herring, R, Jaensch, L, Oring, A, Silcocks & M, Weston 2005, *The breeding bottleneck: breeding habitat and population decline in the Australian Painted Snipe*. In: Straw, P, ed. Status and Conservation of Seabirds in the East Asian-Australasian Flyway, pp. 15-23.

Rowland, J and Ferguson, D 2012, *Targeted species survey guidelines: Common death adder (Acanthophis antarcticus*), Queensland Herbarium, Department of Environment and Science, Brisbane.

Rowland, J 2012, *Painted honeyeater, Grantiella picta*: *Targeted species survey guidelines*. Queensland Herbarium, Department of Environment and Science, Brisbane.

Seedsman, R 2022, *Lake Vermont Meadowbrook Project – Peer review of subsidence impact assessment*, prepared for Bowen Basin Coal Pty Ltd.

Standards Australia 2019, *Control of the obtrusive effects of outdoor lighting AS/NZS 4282:2019*, Standards Australia.

State of Queensland 2020, Nature Conservation Act 1992: *Nature Conservation (Koala) Conservation Plan 2017*.

The Minserve Group Pty Ltd (Minserve) 2004, The Vermont Coal Project, *Environmental Impact Statement*, prepared for Bowen Basin Coal Pty Ltd.

The State of Queensland (Queensland Museum) 2018-2020, *Queensland Museum Zoology Data Search*, The State of Queensland (Queensland Museum), viewed 2018-2020, https://www.qm.qld.gov.au/Research/Biodiversity/Zoology+Data+Search

Threatened Species Scientific Committee (TSSC) 2001, *Commonwealth Listing Advice for the Brigalow (Acacia harpophylla dominant and co-dominant) ecological community*, Commonwealth of Australia, Department of Agriculture, Water and the Environment, Canberra.

Threatened Species Scientific Committee (TSSC) 2009, *Commonwealth Listing Advice on Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin*. Department of the Environment, Water, Heritage and the Arts. Available from:

Threatened Species Scientific Committee (TSSC) 2012a, *Listing advice for Phascolarctos cinereus (Koala)*, Department of Agriculture, Water and the Environment, Commonwealth of Australia, Canberra, <https://www.environment.gov.au/biodiversity/threatened/species/pubs/197-listing-advice.pdf>

Threatened Species Scientific Committee (TSSC) 2012b*, Commonwealth Listing Advice on Chalinolobus dwyeri (Large-eared Pied Bat),* Department of Sustainability, Environment, Water, Population and Communities, ,

Threatened Species Scientific Committee (TSSC) 2013a, Commonwealth Listing Advice on *Dichanthium queenslandicum* (king blue-grass). Canberra, Department of Sustainability, Environment, Water, Population and Communities.

Threatened Species Scientific Committee (TSSC) 2013b, Commonwealth Listing Advice on *Rostratula australis* (Australian Painted Snipe). Canberra, Department of Sustainability, Environment, Water, Population and Communities.

Threatened Species Scientific Committee (TSSC) 2015a, *Conservation Advice Erythrotriorchis radiatus red goshawk*, Department of the Environment.

Threatened Species Scientific Committee (TSSC) 2015b. *Conservation Advice Geophaps scripta scripta squatter pigeon (southern),* Department of the Environment.

Threatened Species Scientific Committee (TSSC) 2015d. *Conservation Advice Nyctophilus corbeni south-eastern long-eared bat,* Department of the Environment,

Threatened Species Scientific Committee (TSSC) 2016a. *Conservation Advice Macroderma gigas ghost bat,* Department of the Environment,

Threatened Species Scientific Committee (TSSC) 2016b, *Conservation Advice Petauroides volans greater glider*, Department of Agriculture, Water and the Environment, Commonwealth of Australia, Canberra,

Threatened Species Scientific Committee (TSSC) 2018*. Conservation Advice Lasiorhinus krefftii northern hairy-nosed wombat,* Department of the Environment.

Threatened Species Scientific Committee (TSSC) 2019, *Conservation Advice Hirundapus caudacutus White-throated Needletail*. Department of the Environment and Energy.

Threatened Species Scientific Committee (TSSC) 2020, *Conservation Advice Falco hypoleucos Grey Falcon,* Department of Agriculture, Water and the Environment.

Van Dyck, S & Strahan, R 2008, *The Mammals of Australia: Third edition*, Reed New Holland, Australia

Wassens, S, Arnaiz, OL, Healy S, Watts, RJ, and Maguire, J 2008, *Hydrological and habitat requirements to maintain viable Southern Bell Frog (Litoria raniformis) populations on the Lowbidgee floodplain- Phase 1*, Charles Sturt University, Institute for Land, Water and Society.

WBM Oceanics Australia Pty Ltd (WBM) 2003, *Vermont Coal Project EIS Nature Conservation Section*. Appendix 6 of the Vermont Coal Project Environmental Impact Statement, prepared for E H & S Systems Pty Ltd.

Whitehaven Coal 2021, Winchester South Project, *Environmental Impact Statement*, prepared for Whitehaven Coal.

Wilson, PR and Taylor, PM 2012, *Land Zones of Queensland, Queensland Herbarium*, State of Queensland, Department of Environment and Science, Brisbane.

Worldwide Wattle 2019, *Acacia arbiana*, WATTLE: Acacias of Australia. Version 3., <http://worldwidewattle.com/speciesgallery/species-intro.php?id=23555>

WRM 2022, Lake Vermont Meadowbrook Project Geomorphology Assessment. Prepared by WRM Water and Environment Pty Ltd for Bowen Basin Coal Pty Ltd, April 2022.

Appendix A Flora Species of Conservation Significance Known from the Surrounding Region

Family	Scientific name	Common name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Previous surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	Lake Vermont Mine[6,7,8]	Olive Downs[9]	Saraji Mine/Saraji East[10,11]	Caval Ridge[12]	Isaac Downs[13]/ Isaac Plains East[14]	Winchester South[15]
Apocynaceae	*Cerbera dumicola*	–	NT	—	x	x	x	x						
Asteraceae	*Trioncinia patens*	Peak Downs Daisy	CE	—		x								
Capparaceae	*Capparis humistrata*	—	E	—		x		x						
Combretaceae	*Macropteranthes leiocaulis*	—	NT	—		x								
Euphorbiaceae	*Bertya pedicellata*	—	NT	—		x		x		x			x[13,14]	
Fabaceae	*Acacia arbiana*	Tony's Wattle	NT	—		x								
Fabaceae	*Acacia spania*	Western Rosewood	NT	—	x	x	x	x						
Fabaceae	*Acacia storyi*	Blackdown Wattle	NT	—				x						
Myrtaceae	*Eucalyptus curtisii**	Brisbane Mallee	NT	—				x						
Myrtaceae	*Eucalyptus raveretiana*	Black Ironbox	LC	V		x								

Family	Scientific name	Common name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Previous surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	Lake Vermont Mine[6,7,8]	Olive Downs[9]	Saraji Mine/Saraji East[10,11]	Caval Ridge[12]	Isaac Downs[13]/ Isaac Plains East[14]	Winchester South[15]
Poaceae	*Aristida annua*	Annual Wiregrass	V	V		x		x						
Poaceae	*Dichanthium queenslandicum*	King Bluegrass	V	E		x		x						x
Poaceae	*Dichanthium setosum*	Bluegrass	LC	V							x[10]			
Solanaceae	*Solanum adenophorum*	—	E	—	x	x	x	x						x
Solanaceae	*Solanum elachophyllum*	—	E	—	x	x	x	x						

1 NC Act Conservation status: E = Endangered; V = Vulnerable; NT = Near Threatened; LC = Least Concern.

2 EPBC Act Conservation status: E = Endangered; V = Vulnerable.

3 Department of Environment and Science (DES) 2018-2021f, *WildNet Wildlife Records - Published - Queensland*, Department of Environment and Science, viewed 2018-2021, <http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={40D75ED6-3959-41EB-A5C8-E563FA5B66CA}>, records within 25 km and 50 km of co-ordinates -22.37077, 148.37802.

4 Queensland Government 2018-2021, *Wildlife Online Extract,* Department of Environment and Science, viewed 2018-2020b, records within 25 km and 50 km of co-ordinates -22.37077, 148.37802.

5 Atlas of Living Australia (ALA) 2018-2021, *Occurrence Records Search*, Atlas of Living Australia, viewed 2018-2020, <https://biocache.ala.org.au/search#tab_spatialSearch>, records within 25 km and 50 km of co-ordinates -22.37077, 148.37802.

6 WBM Oceanics Australia 2003, *Vermont Coal Project EIS Nature Conservation Section*. Appendix 6 of the Vermont Coal Project Environmental Impact Statement, prepared for E H & S Systems Pty Ltd.

7 Australasian Resource Consultants Pty Ltd 2016, *Lake Vermont Northern Extension Flora and Fauna Report*, prepared for Bowen Basin Coal Pty Ltd.

8 Australasian Resource Consultants Pty Ltd 2012, *Lake Vermont Western Extension Terrestrial Flora and Fauna Assessment Report,* prepared for Lake Vermont Resources.

[9] DPM Envirosciences Pty Ltd 2018b, *Olive Downs Coking Coal Project – Terrestrial Flora Assessment,* Appendix A of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

[10] Sinclair Knight Merz Pty Ltd 2011, *Saraji East Coal Mine Project Terrestrial Flora and Fauna Baseline Study*, prepared for BHP Billiton Mitsubishi Alliance.

[11] Aecom 2021, *Saraji East Mining Lease Project Terrestrial Ecology Technical Report*, prepared for BHP Billiton Mitsubishi Alliance.

[12] Biodiversity Assessment and Management Pty Ltd 2009, *Caval Ridge Coal Mine Project Ecological Assessment*, Appendix K of the Caval Ridge Coal Mine Project Environmental Impact Statement, prepared for URS Australia.

[13] Ecological Survey & Management 2020a, *Terrestrial Ecology Impact Assessment,* Appendix 10 of the Isaac Downs Project Environmental Impact Statement, prepared for Stanmore IP South Pty Ltd.

[14] Ecological Survey & Management 2020b, *Isaac Plains East Extension Project Terrestrial Ecology Impact Assessment,* Appendix 11 of the Isaac Plains East Extension Environmental Impact Statement, prepared for Stanmore IP South Pty Ltd.

[15] e2m 2021, *Winchester South Project Terrestrial Ecology Assessment,* Appendix D of the Winchester South Project Environmental Impact Statement, prepared for Whitehaven Coal Pty Ltd.

* *Eucalyptus curtisii* is a species of mallee that is endemic to south-east Queensland. A 1976 record exists for this species in the Atlas of Living Australia at a location described as “Corner of Old Cleveland Road and Creek Road, near Belmont”. The co-ordinates for this record are considered likely erroneous given the known distribution of this species.

Appendix B Fauna Species of Conservation Significance Known from the Surrounding Region

Family	Scientific Name	Common Name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Queensland Museum[6]		Previous Surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	25 km	50 km	Lake Vermont [7,8,9]	Olive Downs[10]	Saraji Mine/ Saraji East[11, 12]	Caval Ridge[13]	Isaac Downs[14]/Isaac Plains East[15]	Winchester South[16]
Amphibians																
Limnodynastidae	*Heleioporus australiacus**	Giant Burrowing Frog	—	V				x								
Reptiles																
Elapidae	*Acanthophis antarcticus*	Common Death Adder	V	-	x	x	x	x				x[#]				
Elapidae	*Denisonia maculata*	Ornamental Snake	V	V	x	x	x	x		x		x	x[11, 12]	x	x[14,15]	x
Scincidae	*Lerista allanae*	Allan's Lerista	E	E		x										
Birds																
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	E	V		x										
Accipitridae	*Pandion cristatus*	Eastern Osprey	SLC	Mi		x										
Apodidae	*Apus pacificus*	Fork-tailed Swift	SLC	Mi									x	x		x

Family	Scientific Name	Common Name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Queensland Museum[6]		Previous Surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	25 km	50 km	Lake Vermont [7,8,9]	Olive Downs[10]	Saraji Mine/ Saraji East[11, 12]	Caval Ridge[13]	Isaac Downs[14]/Isaac Plains East[15]	Winchester South[16]
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	V	V, Mi				x			x[7]		x[11]	x		
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	V	-		x	x	x								
Columbidae	*Geophaps scripta scripta*	Squatter Pigeon (Southern)	V	V	x	x		x			x[8]		x[11,12]		x[14,15]	x
Falconidae	*Falco hypoleucos*	Grey Falcon	V	V^									x			
Laridae	*Gelochelidon nilotica*	Gull-billed Tern	SLC	Mi	x	x	x	x								
Laridae	*Hydroprogne caspia*	Caspian Tern	SLC	Mi		x	x	x			x[8]	x	x	x		
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch	SLC	Mi	x	x	x	x							x[14,15]	
Monarchidae	*Symposiachrus trivirgatus*	Spectacled Monarch	SLC	Mi		x										
Muscicapidae	*Myiagra cyanoleuca*	Satin Flycatcher	SLC	Mi								x		x	x[14]	x

Family	Scientific Name	Common Name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Queensland Museum[6]		Previous Surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	25 km	50 km	Lake Vermont [7,8,9]	Olive Downs[10]	Saraji Mine/ Saraji East[11, 12]	Caval Ridge[13]	Isaac Downs[14]/Isaac Plains East[15]	Winchester South[16]
Phaethontidae	*Phaethon rubricauda*	Red-tailed Tropicbird	V	Mi		x										
Rhipiduridae	*Rhipidura rufifrons*	Rufous Fantail	SLC	Mi	x	x								x	x[15]	
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	V	E, Mi			x	x				x	x			
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	SLC	Mi										x		
Scolopacidae	*Calidris acuminata*	Sharp-tailed Sandpiper	SLC	Mi	x	x	x	x						x		
Scolopacidae	*Calidris ruficollis*	Red-necked Stint	SLC	Mi										x		
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	SLC	Mi								x	x			x
Scolopacidae	*Tringa nebularia*	Greenshank	SLC	Mi	x	x	x	x								
Scolopacidae	*Tringa stagnatilis*	Marsh Sandpiper	SLC	Mi	x	x	x	x						x		
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis	SLC	Mi	x	x	x	x				x				x

Family	Scientific Name	Common Name	Status		WildNet[3]/ Wildlife Online[4]		Atlas of Living Australia[5]		Queensland Museum[6]		Previous Surveys					
			NC Act[1]	EPBC Act[2]	25 km	50 km	25 km	50 km	25 km	50 km	Lake Vermont [7,8,9]	Olive Downs[10]	Saraji Mine/ Saraji East[11, 12]	Caval Ridge[13]	Isaac Downs[14]/Isaac Plains East[15]	Winchester South[16]
Mammals																
Dasyuridae	*Dasyurus hallucatus*	Northern Quoll	LC	E		x										
Emballonuridae	*Taphozous australis*	Coastal Sheathtail Bat	NT	—		x										
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	x	x	x	x				x	x	x	x[14]	x
Pseudocheiridae	*Petauroides volans*	Greater Glider	V	V	x	x	x	x				x	x	x	x[14]	x
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	SLC	—	x	x		x			x[8,9]	x	x		x[14,15]	
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	x	x										
Vombatidae	*Lasiorhinus krefftii*	Northern Hairy-nosed Wombat	CE	CE		x		x								

1 NC Act Conservation status: E = Endangered; V = Vulnerable; NT = Near Threatened; LC = Least Concern; SLC = Special Least Concern.
2 EPBC Act Conservation status: CE = Critically Endangered; E = Endangered; V = Vulnerable; Mi = Migratory.
3 Department of Environment and Science *WildNet Wildlife Records - Published - Queensland*, Department of Environment and Science, viewed 2021 (DES 2018-2021f), <http://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={40D75ED6-3959-41EB-A5C8-E563FA5B66CA}>, records within 25 km and 50 km of co-ordinates -22.3503, 148.3908.
4 Queensland Government 2018-2021b, *Wildlife Online Extract*, Department of Environment and Science, viewed 2018-2021, records within 25 km and 50 km of co-ordinates -22.3503, 148.3908.

5 Atlas of Living Australia (ALA) 2018-2021, *Occurrence Records Search*, Atlas of Living Australia, viewed 2018-2020, <https://biocache.ala.org.au/search#tab_spatialSearch>, records within 25 km and 50 km of co-ordinates -22.3503, 148.3908.

6 The State of Queensland (Queensland Museum) 2018-2020, *Queensland Museum Zoology Data Search*, The State of Queensland (Queensland Museum), viewed 2018-2020, <https://www.qm.qld.gov.au/Research/Biodiversity/Zoology+Data+Search>, records within 25 km and 50 km of co-ordinates -22.37077, 148.37802.

7 WBM Oceanics Australia 2003, *Vermont Coal Project EIS Nature Conservation Section*. Appendix 6 of the Vermont Coal Project Environmental Impact Statement, prepared for E H & S Systems Pty Ltd.

8 Australasian Resource Consultants Pty Ltd 2016, *Lake Vermont Northern Extension Flora and Fauna Report*, prepared for Bowen Basin Coal Pty Ltd.

9 Australasian Resource Consultants Pty Ltd 2012, *Lake Vermont Western Extension Terrestrial Flora and Fauna Assessment Report,* prepared for Lake Vermont Resources.

10 DPM Envirosciences Pty Ltd 2018b, *Olive Downs Coking Coal Project – Terrestrial Flora Assessment*, Appendix A of the Olive Downs Coking Coal Project Environmental Impact Statement, prepared for Pembroke Olive Downs Pty Ltd.

11 Sinclair Knight Merz Pty Ltd 2011, *Saraji East Coal Mine Project Terrestrial Flora and Fauna Baseline Study*, prepared for BHP Billiton Mitsubishi Alliance.

12 Aecom 2021, *Saraji East Mining Lease Project Terrestrial Ecology Technical Report*, prepared for BHP Billiton Mitsubishi Alliance.

13 Biodiversity Assessment and Management Pty Ltd 2009, *Caval Ridge Coal Mine Project Ecological Assessment*, Appendix K of the Caval Ridge Coal Mine Project Environmental Impact Statement, prepared for URS Australia.

14 Ecological Survey & Management 2020a, *Terrestrial Ecology Impact Assessment*, Appendix 10 of the Isaac Downs Project Environmental Impact Statement, prepared for Stanmore IP South Pty Ltd.

15 Ecological Survey and Management 2020b, *Terrestrial Ecology Impact Assessment,* Appendix 11 of the Isaac Plains East Extension Impact Statement, prepared for Stanmore IP Coal Pty Ltd.

16 e2m 2021, *Winchester South Project Terrestrial Ecology Assessment,* Appendix D of the Winchester South Project Environmental Impact Statement, prepared for Whitehaven Coal Pty Ltd.

* The Giant Burrowing Frog (*Heleioporus australiacus*) is an amphibian species that is endemic to the southern coast of New South Wales and Victoria. A 2016 record exists for this species within 50 km of the study area in the Atlas of Living Australia, the record has been flagged as an incorrect identification. As such, the identification of this record is considered likely erroneous given the known distribution of the Giant Burrowing Frog.

\# A dead specimen of the Common Death Adder has previously been recorded on the Isaac River by surveys conducted for the Arrow Bowen Gas Project in 2011.

^ The Grey Falcon was listed as threatened under the EPBC Act after the Controlled Action decision for the Project.

Appendix C Desktop Search Results

Appendix D Flora Species of Conservation Significance Likelihood of Occurrence

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
Cerbera dumicola	NT	—	**Distribution** *C. dumicola* occurs across a range of habitats in central coastal and sub-coastal Queensland with a few populations in central Queensland. The northern populations are located 23 km south-west of Charters Towers and the most southern population occurs at Baralaba (Queensland Government 2019). **Habitat** Associated vegetation and species include: sandstone hills in open *Eucalyptus umbra subsp. carnea*; on plateaus, in woodland of *Acacia shirleyi* with *Corymbia dolichocarpa*; acidic soils in mine rehabilitation area; woodland of *A. catenulata* and *A. shirleyi* with *E. thozetiana* on a slope of sand/clay soil; semi-deciduous notophyll-microphyll vine forest of *Brachychiton australis, Gyrocarpus americanus, Flindersia australis, Pleiogynium timorense, Drypetes deplanchei* and *Sterculia quadrifida* on rhyolite hillslopes; open-woodland of *E. melanophloia* with occasional *Acacia shirleyi, E. populnea* and *E. brownii;* semi-evergreen vine thicket with *Corymbia citriodora* and *Corymbia aureola* emergents; woodland of *A. rhodoxylon* on brown, sandy loam; and in *Corymbia tessellaris - Acacia aneura* open woodland (Queensland Government 2019). **Ecology** This species has been recorded flowering in October (Queensland Government 2019).	<u>Potential</u> Potential habitat may occur within the study area and there are records for the species within 50 km.
Peak Downs Daisy *Trioncinia patens*	CE	—	**Distribution** This species is known only from three locations, all locations are on the toe-slopes of peaks in and near the Peak Range National Park between Claremont and Dysart in central Queensland (Queensland Government 2019). **Habitat** *T. patens* occurs in Eucalypt woodland (*Eucalyptus orgadophila, E. crebra, E. melanophloia* and *Corymbia erythrophloia*) on basalt-derived dark-grey to red-brown clays or clay-loams, often with some surface gravel (Queensland Government 2019). **Ecology** This species has been recorded flowering and fruiting in in January and February (Queensland Government 2019).	<u>Unlikely</u> Potential habitat (basalt-derived dark-grey to red-brown clays or clay-loams) unlikely to occur, and given this species' restricted distribution, is unlikely to be present within the study area.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
Capparis humistrata	E	—	**Distribution** *C. humistrata* is endemic to central-eastern Queensland and occurs between Marlborough and Bouldercombe (Queensland Government 2019). This species has also been recorded further north near Dingo in Central Queensland (Queensland Government 2019). **Habitat** This species is known to occur in Eucalypt woodlands with a shrubby understorey, on stony hard ridges and serpentinite soil (Queensland Government 2019). **Ecology** Flowers have been recorded in March, May and December, and fruits have been recorded in November and December.	<u>Unlikely</u> Potential habitat (i.e. stony hard ridges and serpentinite soils) is unlikely to occur within the study area.
Marlborough Blue# *Cycas ophiolitica*	E	E	**Distribution** Marlborough Blue is endemic to Queensland, occurring from Marlborough to Rockhampton in central-eastern Queensland (DoEE 2019c). **Habitat** It inhabits eucalypt open forest and woodland communities with a grassy understorey (Queensland Government 2019). The species occurs on hill tops or steep slopes, at altitudes of 80 to 620 m above sea level, growing on infertile, shallow, stony, red clay loams or sandy soils (Queensland Government 2019, DoEE 2019c). It occurs in association with *Corymbia dallachiana, C. erythrophloia, C. xanthope* and *Eucalyptus fibrosa* (DoEE 2019c). **Ecology** Marlborough Blue occurs in areas that are subjected to periodic fires of varying intensities, with hot, humid summers and mild, dry winters (DoEE 2019c). It is pollinated by small beetles (DoEE 2019c, Queensland Government 2019), and seeds may be dispersed by mammals such as possums, rodents or fruit bats (DoEE 2019c). This species has a limited dispersal ability due to seed toxicity and the lack of vertebrate dispersers within its range (DoEE 2019c).	<u>Unlikely</u> Potential habitat unlikely to occur and there are no records for this species within 50 km of the study area.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
Macropteranthes leiocaulis	NT		**Distribution** This species is known from Central East Queensland, and from Mingela Bluff south of Townsville to Binjour Plateau west of Maryborough (ANBG 2019). **Habitat** *M. leiocaulis* is known to occur in dry rainforest and vine thicket communities (ANBG 2019). This species has been collected in semi-evergreen vine thickets and vine scrub (AVH 2019). **Ecology** This species occurs as a small shrub or tree up to 25 m high (ANBG 2019). This species is deciduous and has been recorded with prostrate coppiced growth (ANBG 2019). Fruit has been recorded from April through to September, with flowers recorded in September (AVH 2019).	Unlikely Potential habitat (semi-evergreen vine-thickets and vine scrub) unlikely to occur within the study area.
Bertya pedicellata	NT	—	**Distribution** This species is confined to central and south-east Queensland, from near Aramac eastwards to Rockhampton and south to near Biggenden (Queensland Government 2019), with an isolated record from the Warwick district. **Habitat** *B. pedicellata* grows on rocky hillsides in range of community types, including Eucalypt forest or woodland, *Acacia* woodland or shrubland and open heathland or vine thicket communities (Queensland Government 2019). The soils on which this species grow on are mainly skeletal to shallow sandy, sandy clay or clay loams overlaying rhyolite, trachyte or sandstone substrates (Queensland Government 2019). **Ecology** This species has been recorded flowering from March to November and fruits from August to November (Queensland Government 2019).	<u>Potential</u> Potential habitat may occur within the study area, and there are records for the species within 50 km. This species has been recorded by surveys conducted for the Olive Downs Project and Isaac Plains East Project.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
Tony's Wattle *Acacia arbiana*	NT	-	**Distribution** Restricted to the summits of several mountains within the Peak Range (Ropers and Scotts Peak), and potentially on other peaks of the Peak Range east of Clermont, Queensland (World Wide Wattle 2019). **Habitat** This species has been recorded in trachyte outcrops in heath-like vegetation. Tony's Wattle has been found among heath-like vegetation communities growing in rocky soils (ALA 2019). **Ecology** Flowering for this species occurs from July to August (World Wide Wattle 2019).	<u>Unlikely</u> Potential habitat unlikely to occur and given this species' restricted distribution, is unlikely to occur within the study area.
Western Rosewood *Acacia spania*	NT	-	**Distribution** This species has been recorded from 68 km north of Aramac to as far south as Roma (Queensland Government 2019). This species has been recorded within the Idalia National Park and the Bundoora State Forest, and within remnant vegetation and non-remnant vegetation. **Habitat** This species grows mostly on rocky sandstone ridges and hills in sandy to loamy soils in Eucalypt or *Acacia* dominated woodland communities (Queensland Government 2019). Altitudinal range from 400 to 600 m (Queensland Government 2019). **Ecology** Flowering occurs in August-September (Queensland Government 2019).	<u>Unlikely</u> Potential habitat unlikely to occur and the study area is not within the typical altitude and range of this species.
Blackdown Wattle *Acacia storyi*	NT	-	**Distribution** Majority of populations of this species occur within the Blackdown Tablelands National Park (Queensland Government 2019). Three populations occur outside of the Blackdown Tablelands National Park in Rockland Spring, upper Davy Creek at the foot slopes of Expedition Range, 30 km north-east of Woorabinda (Queensland Government 2019).	<u>Unlikely</u> Potential habitat (sandstone plateaus and sandy/shallow skeletal soils over sandstone) unlikely to occur within the study area.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
			Habitat This species grows on sandstone plateaux, and on sandy and shallow skeletal soils over sandstone (Queensland Government 2019). Blackdown Wattle occurs in open forests or within tall open forests. This species occurs in association with *Eucalyptus tereticornis* and *Aristida spp.; E. hendersonii, E. cloeziana, E. melanoleuca* and *E. propinqua* (Queensland Government 2019). **Ecology** This species has been recorded flowering from April to September and maturing pods from August to December (Queensland Government 2019).	
Black Ironbox *Eucalyptus raveretiana*	LC	V	**Distribution** This species occurs in scattered and disjunct populations in central coastal and sub-coastal Queensland (Queensland Government 2019). It has been recorded from Charters Towers and Ayr and south to Rockhampton (Queensland Government 2019). **Habitat** Occurs on alluvial soils, loams, light clays or cracking clays in open forests and woodlands along watercourses and occasionally on river flats (Queensland Government 2019). Associated alluvial soils include sands, loams, light clays, and cracking clays (Queensland Government 2019). This species prefers areas with moderately fertile soil and suitable sub-soil moisture levels (Queensland Government 2019). **Ecology** This species has been recorded flowering from December to March (Queensland Government 2019). Black Ironbox is considered a fast-growing species (Queensland Government 2019).	Potential Potential habitat may occur within the study area and there are records for the species within 50 km.
Annual Wiregrass *Aristida annua*	V	V	**Distribution** Annual Wiregrass is restricted to Emerald and Springsure districts within central Queensland (DoEE 2019c, DoE 2014c). It occurs within the Brigalow Belt North and Brigalow Belt South IBRA Bioregions (DoE 2014c).	Potential Potential habitat may occur within the study area and there are records for the species within 50 km.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
			Habitat This species is restricted to Eucalypt woodland on black clay and basalt soils, and possible disturbed sites (DoEE 2019c, DoE 2014c). It is known to occur within the Natural grasslands of the Queensland Central Highlands and the northern Fitzroy Basin ecological community (DoEE 2019c, DoE 2014c). **Ecology** Annual Wiregrass flowers between March and June (DoEE 2019c).	
King Bluegrass *Dichanthium queenslandicum*	V	E	**Distribution** King Bluegrass is endemic to Queensland, occurring from Dalby north to approximately 90 km north of Hughenden and to Clermont in the west, in three disjunct populations (Queensland Government 2019, DSEWPaC 2013b). **Habitat** This species occurs on black cracking clay soils in tussock grasslands mainly in association with other species of Bluegrasses (TSSC 2013a, Queensland Government 2019). It is mostly confined to natural bluegrass grasslands of central and southern Queensland (TSSC 2013a). Other communities where King Bluegrass can be found include *Acacia salicina* thickets in grassland and eucalypt woodlands in association with *Corymbia dallachiana, C. erythrophloia, E. orgadophila* (Queensland Government 2019). **Ecology** Flowering occurs throughout the year, particularly in March (Queensland Government 2019).	<u>Potential</u> Potential habitat may occur within the study area and there are records for the species within 50 km.
Bluegrass *Dichanthium setosum*	LC	V	**Distribution** Bluegrass has been reported from inland New South Wales and Queensland (DoEE 2019c). In Queensland, it has been recorded from the Leichhardt, Morton, North Kennedy and Port Curtis regions (DoEE 2019c).	<u>Potential</u> Potential habitat may occur within the study area, and the species has been recorded by studies conducted for the Saraji Mine and the Caval Ridge Coal Mine.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
			Habitat Occurs in grassy woodland and open forests usually dominated by *Acacia* or Eucalypt species. Bluegrass is associated with heavy basaltic black soils and stony red-brown hard-setting loam with clay subsoil. It is found in moderately disturbed areas, such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture (DoEE 2019c, Queensland Government 2019). **Ecology** This plant commences growing in spring, flowers in summers and becomes dormant in late autumn (DoEE 2019c).	
Quassia# *Samadera bidwillii*	V	V	**Distribution** Quassia is endemic to Queensland occurring in several localities between Scawfell Island, near Mackay, and Goomboorian, north of Gympie (DoEE 2019c). This species occurs within the Burnett Mary, Fitzroy, Mackay Whitsunday, and Burdekin Natural Resource Management Regions (DoEE 2019c). **Habitat** This species occurs in lowland rainforest often in association with *Araucaria cunninghamii* or on rainforest margins, also commonly found in areas adjacent to both temporary and permanent watercourses (Queensland Government 2019, DoEE 2019c). It can also be found in open forest and woodland in locations up to 510 m in altitude (DoEE 2019c). Spotted Gum (*Corymbia citriodora*), Grey Gum (*Eucalyptus propinqua*), White Mahogany (*E. acmenoides*), Forest Red Gum (*E. tereticornis*), Pink Bloodwood (*C. intermedia*), Ironbark (*E. siderophloia*), Gum Topped Box (*E. moluccana*), Gympie Messmate (*E. cloeziana*) and Broad-leaved Ironbark (*E. fibrosa)* are commonly associated tree species that occur in association with Quassia in open forest/woodland habitat types (Queensland Government 2019). **Ecology** Flowering occurs from November – March (DoEE 2019c).	<u>Unlikely</u> Based on habitat requirements, potential habitat unlikely to occur, and there are no records of the species within 50 km of the study area.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
Solanum adenophorum	E	—	**Distribution** This species is endemic to the Dingo/Nebo/Clermont area in central-eastern Queensland. **Habitat** *S. adenophorum* occurs mostly in Brigalow woodland and on very gently inclined slopes (Queensland Government 2019). It also occurs in Gidgee (*Acacia cambagei*) scrub on deep cracking clay soils (Queensland Government 2019). **Ecology** *S. adenophorum* flowers in October with mature fruit recorded in May, September and October (Queensland Government 2019).	Potential Potential habitat may occur within the study area and there are records for the species within 50 km.
Solanum elachophyllum	E	—	**Distribution** This species has been recorded in areas from south-west of Mackay to south-west of Gladstone (Queensland Government 2019). **Habitat** *S. elachophyllum* grows on fertile cracking-clay soils in open forest of *Eucalyptus thozetiana, Acacia harpophylla*, with understorey of *Geijera parviflora*, *Casuarina cristata, Macropteranthes leichhardtii, E. cambageana*, or woodland of *E. creba* and *E. tenuipes* (Queensland Government 2019). **Ecology** This species has been recorded flowering in February, March, July and September and mature fruits have been recorded in March to May, July and September to October (Queensland Government 2019).	Potential Potential habitat may occur within the study area and there are records for the species within 50 km.
Daviesia discolor	V	V	**Distribution** This species is known from three widely disjunct localities in Queensland, near Blackwater on the Blackdown Tableland, in the Mount Walsh area near Biggenden (Crisp 1991) and north of Mount Playfair within Carnarvon National Park.	Unlikely Based on habitat requirements and known distribution of this species, potential habitat is unlikely to occur within the study area.

Species	Status		Description	Desktop Likelihood of Occurrence
	NC Act[1]	EPBC Act[2]		
			Habitat *Daviesia discolor* occurs from coastal hills to mountain slopes and ridges, 50–1100 m in altitude, mostly on fine-textured soils, which may be derived from acid volcanic or metamorphic rocks. On the Blackdown Tableland, *D. discolor* occurs on sandy soil derived from sandstone and on lateritic clay, at altitudes of 600 to 900 m, in open eucalypt forest dominated by species such as Blackdown Stringybark (*E. sphaerocarpa*) and Black Stringybark (*E. nigra*). In the Mount Walsh area, *D. discolor* grows in very tall open forests of Bloodwood (*Corymbia trachyphloia*) and White Mahogany (*E. acmenoides*) on hillcrests and slopes at 500 to 580 m altitude on well-drained, shallow sandy loam to sandy clays. The population in Carnarvon National Park occurs on brown sandy loam of creek banks, in mixed shrubland with scattered *Triodia sp*. hummocks and *Angophora sp*. trees (DoEE 2019c). **Ecology** This species has been recorded flowering from August to October (DoEE 2019c).	

[1] NC Act Conservation status: E = Endangered; V = Vulnerable; NT = Near Threatened; LC = Least Concern. [2] EPBC Act Conservation status: E = Endangered; V = Vulnerable.

There are no known records for this species within 50 km of the study area. The species is included to address the list of species to be assessed in accordance with Appendix 3 of the Project Terms of Reference.

Appendix E Fauna Species of Conservation Significance Likelihood of Occurrence

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Reptiles				
Common Death Adder *Acanthophis antarcticus*	—	V	**Distribution** This species is known to occur from central Queensland through New South Wales to the southern parts of South Australia and Western Australia (Queensland Government 2019). It is found over a large area of Queensland from Brisbane to Cooktown, with most records held within the south-east (Rowland and Ferguson 2012). **Habitat** Areas that are well drained with a deep leaf litter layer, including wet sclerophyll forests and rainforests, woodland, shrublands, grasslands and coastal heathlands are preferred habitat types for this species (Queensland Government 2019, Rowland and Ferguson 2012). **Ecology** The Common Death Adder is highly cryptic, spending most of its time sitting motionless hiding under low foliage, leaf litter or loose sand. It is active during the day and night but is mostly active during the night when moving between shelter sites (Queensland Government 2019). This species prefers areas that contain a dense groundcover layer (leaves, foliage, sand) to lure in its prey (insects, frogs, lizards, birds, and small mammals). It is an ambush predator waiting until its prey are in range before striking (Queensland Government 2019). Breeding occurs in spring with live young born between February and March every second year (Queensland Government 2019). It is not known to have specific breeding habitat requirements. The Common Death Adder is a sedentary terrestrial snake (Queensland Government 2019). It is most active during the breeding season (September to March) (Queensland Museum 2019), in the warmer months of the year and at night when moving between shelter sites (Rowland and Ferguson 2012).	Potential A dead specimen of the Common Death Adder was recorded by surveys conducted for the Arrow Bowen Gas Project in 2011 (and reported in the Olive Downs Coking Coal Project EIS). However, none of the recent extensive nearby fauna surveys (Olive Downs, Saraji East, Winchester South) have recorded this species.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Ornamental Snake *Denisonia maculata*	V	V	**Distribution** This species is sparsely distributed throughout its range and is known only from the Brigalow Belt North and parts of the Brigalow Belt South biogeographical regions (DoE 2014a, DoEE 2019c). The drainage system of the Fitzroy and Dawson Rivers are core areas associated with this species distribution (DoEE 2019c). **Habitat** The Ornamental Snake's preferred habitat is within, or close to, habitat that is preferred by its prey (frogs) (DoEE 2019c). This species is known to prefer woodlands and open forests associated with moist areas, particularly gilgai (melon-hole) mounds and depressions in Queensland Regional Ecosystem Land Zone 4, as well as lake margins and wetlands (DoEE 2019c). The vegetation communities associated with this species habitat include Brigalow (*Acacia harpophylla*), Gidgee (*Acacia cambagei*), Blackwood (*Acacia argyrodendron*) or Coolibah (*Eucalyptus coolabah*), or grassland associated with gilgais (DoEE 2019c). In Queensland, it has been recorded in Queensland Regional Ecosystems 11.4.3, 11.4.6, 11.4.8 and 11.4.9, 11.3.3 and 11.5.16 (DoEE 2019c). This species has been recorded in abundance at sites that contain the following microhabitat features; in shallow water where some aquatic vegetation is present or in flooded gilgais where the fringing groundcover has been inundated, where there is a diverse range of gilgai size and depth, in soils of high clay content and deep cracking, ground debris, and in habitat patches greater than 10 ha in area connected to or within large areas of remnant vegetation (DoEE 2019c). **Ecology** The Ornamental Snake seeks refuge within soil cracks within gilgai mounds during dry periods. This species is nocturnally active predominantly in early summer throughout the wet season (DoEE 2019c), foraging in areas where burrowing frogs are abundant, with frogs being the main food source (DoEE 2019c). It is not known to have specific breeding or dispersal habitat requirements (DoEE 2019c).	<u>Likely</u> Preferred habitat occurs within the study area. This species has been recorded by a number of surveys conducted for Projects in the nearby surrounds (Olive Downs Project, Saraji, Winchester South) and wider region (e.g. Caval Ridge and Isaac Plains East) (Appendix B).
Dunmall's Snake# *Furina dunmalli*	V	V	**Distribution** This species occurs from near the Queensland border throughout the Brigalow Belt South and Nandewar bioregions, and as far south as Ashford in New South Wales (DoEE 2019c). In Queensland, the Dunmall's Snake is primarily found in the Brigalow Belt region approximately 200-500m asl (DoEE 2019c, DoE 2014e).	<u>Unlikely</u> Potential habitat may occur; however, there are no records for this species within 50 km of the study area

<table>
<tr><th rowspan="2">Species</th><th colspan="2">Status</th><th rowspan="2">Description</th><th rowspan="2">Desktop likelihood of occurrence</th></tr>
<tr><th>EPBC Act[1,2]</th><th>NC Act[3]</th></tr>
<tr><td></td><td></td><td></td><td>Habitat

The Dunmall's Snake can occur in a broad range of habitat types, including forests to woodlands on black alluvial cracking clay/clay loams (DoEE 2019c). Dominant vegetation associated with these habitat types include Brigalow (Acacia harpophylla), Wattles (A. burowii, A. deanii, A. leioclyx), native Cypress (Callitris spp.) or Bull-oak (Allocasuarina luehmannii), Corymbia citriodora, Eucalyptus crebra, E. melanophloia and Callitris glaucophylla (DoEE 2019c). This species has been found sheltering beneath litter and fallen timber and may use cracks in the alluvial clay soils (DoEE 2019c, DSEWPaC 2011a).

Ecology

The Dunmall's Snake is an inconspicuous, terrestrial snake that is difficult to detect (DoEE 2019c). It is nocturnally active between sheltering sites at night, with peak activity likely to occur in early summer through to the wet season (DSEWPaC 2011a). This species eats small skinks and geckos.</td><td></td></tr>
<tr><td>Yakka Skink[#]
Egernia rugosa</td><td>V</td><td>V</td><td>Distribution

The Yakka Skink has a highly fragmented distribution, limited to Queensland (DoE 2014d, DoEE 2019c). The known distribution of this species extends from the coast to the hinterland of sub-humid to semi-arid eastern Queensland (DoEE 2019c, DSEWPaC 2011a), including portions of the Brigalow Belt (North and South), South-east Queensland, Mulga Lands, Einasleigh Uplands, Cape York Peninsula and Wet Tropics Biogeographical Regions (DoEE 2019c).

Habitat

The core habitat for this species is within the Brigalow Belt South and Mulga Lands Bioregions (DoEE 2019c). It occurs in a wide variety of vegetation types including open dry sclerophyll forest, woodland, and scrub (DoEE 2019c). It is known to prefer areas which contain partly buried rocks, logs or tree stumps, root cavities or abandoned animal burrows within these vegetation types, where it occupies burrows and cavities beneath these features (DoEE 2019c, DoE 2014d, DSEWPaC 2011a, Queensland Government 2019, Ferguson and Mathieson 2014).

It is not generally found in trees or rocky habitats (DoEE 2019c, Ferguson and Mathieson 2014) and is known to occur in Queensland Regional Ecosystem 11.3.2 (DoEE 2019c).

This species is known to take refuge around deep gullies, tunnel erosion/sinkholes, rabbit warrens, raked log piles, sheds and loading ramps in areas where its habitat has been cleared (DoEE 2019c, DoE 2014d, DSEWPaC 2011a).</td><td><u>Unlikely</u>

Potential habitat may occur; however, there are no records of the species within 50 km of the study area</td></tr>
</table>

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology The Yakka Skink is a secretive, terrestrial skink that quickly retreats into its burrow shelter sites if it detects movement or disturbance (Queensland Government 2019, DSEWPaC 2011a). This species is limited in its capacity to disperse from a colony site, and active burrows can be identified by scat piles near the entrance (DoEE 2019c, Queensland Government 2019). It is active during the morning and dusk, through to the early evening (DoEE 2019c), feeding on soft plant materials, fruits and a wide variety of invertebrates that venture into, or near the burrow entrance (DoEE 2019c). It is not known to have specific breeding or dispersal habitat requirements.	
Allan's Lerista *Lerista allanae*	E	E	**Distribution** This species is found in three localities in central Queensland comprising of Retro, Logan Downs, and Clermont, based on 13 museum specimens (DoEE 2019c). **Habitat** Only known to occur in the Brigalow Belt North Biogeographic Region on black soil downs (undulating plains formed on basalt, shale, sandstone and unconsolidated sediments) (DoEE 2019c). Earlier records suggest that this species was found under the surface of black-red soil, under tussocks of grass on farmland (DoEE 2019c) in association with Mountain Coolibah (*Eucalyptus orgadophila*)/Red Bloodwood (*E. erythrophloia*) open woodlands and Black Tea-tree (*Melaleuca bracteata*) closed scrub to low closed-forest gravely hills, ridges and gullies (DoEE 2019c). Recent records are from leaf litter and friable soils beneath trees and shrubs (DSEWPaC 2011a), associated with Queensland Regional Ecosystems 11.8.5 and 11.8.11 (DoEE 2019c). **Ecology** No information is available about the life cycle, reproductive behaviour, movement, diet or feeding habits of the Allan's Lerista (DoEE 2019c). This species is thought to be nocturnally active, feeding on termites as its primary food source (DoEE 2019c).	<u>Unlikely</u> There are known records of the species within 50 km of the study area near Clermont; however, based on habitat requirements, potential habitat is unlikely to occur within the study area.
Birds				
Red Goshawk *Erythrotriorchis radiatus*	V	E	**Distribution** Endemic to Australia, the Red Goshawk is sparsely dispersed across coastal and sub-coastal Australia, from western Kimberley Division to north-eastern New South Wales, and occasionally on continental islands (DoEE 2019c, TSSC 2015a).	<u>Potential</u> Potential habitat occurs within the study area, and there are records for the species within 50 km.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Three recently confirmed sightings of dispersive individuals suggest that this species also occurs in central Australia, across South-east Queensland to the western slopes of the Great Dividing Range (DERM 2012, DoEE 2019c). **Habitat** The Red Goshawk prefers forest and woodland with a mix of vegetation types, including eucalypt woodland, tall open forest, gallery rainforest, swamp sclerophyll forest, and at the edge of rainforest (DoEE 2019c). In partly cleared areas of eastern Queensland, it is associated with gorge and escarpment country (TSSC 2015a). *E. radiatus* avoids very dense or very open habitats and prefer areas where large prey populations (birds) and permanent water exist (DoEE 2019c). **Ecology** Forests of intermediate density or ecotones between habitats of differing densities (e.g. between rainforest and eucalypt forest, between gallery forest and woodland) are preferred for foraging (DoEE 2019c). This species ambushes its prey when hunting, feeding on medium to large birds (DoEE 2019c). Nests are located within large trees within 1 km of permanent water (DoEE 2019c). Nest trees have been noted to be significantly taller (>20m) than surrounding trees, with larger crown diameters and greater girth at breast height (approx. 2.9m) (DoEE 2019c, TSSC 2015a, DERM 2012, DEWHA 2010a). Movement patterns of the Red Goshawk are poorly known (DoEE 2019c). They have been observed individually, in pairs and in family groups (DEWHA 2010a).	
Osprey *Pandion cristatus* **Pandion haliaetus*	Mi	SLC	**Distribution** The breeding range of the Eastern Osprey extends around the northern coast of Australia (including many offshore islands) from Albany in Western Australia to Lake Macquarie in New South Wales, with a second isolated breeding population on the coast of South Australia (DoEE 2019c). The total range (breeding plus non-breeding) around the northern coast is more widespread and is continuous around this region, except for Eighty Mile Beach (DoEE 2019c). **Habitat** Predominantly occupies coastal and littoral habitats as well as terrestrial wetlands of tropical and temperate Australia and offshore islands. They visit a variety of wetland habitats, including coastal cliffs, beaches, estuaries, inshore waters, reefs, bays, broad rivers, reservoirs, large lakes, and mangrove swamps (DoEE 2019c).	<u>Unlikely</u> Due to a lack of suitable habitat, the Osprey is unlikely to occur within the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology The Eastern Osprey is mostly resident or sedentary around breeding territories, and forage widely outside breeding periods although continue to make intermittent visits to breeding grounds in the non-breeding season (DoEE 2019c). The species occupy large territories that are used for breeding and at least some foraging (DoEE 2019c). **Foraging** The Eastern Osprey require extensive areas of open fresh, brackish or saline water for foraging, which mostly occurs during the day (DoEE 2019c). They mainly feed on fish, diving directly into the water to obtain their prey (DoEE 2019c). This species does not have specific breeding habitat requirements and are known to nest on a variety of natural and artificial sites (trees, cliffs, rocky headland, jetties, lighthouses cranes for example). Eastern Osprey's occupy large territories that are used for breeding and at least some foraging (DoEE 2019c). They forage more widely, continuing to visit their breeding grounds in the non-breeding season (DoEE 2019c). **Dispersal** There is evidence of movement of the species along the Murrary River and extensions of range in north-western Western Australia and north-eastern Queensland in autumn and an extension of range inland in north-western Queensland in winter (DoEE 2019c). *Note: Taxonomy is controversial, with one taxonomic arrangement recognising a single species, *Pandion haliaetus,* with four subspecies. However, three of the four subspecies (*haliaetus*, *carolinensis* and *cristatus*) proposed as full species based on differences in distribution, morphology and genetics. The NC Act recognises *Pandion cristatus* as a full species. The EPBC Act recognises *Pandion cristatus*, also as a full species, however its listings as Marine and Migratory are linked to *Pandion haliaetus*.	
Fork-tailed Swift *Apus pacificus*	Mi	SLC	**Distribution** The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia (DoEE 2019c). It is widespread throughout Queensland, with sightings common from February to March (DoEE 2019c). **Habitat** This species does not have specific habitat requirements and is found across a range of habitats, from inland open plains to wooded and coastal areas, where it is exclusively aerial (DoE 2015a).	<u>Likely</u> Potential habitat is likely to occur within the study area. The species has been recorded by nearby studies conducted for the Saraji East Project and Winchester South Project and others in the wider region (e.g. Caval Ridge Coal Mine.)

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology The Fork-tailed Swift does not breed in Australia, however migrates annually for its non-breeding season (DoEE 2019c). It is thought that this species roosts aerially but are occasionally observed to land (DoEE 2019c). **Foraging** The Fork-tailed Swift forages aerially, up to hundreds of meters above the ground (DoEE 2019c). They often occur in areas of updraughts and along the edges of low-pressure systems eating small bees, wasps, termites and moths (DoEE 2019c). **Dispersal** The Fork-tailed Swift leaves its breeding grounds in Siberia from August -September and arrives in Australia around October (DoEE 2019c). Within Australia large flocks precede or follow low pressure systems as they cross the country in search of food. The species leaves southern Australia from mid-April and departs Darwin by the end of April (DoEE 2019c).	
White-throated Needletail *Hirundapus caudacutus*	V, Mi	V	**Distribution** The White-throated Needletail migrates to Australia during the non-breeding season around September/October (DoEE 2019c, TSSC 2019). During this time, this species is widespread across eastern and south-eastern Australia (DoEE 2019c, TSSC 2019). In eastern Australia, it has been recorded in all coastal regions of Queensland, extending inland to the western slopes of the Great Divide and occasionally onto adjacent inland plains (DoEE 2019c). **Habitat** Primarily an aerial species, this species is known to occur across a variety of habitats, including wooded areas, open forests, and rainforests (DoEE 2019c). Large tracts of native vegetation, particularly forest, is considered likely to be a key habitat requirement for this species (DoE 2015a). It has been observed flying over farmland, typically over partially cleared pasture or within remnant vegetation at the edge of paddocks (DoEE 2019c). **Ecology**	Likely Potential habitat is likely to occur within the study area. The closest record for this species is from studies conducted for the Lake Vermont Mine.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	**NC Act[3]**		
			The White-throated Needletail does not breed in Australia and forages aerially while in the country. The species is sometiles preyed upon by raptors (DoEE 2019c). **Foraging** This species predominantly forages aerially at heights up to 'cloud level', along the edges of low-pressure systems (DoEE 2019c). This species is also known to forage much closer to the ground (still aerial) in open habitats or recently disturbed areas (DoE 2019p) feeding on a wide variety of insects (DoEE 2019c). It prefers to roost in forest and woodlands, both among dense foliage in the canopy or in tree hollows, as well as on bark or rock faces, and maybe aerially on occasion (DoEE 2019c, DoE 2015a). **Dispersal** The White-throated Needletail breeds in Asia and makes passage through south-east Asia to spend the non-breeding season in Australia and occasionally New Guinea and New Zealand during September and October (DoEE 2019c). While in Australia the species disperses south along both sides of the Great Divide in QLD and NSW and arrives in the southern parts of their range (Victoria and Tasmania) in November. The species leaves for its migration to breeding grounds between March and April.	
Glossy Black-cockatoo (Northern) *Calyptorhynchus lathami erebus*	—	V	**Distribution** The Glossy Black-cockatoo is known to occur in Queensland, New South Wales, and Victoria (Hourigan 2012). Within Queensland, the distribution of this species ranges from the Dawson-Mackenzie-Isaac Rivers basin, north to the Connors-Clarke Ranges, south to Dawes and Many Peaks Ranges, and inland to the Expedition, Peak and Denham Ranges, including the Blackdown Tableland (Hourigan 2012). **Habitat** This species prefers woodland areas dominated by She-oak *Allocasuarina* or open sclerophyll forests and woodlands with a stratum of *Allocasuarina* beneath *Eucalyptus, Corymbia or Angophora* (Hourigan 2012). It has also been observed in mixed vegetation communities consisting of *Allocasuarina*, *Casuarina*, Cypress (*Callitris)* and Brigalow (*Acacia harpophylla*) (Hourigan 2012).	<u>Potential</u> Potential habitat may occur within the study area, and there are records for the species within the wider surrounds.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology Feeding exclusively on the seeds of nine *Allocasuarina* and *Casuarina* species, the Glossy Black-cockatoo shows a strong preference to certain feed trees, returning to selected trees over consecutive years (Hourigan 2012). It feeds within these trees, dropping the chewed remains of seed cones, twigs and leaves beneath when feeding (Hourigan 2012). Nesting sites occur in areas that contain large old trees (living or dead) usually in eucalyptus trees for breeding (Hourigan 2012). It is an obligate hollow nester, requiring hollows that are usually between 10-20 m above ground, in vertical or near vertical branches, stems, and spouts, or in trunk cavities (Hourigan 2012). They will often nest near other breeding pairs, using the same nest over consecutive years during the breeding season (Hourigan 2012). Outside the breeding season, the Glossy Black-cockatoo will roost communally in groups of up to 40 individuals in live trees (Hourigan 2012). Seasonal movements might occur more frequently in areas where resources (feeding and breeding requirements) are more dispersed, or in response to dry conditions (Hourigan 2012). The peak breeding season occurs from March to August in South-east Queensland (Hourigan 2012).	
Squatter Pigeon (Southern) *Geophaps scripta scripta*	V	V	**Distribution** The southern sub species for the Squatter Pigeon occurs on the inland slopes of the Great Dividing Range. Its range extends from the Burdekin-Lynd Divide in central Queensland in the southern region of Cape York Peninsula to the Border Rivers region of northern New South Wales, and from the east coast to Hughenden, Longreach and Charleville in Queensland (DoEE 2019c, TSSC 2015b). **Habitat** Defined as open-forests to sparse, open-woodlands and scrub, this species inhabits the grassy understory of open eucalypt woodland (TSSC 2015b, DEWHA 2010a). Sandy areas separated by gravel ridges, which have open and short grass cover allowing easier movement, are preferred (TSSC 2015b). Important microhabitat features include vegetation that is within 3 km of water bodies or courses, within remnant, regrowth or partly modified vegetation communities and areas that are mostly dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species within the overstorey (DoEE 2019c).	<u>Likely</u> Potential habitat for this species is likely to occur within the study area. This species has been recorded by studies conducted for the Lake Vermont Mine, Saraji Mine, Saraji East Project, Olive Downs Coking Coal Project and Winchester South Project and others.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology Natural foraging habitat for this species occurs in any remnant or regrowth open-forest to sparse, open-woodland or scrub dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species (DoEE 2019c). It prefers landscapes with well-draining, sandy or loamy soils on low, gently sloping, flat to undulating plains and foothills (DoEE 2019c). Access to water is important and foraging habitat is usually within 3 km of a suitable, permanent, or seasonal waterbody (DoEE 2019c). Typically, the ground covering vegetation layer is patchy consisting of native, perennial tussock grasses or a mix of perennial tussock grasses and low shrubs or forbs (DoEE 2019c), rarely exceeding 33% of the ground area. The remaining ground cover is areas of bare soil and light leaf litter/coarse woody debris (DoEE 2019c). Breeding habitat occurs on stony rises occurring on sandy or gravelly soils, within 1 km of a suitable, permanent waterbody. The ground covering vegetation layer is consistent with foraging habitat (DoEE 2019c). Any forest or woodland occurring between patches of foraging or breeding habitat which facilitates movement between patches of foraging habitat, breeding habitat and/or waterbodies, as well as areas of cleared land less than 100 metres (m) wide linking areas of suitable breeding and/or foraging habitat are important for dispersal (DoEE 2019c). Dispersal habitat typically occurs on non-alluvial clays (Queensland RE Land zone 4) where the ground vegetation layer has been thinned through current land-use practices (cattle grazing) (DoEE 2019c).	
Grey Falcon *Falco hypoleucos*	V^	V	**Distribution** The species occurs in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia. The species is mainly found where annual rainfall is less than 500 mm, except when wet years are followed by drought, when the species might become marginally more widespread, although it is essentially confined to the arid and semi-arid zones (TSSC 2020). **Habitat** The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses. The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (TSSC 2020).	<u>Potential</u> Potential habitat for this species is likely to occur within the study area. This species has been recorded by studies conducted for the Saraji East Project.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology The Grey Falcon occurs at low densities across inland Australia. While breeding, the species feeds almost exclusively on birds. Prey species include doves, pigeons, small parrots and cockatoos, and finches, but a variety of other bird prey species has been recorded. Breeding occurs from June to November. Eggs are laid in the old nests of other birds, particularly those of other raptors or corvids. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but falcons also nest in telecommunication towers (TSSC 2020).	
Oriental Cuckoo# *Cuculus optatus*	Mi	SLC	**Distribution** Distributed throughout the northern parts of Western Australia, Northern Territory and Queensland, as well as along the Queensland and New South Wales coastline (DoEE 2019c). **Habitat** Nonbreeding habitat occurs within rainforest margins, monsoon forest, vine scrubs, riverine thickets, wetter, densely canopied eucalypt forests or open *Casuarina, Acacia or Eucalyptus* woodlands (DoE 2015a). **Ecology** The Oriental Cuckoo breeds in the northern hemisphere migrates for its non-breeding season to Australia and south-east Asia. The species typcally inhabits forests, but can inhabit open woodlands, forest edges, and clearings. The Oriental Cuckoo is a cpyptic species with secretive behaviours. The species is a brood parasite, but does not breed in Australia. **Foraging** The Oriental Cuckoo forages for insects in the trees and ground of forested areas. **Dispersal** The Oriental Cuckoo breeds across northern Eurasia. It migrates for the non-breeding season to Australia and south-east Asia and has been recorded along the eastern and northern portions of Australia.	Unlikely Preferred habitat (i.e. more humid habitats, such as monsoon forest, wet eucalypt forest, river margins and near mangroves) does not occur, and there are no records for this species within 50 km of the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Star Finch[#] *Neochmia ruficauda ruficauda*	E	E	**Distribution** The eastern sub species for the Star Finch is known to occur in Central Queensland only (DoEE 2019c). Its distribution extends north to Bowen, west to beyond Winton and, south to near Wowa (DoEE 2019c, DEWHA 2008c), within the Desert Channels, Burdekin and Fitzroy Natural Resource Management Regions (DoEE 2019c). **Habitat** The Star Finch occurs in damp grasslands, sedgelands and grassy woodlands, near permanent water, and often in or near suburban areas (DoEE 2019c, DEWHA 2008d). Common species associated with these areas include *Eucalyptus coolabah, E. tereticornis, E. tessellaris, Melaleuca leucadendra, E. camaldulensis* and *Casuarina cunninghamii* (DoEE 2019c). **Ecology** Little is known about the foraging ecology of this species (DoEE 2019c). It has been seen eating insects in fig trees and is said to forage in the shade of *Eucalyptus* trees (DoEE 2019c). This species predominantly eats seeds taken from a range of grasses including *Arundinella, Brachyachne, Chloris, Chrysopogon, Digitaria, Echinochloa, Heterachne, Iseilema, Oryza, Panicum, Setaria, Sorghum, Themeda* and *Urochloa* (DoEE 2019c). Nests are bottle-shaped made from grass, often placed in trees 3–9m above the ground, in a shrub or tree or amongst grass, sedges or reeds (DoEE 2019c). The Star Finch is sedentary or resident species that may undertake some local dispersal at the completion of the breeding season. This species is not known to have specific dispersal requirements (DoEE 2019c).	Unlikely Potential habitat may occur; however, there are no records for this species within 50 km of the study area.
Gull-billed Tern *Gelochelidon nilotica*	Mi	SLC	**Distribution** This species occurs on all continents except Antarctica (BirdLife Australia 2019a). **Habitat** Gull-billed Terns are found in coastal environments consisting of, freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands, and grasslands (BirdLife Australia 2019a). **Ecology**	Potential Potential habitat may occur within the study area, and there are records for the species within 50 km. However, it is only likely to be present when climatic conditions are suitable.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Little is known on the ecology of this species. The breeding season for this species is flexible and can change depending on the location (BirdLife Australia 2019a). Their nests usually occur in shallow depressions scraped in sand or mud, lined with some vegetation, and they feed on the surface of the water (BirdLife Australia 2019a). **Foraging** The Gull-billed Tern forages for a varied diet of small fish, reptiles, amphibians, crustaceans, small mammals, and insects in freshwater swamps, brackish/salt lakes, beaches, estuarine mudflats, floodwaters, sewage farms, irrigated land and grassland (BirdLife Australia 2019a)s. **Dispersal** The species inhabits a range of freshwater and wet area habitats. Breeding occurs across a wide partion of its range, though is generally not north of 25° south (BirdLife Australia 2019a).	
Caspian Tern *Hydroprogne caspia*	Mi	SLC	**Distribution** The Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat within Australia (DoEE 2019c). Within Queensland it occurs in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast (DoEE 2019c). It has also been recorded in western parts of Queensland, including the Lake Eyre Drainage Basin, north-west to the Gulf Country, north of Mt Isa and Cloncurry (DoEE 2019c). **Habitat** It is predominantly found in sheltered coastal embayments, near coastal, inland, or artificial terrestrial wetlands in varying levels of salinity (DoEE 2019c). Areas that contain sandy or muddy margins is preferred (DoEE 2019c). Habitat types include harbours, lagoons, inlets, bays, estuaries, river deltas, lakes, waterholes, reservoirs, rivers, creeks, sewage ponds and saltworks (DoEE 2019c). Large numbers may shelter along the coast, behind coastal sand-dunes or coastal lakes during rough weather and have been observed inland after inclement weather (DoEE 2019c). **Ecology** Breeding occurs in select locations within Queensland, including the Wellesley Islands, south-east Gulf of Carpentaria, islands off the far north coast from Bird Island south to Three Isles, and from islands around Shoalwater Bay (DoEE 2019c). Breeding locations include low islands, cays, spits, banks, ridges,	<u>Likely</u> Potential habitat may occur within the study area. This species has been recorded by studies conducted for the Lake Vermont Mine, Olive Downs Coking Coal Project and Caval Ridge Coal Mine.

<table>
<tr><th rowspan="2">Species</th><th colspan="2">Status</th><th rowspan="2">Description</th><th rowspan="2">Desktop likelihood of occurrence</th></tr>
<tr><th>EPBC Act[1,2]</th><th>NC Act[3]</th></tr>
<tr><td></td><td></td><td></td><td>beaches of sand or shell, terrestrial wetlands and stony or rocky islets or bank (DoEE 2019c). Nests may be among low/sparse vegetation or in the open (DoEE 2019c).

Roosting occurs on bare exposed sand or shell spits, banks or shores of coasts, lakes, estuaries, coastal lagoons and inlets (DoEE 2019c).

Foraging

Usually foraging in open wetland (including lakes and rivers), the Caspian Tern prefers sheltered shallow water near the margins (DoEE 2019c). It can also be found in open coastal waters, and in coastal inlets they may prefer to forage in tidal channels or over submerged mudbanks (DoEE 2019c). Their diet consists of fish, eggs/young from other birds, carrion, aquatic invertebrate, flying insects and earthworms (DoEE 2019c), foraging diurnally.

Dispersal

In Australia, the Caspian Tern is a resident and present throughout the year at sites, where breeding occurs year-round (DoEE 2019c). Some birds may move from coastal breeding colonies to inland non-breeding areas. They might follow watercourses inland, and their occurrence at small lakes suggest that at least some movement occurs overland (DoEE 2019c). Foraging diurnally, this species may venture up to 60 km from their nesting site in search of food (DoEE 2019c).</td><td></td></tr>
<tr><td>Painted Honeyeater#
Grantiella picta</td><td>V</td><td>V</td><td>Distribution

The Painted Honeyeater is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory (DoE 2015c). Breeding records are west of the dividing range in Queensland, whereas non-breeding records also occur in coastal areas along the eastern seaboard (Rowland 2012).

Habitat

This species occurs in eucalyptus forests/woodlands, which consist of Eucalyptus, Melaleuca, Casuarina, Callitris and Acacia species (Queensland Government 2019, DoE 2015d, Rowland 2012). It prefers woodlands, containing a higher number of mature trees, with flowering and fruiting mistletoe and flowering eucalypts (Queensland Government 2019, Rowland 2012).

Ecology</td><td><u>Unlikely</u>

Potential habitat may occur; however, there are no records for this species within 50 km of the study area despite extensive fauna surveys for projects nearby and in the wider region.</td></tr>
</table>

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			The diet of the Painted Honeyeater primarily consists of the fruit of mistletoes (*Amyema sp*), and occasionally nectar and insects (Queensland Government 2019, Rowland 2012). The nesting locations are within the vicinity of abundant fruiting mistletoes, or within the mistletoe itself (Rowland 2012). Breeding occurs from October to March when mistletoe fruits are most available (DoE 2015c). Dispersal habitat requirements for this species are not known; however, its movements are in response to mistletoe flowering and fruiting (Queensland Government 2019, Rowland 2012, DoE 2015c).	
Black-faced Monarch *Monarcha melanopsis*	Mi	SLC	**Distribution** Widespread in eastern Australia and throughout Queensland (DoEE 2019c). It is known to occur on the eastern slopes of the Great Divide and occasionally further inland within this Queensland range (DoEE 2019c). **Habitat** The Black-faced Monarch mainly occurs in rainforest ecosystems (semi-deciduous vine-thickets, vine-forest, warm temperate rainforest, dry (monsoon) rainforest for example) (DoEE 2019c). It may also occur in regrowth rainforest, open eucalypt forests, in dry sclerophyll forests and woodlands, gullies in mountain areas or coastal foothills (DoEE 2019c), and occasionally in suburban parks/ gardens or among mangroves (DoEE 2019c).	Unlikely Preferred habitat (rainforest ecosystems) does not occur in the study area and this species is unlikely to occur.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology Breeding occurs in select locations, including the Atherton Region (Julatten south to the Paluma Range), inland to the Atherton Tableland and in south-eastern Queensland to Lakes Entrance, Victoria (DoEE 2019c). This species breeds in rainforest habitat, and generally nests near the top of trees with large leaves, in the tops of small saplings, or in lower shrubs (DoEE 2019c). Tree and shrub species used as nest sites include Daisy bushes (*Olearia spp*.), Lilly Pilly (*Acmena smithii*), Yellow Sassafras (*Doryphora sassafras*), wattles (*Acacia spp*.), Coachwood (*Ceratopetalum apetalum*), Grey Myrtle (*Backhousia myrtifolia*) and Turpentine (*Syncarpia glomulifera*) (DoEE 2019c). **Foraging** The Black-faced Monarch feeds mostly in rainforest but also in open eucalypt forest within the mid-upper canopy (DoEE 2019c). They feed on spiders, wasps, insects, moths/caterpillars aerially and from the foliage (DoEE 2019c). **Dispersal** In Queensland, the Black-faced Monarch migrates between February and May, where a large proportion leaves Australia during winter (DoEE 2019c). There is no specific dispersal habitat requirements for this species; however, it can occur in 'marginal' habitats during winter or during passage (migration) (DoEE 2019c).	
Spectacled Monarch *Symposiachrus trivirgatus*	Mi	SLC	**Distribution** The Spectacled Monarch is found in coastal north-eastern and eastern Australia; from Cape York, Queensland to Port Stephens, New South Wales (BirdLife Australia 2019b). **Habitat** This species inhabits dense rainforests and moist *Eucalyptus* forests. The Spectacled Monarch is known to also inhabit areas of mangroves and other dense vegetation including areas of thick understory in rainforests, wet gullies, and waterside vegetation (BirdLife Australia 2019b). **Ecology** This species forages mostly below the canopy in foliage and on tree trunks and vines. The Spectacled Monarch feeds on insects and is known to call persistently while foraging (BirdLife Australia 2019b). **Foraging**	<u>Unlikely</u> Preferred habitat (dense rainforests and moist Eucalypt forests) does not occur in the study area. This species is unlikely to occur.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			The Spectacled Monarch feeds on insects, foraging mostly below canopy foliage and on tree trunks or vines (BirdLife Australia 2019b). **Dispersal** The Spectacled Monarch is found in coastal north-eastern and eastern Australia from Cape York to Port Stephens. It also occurs in Papua New Guinea, the Moluccas and Timor (BirdLife Australia 2019b).	
Satin Flycatcher *Myiagra cyanoleuca*	Mi	SLC	**Distribution** The Satin Flycatcher is widespread in eastern Australia. In Queensland, it is widespread and scattered in the east, mostly in coastal areas but also on the Great Divide and occasionally further west (DoEE 2019c). **Habitat** This species Inhabits vegetated gullies in eucalypt forests, often near wetlands or watercourses (DoEE 2019c). It also occurs in eucalypt woodlands with open understorey and grass ground cover, and in tall wet sclerophyll forest. This species is generally absent from rainforest (DoEE 2019c, DoE 2015a). **Ecology** Satin Flycatchers prefer to nest in a fork of outer branches of trees, such as paperbarks, eucalypts, and banksias (DoEE 2019c). They show a preference for eucalypt forest and woodlands, at high elevations during the breeding season from November to early January (DoE 2015a, DoEE 2019c). They nest in the same locality each year, and sometimes in the same tree (DoEE 2019c). **Foraging** Not known to have specific foraging habitat, the Satin Flycatcher forages high in the mid to upper canopy in trees, usually sallying for prey in the air or picking prey (mainly insects) from foliage and branches of trees (DoEE 2019c). **Dispersal** On migration the Satin Flycatcher occurs in coastal forests, woodlands, mangroves and drier woodlands and open forests (DoEE 2019c). They are inconspicuous when on passage, because movements are thought to be made singly or in pairs, or small loose groups through the tree-tops at	<u>Likely</u> Potential habitat may occur within the study area and there are records for the species from studies conducted for the Olive Downs Coking Coal Project, Caval Ridge Coal Mine, Isaac Plains East Project and Winchester South Project.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			night (DoEE 2019c). The departure and arrival time varies between different regions, moving through Queensland late August–November (DoEE 2019c).	
Rufous Fantail *Rhipidura rufifrons*	Mi	SLC	**Distribution** Within Australia, the Rufous Fantail occurs in coastal and near coastal districts, which is consistent with its distribution throughout Queensland (DoEE 2019c). **Habitat** In east and south-east Australia, the Rufous Fantail mainly occupies wet sclerophyll forests, and gullies dominated by eucalyptus species with a dense shrubby understory (DoEE 2019c, DoE 2015a). The Rufous Fantail has also been recorded from parks and gardens when on passage (DoEE 2019c). In north and northeast Australia, *R. rufifrons* often occurs in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semideciduous vine thickets or thickets of *Melaleuca spp*. (DoEE 2019c). **Ecology** This species does not have specific breeding habitat requirements (DoEE 2019c). **Foraging** The Rufous Fantail forages mainly in the low to middle strata of forests, sometimes in/below the canopy or on the ground (DoEE 2019c). It forages aerially at lower levels in the wet season compared to the dry season, eating insects (DoEE 2019c). **Dispersal** Some population of the Rufous Fantail in east Australia are migratory, populations in north Queensland move altitudinally, however other populations may be migrate from south-east Queensland in winter (March to April) to north Queensland and Torrest Strait, returning in August to December (DoEE 2019c).	<u>Potential</u> Potential habitat may occur within the study area; however, it is unlikely to be preferred habitat.
Red-tailed Tropicbird *Phaethon rubricauda*	Mi	V	**Distribution** The Red-tailed Tropicbird is solitary, highly pelagic, and may be seen hundreds of kilometres from land (Marchant and Higgins 1998). In Australia this species has a discontinuous distribution and has been	<u>Unlikely</u> Potential habitat does not occur in the study area for this species and is unlikely to occur.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			recorded in all states (Marchant and Higgins 1998). The majority of records from northern Australia (Marchant and Higgins 1998). **Habitat** The Red-tailed Phaeton breeds in loose colonies in inaccessible areas on small remote islands or the south-west coats of Australia and adults are found in the vicinity of colonies all year round (BirdLife Australia 2019b). **Ecology** The species is known to stay closer to land during breeding seasons. The Red-tailed Tropicbird is known to breed in Tropical and Subtropical Zones, on volcanic and other islands, stacks, atolls, cays; usually far from mainland (Marchant and Higgins 1998). The Red-tailed Tropicbird is monogamous, maintaining bonds from year to year (Marchant and Higgins 1998). The species is solitary at sea and breeds solitary or in loose colonies (Marchant and Higgins 1998). Species predominantly roots at sea, with only the incubating or brooding adult remaining on land at night (Marchant and Higgins 1998). **Foraging** The Red-tailed Tropicbird feeds mostly on fish, especially flying-fish, squid and crustaceans and the species catches prey by plunge diving (BirdLife Australia 2019b). **Dispersal** The Red-tailed Tropicbird is a dispersive or migratory species; adults and juveniles appear to disperse widely (Marchant and Higgins 1998). Primarily feeds on fish and cephalopods and is known to dive into water up to depths of 50 m. Feeding chiefly occurs during the day (Marchant and Higgins 1998).	
Australian Painted Snipe *Rostratula australis*	E	E	**Distribution** Known to occur within wetlands within all states of Australia (DoEE 2019c). This species is most common in eastern Australia, where it has been recorded throughout much of Queensland, New South Wales, Victoria, and south-eastern South Australia at scattered locations (DoEE 2019c).	<u>Potential</u> Potential habitat is likely to occur within the study area; however, the condition and extent of the habitat requires assessment. This species was recorded by studies conducted for the Olive Downs Coking Coal Project,

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Habitat The Australian Painted Snipe generally inhabits shallow freshwater (sometimes brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DoEE 2019c). It has also been known to occupy inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (DoEE 2019c). These areas usually include emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia*, Canegrass or Tea-tree (*Melaleuca*) (DoEE 2019c). Areas lined with trees, or that have some scattered fallen or washed-up timber are sometimes also used (DoEE 2019c). **Ecology** This species generally remains in dense cover when feeding, although may forage over nearby mudflats and other open areas such as ploughed land or grassland (DoEE 2019c). This species requires suitable wetland areas even in drought conditions (DoEE 2019c). Breeding habitat requirements are specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover (low and sometimes tall and dense) nearby (DoEE 2019c). This species may breed in response to wetland conditions rather than during a season (DoEE 2019c). Most nest records are from or near small islands in freshwater wetlands, which contain a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (DoEE 2019c). The Australian Painted Snipe is possibly dispersive or migratory (DoEE 2019c). Dispersive movements have been attributed to local conditions: moving to flooded areas; moving from drying to permanent wetlands; moving away from areas affected by drought (DoEE 2019c). This species is mainly crepuscular (active at dawn and dusk) and highly cryptic (DoEE 2019c).	Saraji East Project and Winchester South Project.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Common Sandpiper *Actitis hypoleucos*	Mi	SLC	**Distribution** The Common Sandpiper is widespread in small numbers. It is known to occur along all coastlines in Australia, and in many areas inland (DoEE 2019c). In Queensland, this species has been recorded in South-eastern Gulf of Carpentaria and Cairns Foreshore (DoEE 2019c). It migrates to Australia during the non-breeding season, migrating to Queensland from August (DoEE 2019c). **Habitat** The Common Sandpiper can occur in a broad range of coastal and inland wetlands with varying levels of salinity (DoEE 2019c). It is mostly found around muddy margins or rocky shores, which may be narrow and or steep (DoEE 2019c). Rarely found on mudflats (DoEE 2019c). **Ecology** The Common Sandpiper Roost sites are typically on rocks or in roots/ branches of vegetation, especially mangroves (DoEE 2019c). **Foraging** The Common Sandpiper forages on bare soft mud at the edges of wetlands in shallow water, often in areas where objects protrude from the substate (rocks or pneumatophores) (DoEE 2019c). Sometimes the Common Sandpiper will venture into grassy areas adjoining wetlands in search of food for extensive periods (molluscs, bivalves, crustaceans and a variety of insects) (DoEE 2019c). **Dispersal** The southern migration passage is said to be mostly diurnal, whereas the northern passage mainly occurs by night (DoEE 2019c).	<u>Potential</u> Potential habitat may occur within the study area when climatic conditions are suitable.
Sharp-tailed Sandpiper *Calidris acuminata*	Mi	SLC	**Distribution** The Sharp-tailed Sandpiper is a non-breeding visitor to all states and territories of Australia (DoEE 2019c). It is widespread throughout Queensland, arriving in large numbers in September (DoEE 2019c). **Habitat** This species prefers fresh or saltwater shallow wetlands with muddy edges (DoEE 2019c), with the presence of inundated or emergent sedges, grass, saltmarsh, or other low vegetation (DoEE 2019c).	<u>Potential</u> Potential habitat may occur within the study area when climatic conditions are suitable.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			This includes swamps, lakes, lagoons, and pools near the coast, and waterholes, soaks, dams, bore drains and bore swamps, saltpans, and hypersaline salt lakes inland (DoEE 2019c). Sometimes they occur on rocky shores and rarely on exposed reefs (DoEE 2019c). **Ecology** Roosting occurs at edges of shallow wetlands, on wet open mud or sand, or in short sparse vegetation, such as grass or saltmarsh (DoEE 2019c). Mangroves and on rocks in water are some other locations this species has been seen roosting (DoEE 2019c). **Foraging** The Sharp-tailed Sandpiper forages at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water (DoEE 2019c). This species can also forage among inundated vegetation of saltmarsh, grass, or sedge, eating seeds, worms, molluscs, crustaceans, and insects (DoEE 2019c). **Dispersal** The Sharp-tailed Sandpiper is found in australia from September to June. Movements occur during the non-breeding period, moving to temporary or flooded wetlands and leaving them when they dry (DoEE 2019c).	
Curlew Sandpiper[#] *Calidris ferruginea*	CE, Mi	E	**Distribution** Widespread in small numbers, this species is known to occur around coasts in Australia and in many areas inland during the non-breeding season (DoEE 2019c). In Queensland, this species has been recorded in the Gulf of Carpentaria, with widespread records along the coast, south of Cairns (DoEE 2019c). **Habitat** Inhabiting wetland environments, the Curlew Sandpiper mainly occurs on intertidal mudflats in sheltered coastal areas, (estuaries, bays, inlets and lagoons), as well as around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms (DoE 2015d). Small numbers have been recorded living inland around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand (DoE 2015d).	<u>Unlikely</u> Potential habitat may occur in suitable climatic conditions; however, there are no records of this species within 50 km of the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology Roosting occurs on bare dry shingle, shell, or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (DoEE 2019c). Occasionally roosting occurs in dunes during very high tides and sometimes in saltmarsh (DoEE 2019c). **Foraging** Curlew Sandpipers forage on mudflats and nearby shallow water at the edge of shallow pools, wading through water 15–60 mm deep (DoEE 2019c). At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated salt flats (DoEE 2019c). **Dispersal** Substantial numbers of Curlew Sandpipers remain in northern Australia throughout the nonbreeding season, arriving around September (DoE 2015d).	
Pectoral Sandpiper[#] *Calidris melanotos*	Mi	SLC	**Distribution** The Pectoral Sandpiper occurs around Cairns in Queensland (DoEE 2019c). There are scattered records elsewhere, mainly from east of the Great Divide between Townsville and Yeppoon (DoEE 2019c). A few inland records have also been recorded at Mount Isa, Longreach, and Oakley (DoEE 2019c). **Habitat** This species prefers shallow wetlands with varying levels of salinity, in coastal or near coastal habitat (DoEE 2019c). It is sometimes found further inland in the following habitat types, coastal lagoons, swamps, lakes, inundated grasslands, estuaries, bays, saltmarshes, river pools, creeks, floodplains, and artificial wetlands (DoEE 2019c). Its preferred habitat is wetlands that have open fringing mudflats and low, emergent, or fringing vegetation, such as grass or samphire (DoEE 2019c). It has also been recorded in swamp overgrown with lignum (DoEE 2019c). **Ecology** The Pectoral Sandpiper breeds in northern Russia and North America. It is not known to have specific dispersal or roosting habitat requirements, and this species is found in Australia from September to June (DoEE 2019c). **Foraging**	<u>Unlikely</u> Potential habitat may occur when climatic conditions are suitable; however, there are no records of this species within 50 km of the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Foraging occurs in shallow water or soft mud at the edge of wetlands where they consume algae, seeds, crustaceans, arachnids, and insects (DoEE 2019c). **Dispersal** The species is transient through Central America and the Caribbean while on route to the non-breeding areas in South America. In the tropical Pacific, there are scattered records from Hawaii, Polynesia, Micronesia and Australasia. The species occurs in small numbers through east Asia.	
Red-necked Stint *Calidris ruficollis*	Mi	SLC	**Distribution** The Red-necked Stint is distributed along most of the Australian coastline (DoEE 2019c). This species has been found inland in all states when conditions are suitable and is known from the coastlines of all states (DoEE 2019c). **Habitat** This species is found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (DoEE 2019c). It can also occur along ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in salt flats. The Red-necked Stint has also been known to use flooded paddocks or damp grasslands; and have been recorded in areas with little or no perennial vegetation (Higgins & Davies 1996). **Foraging** The Red-necked Stint forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water (DoEE 2019c). The species is also known to forage in non-tidal wetlands during high tides; including areas of flooded paddocks (DoEE 2019c). This species is omnivorous. **Ecology** This species is a non-breeding visitor to Australia, it is known to breed in Siberia and sporadically in north and west Alaska (DoEE 2019c). The Red-necked Stint roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle, sometimes in saltmarsh or other vegetation (DoEE 2019c). **Dispersal** The Red-necked Stint spends winter in Australasia, mostly in Australia for its non-breeding season (DoEE 2019c). The species begins to arrive in Australia from August, with the majority arriving from	<u>Potential</u> Potential habitat may occur within the study area when climatic conditions are suitable.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			early September (DoEE 2019c). The Red-necked Stint leaves Australia from late February/ March through to April, with a few individuals remaining as late as May (DoEE 2019c).	
Latham's Snipe *Gallinago hardwickii*	Mi	SLC	**Distribution** The Latham's Snipe is a non-breeding visitor to south-eastern Australia, and a passage migrant through northern Australia (DoEE 2019c). In Queensland, their range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range (DoEE 2019c). **Habitat** This species prefers open freshwater permeant and ephemeral wetlands, typically with low dense vegetation (DoEE 2019c). It can be found in a variety of vegetation communities including but not limited to tussock grasslands, coastal and alpine heathlands, tea-tree scrub and open forests (DoEE 2019c). **Ecology** Latham's Snipe is dispersive during its stay in Australia, arriving from July to November. The snipe is thought to disperse in response to rainfall and the availability of food (DoEE 2019c). **Foraging** The foraging habitat of the Latham's Snipe consist of areas of mud (exposed or beneath very shallow water) with low, dense vegetation present (DoEE 2019c). They roost near their foraging sites, in areas that provide some shelter (clumps of vegetation, in drainage ditches, among boulders, or in shallow water if cover is not available) (DoEE 2019c). **Dispersal** Latham's Snipe is a migratory species that breeds in Japan and Russia and migrates to Australia where is remains for the duration of the northern winter. Once in Australia the species move slowly southward along the coastal regions and most individuals end up south of the Richmind River in NSW (DoEE 2019c).	<u>Likely</u> Potential habitat may occur within the study area when climatic conditions are suitable. The species has been recorded by nearby studies including the Olive Downs Coking Coal Project, Saraji East Project and Winchester South Project.
Greenshank *Tringa nebularia*	Mi	SLC	**Distribution**	<u>Potential</u> Potential habitat for the Greenshank may occur within the study area and

Species	Status		Description	Desktop likelihood of occurrence
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			This species distribution is widespread in the Gulf country and eastern Guld of Carpentaria (DoEE 2019c). This species is recorded in most coastal regions. There have been few records south of a line near Dalby to Mt Guide, with sparsely scattered records elsewhere (DoEE 2019c). **Habitat** The Greenshank occurs in all types of wetlands and is described as having the widest distribution of any shorebird in Australia (DoEE 2019c). This species in habits a wide variety of inland wetlands and sheltered coastal habitats (varying salinity) (DoEE 2019c). Habitats include; embankments, harbours, river estuaries, deltas and lagoons but can also include tidal pools, rock-flats, and rock-platforms (DoEE 2019c). Sheltered coastal habitat features include; large mudflats, saltmarsh, mangroves, and seagrass (DoEE 2019c). The Greenshank utilises both permanent and ephemeral systems including; swaps, lakes, rivers, creeks, dams, billabongs, waterholes, and inundated floodplains, claypans and salt flats (DoEE 2019c). This species will also inhabit artificial waterbodies including; sewage farms, saltworks dams, inundated rice crops and bores (DoEE 2019c). **Foraging** The Greenshank is known to forage in soft mud on mudflats, in channels or in shallows around the edge of water and on the edges of wetlands, often in areas of sparse emergent or fringing vegetation (DoEE 2019c). **Ecology** This species is a non-breeding visitor to Australia. The Greenshank roosts and loafs around wetlands and in shallow pools and puddles or on slightly elevated rocks, sandbanks or small muddy islets (DoEE 2019c). An important roost site for this species during the non-breeding season occurs on an inland claypan near Roebuck Bay in Western Australia (DoEE 2019c). **Dispersal** The Greenshank arrives in Australia from August, primarily in Western Australia (DoEE 2019c). By November, the Greenshank appears to disperse across Australia from Western Australia (DoEE 2019c). This species numbers slowly increase during August and September with some larger increases at some sites in October and November. The Greenshank begins its Northward migration from March, but primarily occurs in April (DoEE 2019c).	there is potential for this species to occur.
Marsh Sandpiper *Tringa stagnatilis*	Mi	SLC	**Distribution**	<u>Potential</u>

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			The Marsh Sandpiper is found on coastal and inland wetlands throughout Australia and is widespread in coastal Queensland (DoEE 2019c). This species is also recorded in all regions of New South Wales and is found in coastal Victoria (DoEE 2019c). Scattered records of this species have been found across Western Australia, Northern Territory and South Australia (DoEE 2019c). **Habitat** This species lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats (DoEE 2019c). The species is less often found at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes (DoEE 2019c). **Foraging** The Marsh Sandpiper usually forages in shallow water at the edge of wetlands. They probe wet mud of mudflats or feed among marshy vegetation (Higgins & Davies 1996). This species is carnivorous and has been recorded eating insects, molluscs, and crustaceans (DoEE 2019c). **Ecology** This species is a non-breeding visitor to Australia and is known to breed from eastern Europe to eastern Siberia (DoEE 2019c). This species has been recorded potentially roosting on tidal mudflats, near low saltmarsh, and around inland swamps (Higgins and Davies 1996). **Dispersal** This species is known to arrive in Australia from September and disperse across Australia from September to December (DoEE 2019c). The Marsh Sandpiper begins to migrate north in March and April, with temporary influxes of populations occurring at some sites along the eastern coast (DoEE 2019c).	Potential habitat for the Marsh Sandpiper may occur within the study area, and there is potential for this species to occur.
Glossy Ibis *Plegadis falcinellus*	Mi	SLC	**Distribution** Within Australia, the Glossy Ibis is generally located east of the Kimberley in Western Australia and Eyre Peninsula in South Australia (DoEE 2019c). This species is known to breed in select locations, which include the Channel Country in Queensland (DoEE 2019c). **Habitat** Fresh water marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation are the preferred foraging	<u>Likely</u> Potential habitat is likely to occur within the study area, and there are nearby records for the species by studies conducted for the Olive Downs Coking Coal Project and Winchester South Project.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			and breeding habitats for this species. They are also occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (DoEE 2019c). It is known to occur in large densities in drying Top End grass/sedge swamps and Channel Country grass/forb meadows (DoEE 2019c). **Foraging** The species feeds in very shallow water, probing the water/mud in search of its preferred food source (aquatic invertebrates/insects) (DoEE 2019c). Preferred foraging habitat mentioned above. **Roosting/Breeding** Australian breeding habitat types include wooded and shrubby swamps in the semi-arid and arid regions, including the Channel Country in Queensland (DoEE 2019c). Glossy Ibis roost in trees or shrubs usually near water bodies (DoEE 2019c). The breeding season is from mid-spring to the end of summer; however, reproduction may extend to September to April if persistent food resources are available at breeding sites (DoEE 2019c). **Dispersal** Within Australia, the species moves in response to good rainfalls, expanding its range (DoEE 2019c). It often moves north in autumn, then return south to the main breeding areas in spring and summer (DoEE 2019c).	
Yellow Wagtail[#] *Motacilla flava*	Mi	SLC	**Distribution** This species may occur throughout Australia during the non-breeding season (DoEE 2019c).	<u>Unlikely</u> There are no known records for this species within 50 km of the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Habitat The Yellow Wagtail prefers mostly well-watered open grasslands and the fringes of wetlands, it roosts in mangroves and other dense vegetation (DoE 2015a). **Ecology** The Yellow Wagtail occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra. The species breeds from April to August (BirdLife Australia 2019b). **Foraging** The Yellow Wag Tail feeds on a range of invertebrates and plant material, particularly seeds (BirdLife Australia 2019b). **Dispersal** The Yellow Wagtail has an extremely large range, extending from Europe to West Asia and south to Egypt (BirdLife Australia 2019b).	
Mammals				
Northern Quoll *Dasyurus hallucatus*	E	LC	**Distribution** The Northern Quoll occurs in five regional populations across Queensland, the Northern Territory and Western Australia both on mainland and on offshore islands (DoEE 2019c). In Queensland, it is known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton, as far north as Weipa in Queensland and as far west into central Queensland to the vicinity of Carnarvon Range National Park (DoEE 2019c). **Habitat** This species does not have highly specific habitat requirements, living in a range of open woodland and open forest types preferring rocky areas (DoEE 2019c, Hill and Ward 2010). They have also been recorded in vine forest, vegetation along creek lines, adjacent to mangroves, around urban areas and on beaches (DSEWPaC 2011b). In central Queensland, the Northern Quoll is also known to occupy non-rocky lowland habitats such as beachscrub communities. Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal (DAWE 2021). Important factors in the landscape include shallow soils, large	<u>Unlikely</u> Potential habitat for this species is unlikely to occur within the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			cover of rocks including outcropping rock, distance to permanent water and time since last fire (DSEWPaC 2011b). **Ecology** Day time den sites occur in a wide range of areas including rock overhangs, tree hollows, hollow logs, termite mounds, goanna burrows and human structures (DSEWPaC 2011b), generally including some form of rocky area for denning purposes (DoEE 2019c). Their greatest breeding success is known to occur at sites near water (DoEE 2019c), and they are active at night and twilight (DSEWPaC 2011b). Little is understood about the characteristics of foraging or dispersal habitat for the Northern Quoll (DoE 2016). Current knowledge is that foraging/dispersal habitat is recognised to be any land comprising predominantly of native vegetation in the immediate area (i.e. within 1 km) of shelter habitat (DoE 2016).	
Coastal Sheathtail Bat *Taphozous australis*	—	NT	**Distribution** Known to occur along a narrow coastal zone in Queensland (Shoalwater Bay to Cape York), extending a few kilometres inland (Queensland Government 2019, Hourigan 2011b). **Habitat** The Coastal Sheathtail Bat depends on coastal roosts (Queensland Government 2019, Hourigan 2011b). This species can roost in disused mines, boulder piles, rock fissures, concrete bunkers and building, although sea caves and rocky clefts are preferred (Queensland Government 2019, Hourigan 2011b). In central Queensland coast bioregion, it occupies airy boulder sea caves with multiple openings located on rocky foreshore of peninsulas, < 50 m of the Highest Astronomical Tide (Queensland Government 2019, Hourigan 2011b). **Ecology** Foraging at night <3km of the ocean, these bats forage in sand dune scrub, mangroves, melaleuca swamps, coastal heathlands, open eucalypt forest grasslands, lowlands, and foothills (Queensland Government 2019, Hourigan 2011b). Roost conditions may vary from warm (26–28°C) and humid (84–92%), roosting individually or in small groups. This species can commute up to 15km up or down the coast from their roost (Queensland Government 2019, Hourigan 2011b).	<u>Unlikely</u> Potential habitat for this species is unlikely to occur within the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Ghost Bat# *Macroderma gigas*	V	E	**Distribution** The Ghost Bat is endemic to Australia, occurring in Queensland, northern Pilbara and Kimberley in Western Australia, and the top end of the Northern Territory (TSSC 2016a, Hourigan 2011a). In Queensland, this species is currently distributed in 4-5 highly disjunct populations along the coast and inland from the McIlwraith Range in Cape York to Rockhampton, with the biggest colony occurring at Mount Etna (Hourigan 2011a). Habitat modelling studies suggest that the Ghost Bat is a geographically relictual species in southern, arid landscapes, present only because caves provide suitable roost microclimates (TSSC 2016a). **Habitat** This species occupies a variety of habitats ranging from arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines. (TSSC 2016a). **Foraging** Foraging areas are approximately 60 ha in size (TSSC 2016a). Their diet consists of large insects, small mammals, reptiles, birds and bats, and prey availability is thought to influence foraging habitat for this species (Hourigan 2011a). **Roosting/Breeding** Roost sites consist of caves, rock crevices and disused mine adits (TSSC 2016a). Permanently used roost sites are generally deep natural caves or disused mines with a relatively stable temperature of 23°−28°C, with a moderate to high relative humidity of 50−100% and the ceiling at least 2 m above the floor (TSSC 2016a, Hourigan 2011a). Individuals aggregate in these maternity roosts during spring and summer (Hourigan 2011a). **Dispersal** Ghost Bats usually require several caves to move between seasonally or as dictated by weather conditions (TSSC 2016a). It is known to forage up to 2 km from its daytime roost area and will use the same foraging area each night (TSSC 2016a, Hourigan 2011a).	Unlikely There are no known records for this species within 50 km of the study area. Given the extensive surveys that have occurred nearby and in the wider region, this species is considered unlikely to occur within the study area.

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Koala *Phascolarctos cinereus*	V	V	**Distribution** The Koala is endemic to Australia, ranging from north-eastern Queensland to the south-east corner of South Australia, across coastal and inland areas (DoEE 2019c). Biogeographic regions of Queensland where Koalas have been recorded include; the Einasleigh Uplands, Wet Tropics, Desert Uplands, Central Mackay Coast, Mitchell Grass Downs, Mulga Lands, Brigalow Belt, South-eastern Queensland and Channel Country. South-eastern Queensland contains the highest density of Koalas (DoEE 2019c, TSSC 2012a). **Habitat** Koalas occupy a range of temperate, sub-tropical and tropical forest, woodland and semi-arid communities dominated by species from the *Eucalyptus* genus or related genera (including *Corymbia* and *Angophora* species), as well as *Lophostemon* and *Melaleuca* species (DSEWPaC 2012a, DoEE 2019c, TSSC 2012a).These habitat types are largely influenced by land elevation, annual temperature and rainfall patterns, soil types and the available soil moisture and fertility (DoEE 2019c, TSSC 2012a, DSEWPaC 2012a, DSEWPaC 2012a). Preferred food and shelter trees are naturally abundant on fertile clay soils, and there is a tendency to find the highest densities of Koalas along creek lines (DoEE 2019c, TSSC 2012a, DSEWPaC 2012a). **Ecology** Koalas are leaf-eating specialists, occupying a range of vegetation communities; dominated by *Eucalyptus* species, or related genera (including *Corymbia* and *Angophora* species), as well as *Lophostemon* and *Melaleuca* species usually along watercourses (DSEWPaC 2012a, TSSC 2012a). The Koala is also known to supplement its diet with other genera at times, including *Leptospermum* and *Melaleuca* (DoEE 2019c, TSSC 2012a). The species is known to have quite specific foraging habitat requirements, as Koalas have been known to show a strong preference between individual trees within species (DoEE 2019c, TSSC 2012a), and individual Koalas usually obtain most of their nutrition from one or a few species present at a site (DoEE 2019c, TSSC 2012a). This species tends to move little under most conditions, changing trees only a few times each day (DoEE 2019c). Dispersing individuals, mostly young males, may occasionally cover distances of several kilometres over land with little vegetation (DoEE 2019c). Koala's often change trees at night, as preferred food trees may be several hundred metres apart, they spend a considerable amount of time on the ground (Van Dyck & Strahan 2008).	Likely Potential habitat for this species is likely to occur within the study area, and the species has been recorded by nearby studies including the Olive Downs Coking Coal Project and Saraji East Project

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
Grey-headed Flying-fox# *Pteropus poliocephalus*	V	LC	**Distribution** Australia's only endemic flying-fox, The Grey-headed Flying-fox occurs in the coastal belt from Rockhampton in central Queensland to Melbourne in Victoria (DoEE 2019c, DEWHA 2010b). Only a small proportion of this range is used at any one time, as the species selectively forages where food is available (DoEE 2019c). **Habitat** This species requires foraging and roosting sites (DoEE 2019c). It utilises a range of habitat types including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and Banksia woodlands, in search of its flowering and fruiting trees (DoEE 2019c, Queensland Government 2019). **Foraging** They primarily eat nectar and pollen from *Eucalyptus* and related genera (*Corymbia* and *Angophora*), as well as from *Melaleucas* and *Banksias* (DoEE 2019c). In some areas they have also been known to eat a wide range of rainforest fruits (DoEE 2019c). They will also feed on cultivated fruit trees in gardens and orchards (DEWHA 2010b). Flying-fox camps form in response to the location and timing of local flowering and fruiting events. An area will be occupied for a few weeks to several months until the food resource is exhausted (DEWHA 2010b). **Roosting/Breeding** The Grey-headed Flying-fox roosts in groups of various sizes (few individuals to over 70,000) on exposed branches during the day (DoEE 2019c, DEWHA 2010b). These roost sites are generally in proximity to water (rivers, lakes on the coast), and can include stands of *Melaleuca,* mangroves, riparian vegetation, and rainforest patches of vegetation (DoEE 2019c). Flying-fox colonies can also use highly modified vegetation in urban and suburban areas for roost sites (DoEE 2019c). **Dispersal** Flying-foxes typically commute within 15 km of their day roost site to daily foraging areas (DoEE 2019c). They are capable of nightly flights of up to 50km from their roost to different feeding areas, as different plant species flower and fruit (DoEE 2019c, Queensland Government 2019, DEWHA 2010b). The national population is fluid and highly mobile, moving up and down the east coast in search of food (DoEE 2019c).	<u>Unlikely</u> Potential habitat may occur; however, there are no records for this species within 50 km of the study area despite the extensive surveys conducted nearby and in the wider region.

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<tr><th rowspan="2">Species</th><th colspan="2">Status</th><th rowspan="2">Description</th><th rowspan="2">Desktop likelihood of occurrence</th></tr>
<tr><th>EPBC Act[1,2]</th><th>NC Act[3]</th></tr>
<tr><td>Greater Glider (southern and central) Petauroides volans</td><td>V</td><td>V</td><td>Distribution
The Greater Glider (Petauroides volans) is restricted to eastern Australia, occurring from Proserpine in QLD through to central Victoria, with an elevational range from sea level to 1200 m above sea level (TSSC 2016b, DCCEEW 2022).
Habitat
Largely restricted to eucalypt forests and woodlands, the Greater Glider's preferred habitat consists of taller, montane, moist eucalypt forests with relatively old trees and abundant hollows. It also favours forests with a diversity of eucalypt species, due to seasonal variation in its preferred tree species (TSSC 2016b, DCCEEW 2022).
Ecology
This species is primarily folivorous, with a diet mostly comprising of eucalypt leaves, and occasionally flowers (TSSC 2016b, DCCEEWW 2022). It is an arboreal nocturnal marsupial, sheltering in den trees (large hollows in large, old trees) during the day (TSSC 2016b, DCCEEW 2022). Home ranges of the Greater Glider are typically relatively small (1 to 4 ha) but are larger in lower productivity forests and more open woodlands (up to 19 ha) (TSSC 2016b, DCCEEW 2022). Due in part to the Greater Gliders relatively small home range, and due to its low dispersal ability, this species disperses poorly across vegetation that is not native forest (TSSC 2016b, DCCEEW 2022).</td><td><u>Likely</u>
Potential habitat for this species is likely to occur within the study area. The species has been recorded by studies conducted for the Lake Vermont Mine and other nearby projects.</td></tr>
<tr><td>Short-beaked Echidna Tachyglossus aculeatus</td><td>—</td><td>SLC</td><td>Distribution
The Short-beaked Echidna is found in almost all Australian environments and is present is all Australian states (Van Dyck and Strahan 2008). This species is known from a variety of habitat types including open forests, grasslands and heavily vegetated woodlands. Distributions in arid regions is generally sparse.
Habitat
This species has no particular habitat requirements outside of the supply of ants and termites for its diet (Van Dyck and Strahan 2008). This species generally seeks shelter under thick bushes, in hollow logs, in debris and has been known to occasionally shelter in rabbit or wombat burrows (Van Dyck and Strahan 2008).</td><td><u>Likely</u>
Potential habitat for this species is likely to occur within the study area, and the species has been recorded from studies conducted for the Lake Vermont Mine and other nearby projects.</td></tr>
</table>

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Ecology Adults have no significant predators; however, juveniles are known to be predated upon by goannas (Van Dyck and Strahan 2008). The Short-beaked echidna is a solitary species, with overlapping homes ranges with no fixed nesting sites (Van Dyck and Strahan 2008). **Foraging** In arid regions the species is known to forage at night to avoid high temperatures (Van Dyck and Strahan 2008). In temperate regions the pattern of activities varies depending on temperatures, the species typically forages around dusk and dawn (Van Dyck and Strahan 2008).	
Large-eared Pied Bat *Chalinolobus dwyeri*	V	V	**Distribution** Records exist from Shoalwater Bay, north of Rockhampton, through to the vicinity of Ulladulla, NSW in the south, however this species current distribution is also poorly known (DoEE 2019c, TSSC 2012b). In Queensland, further records are known from sandstone escarpments in the Carnarvon, Expedition Ranges, Blackdown Tableland and in the Scenic Rim near the border (DoEE 2019c, TSSC 2012b). **Habitat** This species occurs in areas with extensive cliffs and caves. Suitable habitat consists of sandstone gorges in tall, open, moist eucalypt forest with a rainforest sub-canopy, wet and dry sclerophyll forests and woodlands, rainforest edges, wet sclerophyll forest and *Callitris* or pine dominant forest (DoEE 2019c, DEWHA 2010b). **Ecology** The species requires a combination of sandstone cliff/escarpment to provide roosting habitat, adjacent to higher fertility sites, particularly woodland valley or river/rainforest corridors which are used for foraging (DoEE 2019c). Roosting has also been recorded in caves, overhangs, disused Fairy Martin (*Hirundo ariel*) nests and mine shafts, and potentially in tree hollows (DoEE 2019c, DEWHA 2010b, TSSC 2012b, DERM 2011). The structure of primary nursery roosts is specific, including arch caves with dome roofs with indentations in the roof (TSSC 2012b, DoEE 2019c, DERM 2011). These characteristics are not very common in the landscape and therefore a limiting factor (DoEE 2019c). This species forages for insects at night around roost sites for up to several kilometres (DoEE 2019c).	<u>Unlikely</u> Potential habitat for this species (areas with extensive cliffs and caves) is unlikely to occur within the study area, and the distribution of this species is to the south of the study area.

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<tr><th>EPBC Act[1,2]</th><th>NC Act[3]</th></tr>
<tr><td>Corben’s Long-eared Bat#
Nyctophilus corbeni</td><td>V</td><td>V</td><td>Distribution
This species is found across semi-arid southern Australia, where it is patchily distributed in southern central Queensland, central western New South Wales, north-western Victoria, and eastern South Australia (TSSC 2015d). In Queensland, approximately 30% of its distribution is within the Brigalow Belt South Bioregion (TSSC 2015d).
Habitat
Known to occur in a range of inland woodland vegetation types, including Bulloke woodlands, Brigalow woodland, Belah woodland, Smooth-barked Apple woodland, River Red Gum forest, Black Box woodland (TSSC 2015d). Corben’s Long-eared Bat is more common in box / ironbark / cypress-pine vegetation, with a distinct tree canopy and a dense, cluttered understorey layer (TSSC 2015d).
Foraging
Foraging appears concentrated around patches of trees, with many individuals from different species of bat sharing the same foraging area (TSSC 2015d). This bat feeds on insects in flight, by gleaning vegetation and during ground foraging (TSSC 2015d).
Roosting Breeding
Corben’s Long-eared Bat roosts solitarily in tree hollows, crevices, under loose bark and possibly under dense foliage (DoEE 2019c, DEWHA 2010b, TSSC 2015d).
Dispersal
Most roost sites are used just for a single day and large distances are travelled at night, with consecutive roost sites generally within 4 km (TSSC 2015d).</td><td><u>Unlikely</u>
Potential habitat may occur; however, there are no records within 50 km of the study area, and the study area is located to the north of the known distribution of this species.</td></tr>
<tr><td>Northern Hairy-nosed Wombat
Lasiorhinus krefftii</td><td>CE</td><td>CE</td><td>Distribution
Only remaining population occurs in the Epping Forest National Park, along the Belyando River system (DoEE 2019c).</td><td><u>Unlikely</u>
Given the known distribution of this species and the extensive surveys conducted nearby for other projects, this species is unlikely to occur. The records that occur within 50 km of the study area are historic records.</td></tr>
</table>

Species	Status		Description	Desktop likelihood of occurrence
	EPBC Act[1,2]	NC Act[3]		
			Habitat Within Epping Forest National Park, the vegetation is dominated by Brigalow and Gidgee (*Acacia harpophylla* and *A. cambagei*) scrub, intersected by a gully with deep sandy soils supporting mixed eucalypt woodland (DoEE 2019c, TSSC 2018). Dominant native grasses are *Aristida spp*. and *Enneapogon spp.* Buffel Grass (*Cenchrus ciliaris*) is increasing in abundance (DoEE 2019c). **Ecology** Deep sandy soils are required for burrow construction, occurring along the banks of a single wide gully within Epping Forest National Park (DoEE 2019c). Burrows are located close to trees, specifically Native Bauhinia (*Lysiphyllum hookeri*) providing shade and support in the soft, sandy soil (DoEE 2019c, TSSC 2018). The Northern Hairy-nosed Wombat is strictly nocturnal, feeding at night and only when it's not too cold or too hot and dry (DoEE 2019c, TSSC 2018).	

Appendix F Fauna Survey Site Descriptions

Appendix G Relevant Survey Guidelines and Survey Effort Implemented for Threatened Species

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Reptiles							
Acanthophis antarcticus Common Death Adder	-	V	Potential	Not applicable.	Not applicable.	Guideline[2]: • Survey in breeding period (September to March), at night when species is active. • Nocturnal vehicle transects on suitable roads with limited overlying debris, where roads/tracks intersect suitable habitat. Approximately 500 km or all suitable roads surveyed multiple times. Surveys to occur on warm humid nights, over two nights over two surveys.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • A total of 58.6 person hours of spotlighting, including in areas of potential habitat and vehicle transects was conducted during surveys. Spotlighting was undertaken over several nights across the surveys. • A total of 75 person hours of active searching and vehicle transects was conducted during surveys. Total survey effort and methodology satisfies the guideline[2] requirements. Timing of the surveys occurred within the identified breeding period for this species. This species was not detected.
Denisonia maculata Ornamental Snake	V	V	Likely	Guideline[1]: • **Habitat search** around suitable gilgai habitat while frogs are active.	Guideline[3]:	• No species-specific guidelines, survey guidelines for reptiles[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September -	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
				• **Spotlight driving** roads at night, after wet weather when frogs are active. Survey in warm evenings. • **Diurnal searches** under sheltering sites (rocks, logs etc).	• **Spotlighting** is more effective on warm/humid nights. Target areas of water-inundated gilgais, wetlands, riparian habitat and large logs between early morning hours and dusk. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. • One off **diurnal searches** of target areas of water-inundated gilgais, wetlands, riparian habitat, and large logs. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. • Opportunistic **active searches** whilst driving along roads/tracks in study area. • **Trapping (pitfall & funnel)** with three replicates sites per habitat type. Traps to be checked over four days morning and early evening (after optimal foraging). Trap lines to consist of: o six 20L buckets, buried 500mm deep. Buckets to be evenly distributed under a 30 m drift fence.	mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Pitfall trapping** consisting of four buckets 7.5 m apart in a 'T' shape design along 45 m drift fence. Traps set for four nights in total. • **Funnel trapping** consisting of six funnels placed 3 m from the distal ends of the 'T' shape drift fence. Traps set for four nights in total. design. • **Diurnal searches** consisting of two 30 person-minute searches within two different 50 m by 50 m plots within a survey site. • **Nocturnal searches** consisting of two 30 person-minute searches within the 100 m by 100 m survey site. • **Scat and sign searches** to coincide with the diurnal searches. Otherwise, incidental observations. • **Incidental** detection of species unintentionally.	April 2021) and spring 2021 (6–10 September). • Autumn surveys (2019, 2020, 2021) occurred during suitable weather conditions and frog activity. • Fourteen systematic survey sites were established during the surveys with at least three survey sites in each habitat type. • Three systematic survey sites were established in potential habitat for the Ornamental Snake. Each site consisted of the recommended design and trap numbers for pitfalls and funnels as per the Queensland guideline4. • Four supplementary survey sites (MSS01-MSS04) were established in Autumn 2021 targeting Ornamental Snake habitat in cleared agricultural areas. • Survey effort for each survey method utilised for Ornamental Snake detection is as follows: o Pitfall traps: 176 trap nights o Funnel traps: 264 trap nights o Diurnal searches: 75 person hours o Camera trapping: 56 trap nights o Spotlighting: 58.6 person hours in total

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					o Funnels to be placed each end of pitfall line.	• **Camera trapping** consisting of camera per site, for a minimum of four nights.	Survey timing, methodology and effort were consistent with the Queensland guideline[4] and Commonwealth guideline[1]. Pitfall and funnel trapping methodology varied from Commonwealth guideline[3], however the survey effort for the pitfall and funnel trapping was consistent with or exceeded the required levels. Survey effort for active searching and spotlighting did not meet duration requirements as per Commonwealth Guideline[3]. This guideline[3] requires 1.5 person-hours of spotlighting and diurnal searches per ha for habitats of average complexity. It was determined that targeted surveys are the most appropriate means of survey in these habitats given the size of the survey area. This species was recorded during surveys.
Furina dunmalli Dunmall's Snake[#]	V	V	Unlikely	Guideline[1]: No survey methods known to reliably detect the species. Recommended methods include: • Spotlight driving roads at night, after wet weather. • Diurnal searches under sheltering sites (rocks, logs etc).	Guideline[3]: • Spotlighting is more effective on warm/humid nights. Target areas of water-inundated gilgais, wetlands, riparian habitat and large logs between early morning hours and dusk. 1.5 person-hours per ha for habitats of average	No species-specific guidelines, survey guidelines for reptiles[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
				• Pitfall trapping.	complexity. Survey three nights minimum. • Transects should be strategically designs/placed in large habitat patches (>10 ha) to sample representative microhabitats in each habitat type. • One off diurnal searches of target areas of water-inundated gilgais, wetlands, riparian habitat, and large logs. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. • Opportunistic **active searches** whilst driving along roads/tracks in study area. • **Trapping (pitfall & funnel**) with three replicates sites per habitat type. Traps to be checked over four days morning and early evening (after optimal foraging). Trap lines to consist of: o six 20L buckets, buried 500mm deep. Buckets to be evenly distributed under a 30 m drift fence. o Funnels to be placed each end of pitfall line.	• Pitfall trapping consisting of four buckets 7.5 m apart in a 'T' shape design along 45 m drift fence. Traps set for four nights in total. • Funnel trapping consisting of six funnels placed 3 m from the distal ends of the 'T' shape drift fence. Traps set for four nights in total. design. • Diurnal searches consisting of two 30 person-minute searches within two different 50 m by 50 m plots within a survey site. • **Nocturnal searches** consisting of two 30 person-minute searches within the 100 m by 100 m survey site. • **Scat and sign searches** to coincide with the diurnal searches. Otherwise, incidental observations. • **Incidental** detection of species unintentionally. • **Camera trapping** consisting of camera per site, for a minimum of four nights.	• Survey effort for each survey method utilised for Dunmall's Snake detection is as follows: o Pitfall traps: 176 trap nights o Funnel traps: 264 trap nights o Diurnal searches: 75 person hours o Camera trapping: 56 trap nights o Spotlighting: 58.6 per hours in total Survey timing, methodology and effort were consistent with the Queensland guideline[4] and Commonwealth guideline[1]. Pitfall and funnel trapping methodology varied from Commonwealth guideline[3], however the survey effort for the pitfall and funnel trapping was consistent with or exceeded the required levels. Survey effort for active searching and spotlighting did not meet duration requirements as per Commonwealth Guideline[3]. This guideline[3] requires 1.5 person-hours of spotlighting and diurnal searches per ha for habitats of average complexity. This species was considered unlikely to occur within the study area and targeted surveys undertaken within the study area were deemed sufficient for this species. This species was not detected.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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Egernia rugosa Yakka Skink#	V	V	Unlikely	Guideline[1]: • **Diurnal searches** focused on identifying burrow systems and communal defecation sites. • **Elliott trapping** through the placement of traps around suspected burrows. • **Observation surveys** utilising binoculars from afar. • **Nocturnal searches** utilising torches to shine down suspected burrows at night.	Guideline[3]: • **Spotlighting** is more effective on warm/humid nights. Target areas of water-inundated gilgais, wetlands, riparian habitat and large logs between early morning hours and dusk. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. • **Transects** should be strategically designs/placed in large habitat patches (>10 ha) to sample representative microhabitats in each habitat type. • One off **diurnal searches** of target areas of water-inundated gilgais, wetlands, riparian habitat, and large logs. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. Potential colony sites cab be observed utilising telescope or binoculars at a 30 m distance. • **Elliott and cage trapping** targeting colony sites, one large Elliott-style trap	Guideline[5]: • Survey in optimal conditions • single **diurnal search** to occur during one survey. Survey effort to equal 'a total of 20 minutes per hectare' or 'search 20% of suitable habitat when 50 ha or more' or 'search 40% of suitable habitat when <50 ha of suitable habitat present'. • **Distant Observation** by 20 minutes scanning suitable microhabitat, conducted three times on separate days. Scans should be conducted where abundant microhabitat features occur. To be conducted over three days. • **Camera trapping** consisting of three cameras per potential colony site, for four consecutive nights. • **Funnel trapping** consisting of ten funnel traps set for four consecutive nights at potential colony sites.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • Camera trapping: 56 trap nights. • Funnel traps: 177 trap nights. • Elliott trapping: 880 total trap nights. • A total of 73 person hours of active searching. • A total of 58.6 person hours of spotlighting. Survey timing, methodology and effort were consistent with the Commonwealth guideline[1,3] and the Queensland guideline[4]. Elliott and cage trapping targeting colony sites was not undertaken during the surveys as no potential colonies were identified. This species was not detected.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					(15.5 cm x 15 cm x 46 cm) and one cage trap placed as close as possible to potential burrow entrances o Traps to be placed for four days and checked every morning and early evening.		
Lerista allanae Allan's Lerista	E	E	Unlikely	Guideline[1]: • Diurnal searches, through the raking of surface soil, leaf litter in suitable shelter habitats. • Pitfall trapping consisting of six 10L buckets, buried 500mm deep. Buckets to be evenly distributed under a 30 m drift fence.	Guideline[3]: • One off diurnal searches of target areas of water-inundated gilgais, wetlands, riparian habitat, and large logs. 1.5 person-hours per ha for habitats of average complexity. Survey three nights minimum. • Trapping (pitfall & funnel) with three replicates sites per habitat type. Traps to be checked over four days morning and early evening (after optimal foraging). Trap lines to consist of: o six 20L buckets, buried 500mm deep. Buckets to be evenly distributed under a 30 m drift fence. o Funnels to be placed each end of pitfall line.	No species-specific guidelines, survey guidelines for reptiles[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • Pitfall trapping consisting of four buckets 7.5 m apart in a 'T' shape design along 45 m drift fence. Traps set for four nights in total. • Funnel trapping consisting of six funnels placed 3 m from the distal ends of the 'T' shape drift fence. Traps set for four nights in total. design. • **Diurnal searches** consisting of two 30 person-minute searches within two different 50 m	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • Camera trapping: 56 trap nights. • Pitfall trapping: 176 trap nights. • Funnel traps: 264 trap nights. • Elliott trapping: 880 total trap nights. • A total of 75 person hours of active searching. • A total of 58.6 person hours of spotlighting. Survey timing, methodology and effort were consistent with the Commonwealth guideline[1,3] and the Queensland guideline[4]. Artificial survey sites were not established during surveys as species was

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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					• **Artificial survey sites**, placement of tile grids (50 tiles at 5 m intervals) in suitable habitat. Minimum two grids for sites < 2 ha, one grid per 2 ha for sites up to 40 ha, and 20 grids for sites >40 ha. o Sites to be established three months in advance of survey and checked once per week over a one month survey.	by 50 m plots within a survey site. • **Nocturnal searches** consisting of two 30 person-minute searches within the 100 m by 100 m survey site. • **Scat and sign searches** to coincide with the diurnal searches. Otherwise, incidental observations. • **Incidental** detection of species unintentionally. • **Camera trapping** consisting of camera per site, for a minimum of four nights.	deemed unlikely to utilise the study area and this method is only recommended as a trial method to be used as a supplementary survey technique as per Commonwealth Guideline[3]. This species was not detected.
Birds							
Erythrotriorchis radiatus Red Goshawk	V	E	Potential	Guideline[6]: • Surveys to be conducted during breeding season, primarily August to November (though can occur June/July and December). • **Ground searches** for nesting sites best undertaken early or late in the day. • **Driving searches** along tracks in suitable habitats.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys.

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				• **Point counts** at locations where observers can see over the canopy (ideal for rugged terrains). Guideline[7]: • **Area searches** of potential suitable habitats, can be undertaken through traversing the area on foot or driving slowly. Survey effort consists of minimum 80 hours over ten days or for areas ≤50 ha is 50 hours over eight days.		• **Incidental** detection of species unintentionally.	Survey timing, methodology and effort were consistent with the Commonwealth guideline[6,7] and the Queensland guideline[4]. This species was not detected.
Hirundapus caudacutus White-throated Needletail	V, Mi	V, SLC	Likely	Guideline[9]: • Survey between October and April in northern and eastern Australia, and between December and March in south-eastern Australia. • **Diurnal incidental** detection of species.	Guideline[8]: • Observations made in the evening when birds come in to roost (tall trees along ridge tops).	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Surveys occurred within the survey window for northern and eastern Australia. • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching. • A total of 83 person hours of diurnal bird surveys.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
							Survey timing, methodology and effort were consistent with the Commonwealth guidelines[8,9] and the Queensland guideline[4]. • This species was recorded during surveys.
Calyptorhynchus lathami erebus Glossy Black-cockatoo (Northern)	-	V	Potential	Not applicable.	Not applicable.	Guideline[10]: • **Diurnal bird surveys**, to be undertaken in suitable habitats incorporating dawn and dusk surveys. Minimum effort is five hours over a minimum of one day. • **Area searches**, consisting of searches within suitable habitats for evidence of presence (e.g. orts or breeding hollows). Minimum effort is 20 hours over a minimum of four days.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching. • A total of 83 person hours of diurnal bird surveys. Survey timing, methodology and effort were consistent with the Queensland guideline[10]. This species was not detected.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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Geophaps scripta scripta Squatter Pigeon (Southern)	V	V	Likely	Guideline[7]: • **Area searches or transect surveys** with a survey effort of 15 hours over three days. Based on areas smaller than 50 ha in size. • **Flushing surveys** with a survey effort of ten hours over three days. Based on areas smaller than 50 ha in size. Guideline[11]: • **Slow driving surveys** at a constant speed, with a minimum of two along the same roads/ tracks/dusty areas. Timing recommended is sunrise to 9:00 am and from 3:30 pm to sunset.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5–10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching. • A total of 83 person hours of diurnal bird surveys. • Tracks and dusty areas were surveyed during travel between sites resulting in incidental recordings. Survey timing, methodology and effort were consistent with the Queensland guideline[4] and the Commonwealth guideline[11]. Survey techniques and effort utilised were partially compliant with Commonwealth guideline[7] requirements. No flushing surveys were undertaken, while area searches were conducted in accordance with Commonwealth guideline[7] requirements. It is noted that Commonwealth guideline[7] identifies that these methods are based on areas smaller than 50 ha in size. Flushing surveys were deemed

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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							unnecessary given the size of the study area and was sufficiently covered using other methods. This species was recorded during surveys.
Falco hypoleucos Grey Falcon	V^	V	Potential	No specific guideline for this species. [The Grey Falcon was listed under the EPBC Act after the Project Controlled Action decision.]	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys. Survey timing, methodology and effort were consistent with the Commonwealth guideline[6,7] and the Queensland guideline[4]. • This species was not detected.
Neochmia ruficauda ruficauda Star Finch[#]	E	E	Unlikely	No species-specific guidelines, survey guidelines for EPBC Act threatened birds[7]: • **Diurnal area searches** or transect-point surveys in areas of favoured habitat in and around the study area.	Guideline[8]: • **Area searches** or transect-point surveys in suitable habitat, minimum survey effort 15 hours over five days (in areas <50 ha). • **Broadcast surveys**, to be undertaken in morning and	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May).	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the

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	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					evening has proven effective. Minimum survey effort 15 hours over three days (in areas <50 ha). • **Targeted surveys,** minimum survey effort ten hours over four days, targeting waterholes.	• Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys. Survey timing, methodology and effort were consistent with the Commonwealth guideline[7,8] and the Queensland guideline[4]. This species was not detected.
Grantiella picta Painted Honeyeater[#]	V	V	Unlikely	No species-specific guidelines, survey guidelines for EPBC Act threatened birds[7]: • **Diurnal area searches** or transect-point surveys in areas of favoured habitat in and around the study area. • **Diurnal transect surveys** along watercourses or roads.	There is no specific guideline for this species.	Guideline[12]: • **Area searches**, consisting of systematically searching for birds and signs of their presence as well as listening for calls. Surveys should be undertaken on foot and target foraging and breeding habitats. Minimum survey effort is four hours over four days.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys. Survey timing, methodology and effort were consistent with the Commonwealth guideline[7] and the Queensland guideline[12]. This species was not detected.

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Rostratula australis Australian Painted Snipe	E	E	Potential	Guideline[7]: • Targeted **stationary observations** with a survey effort of ten hours over five days at dusk and dawn within suitable foraging locations. • **Land-based searches or line transects** for sites smaller than 50 ha. To occur when wetlands hold water but not flooded. With a total of ten hours over three days.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally. • **Spotlighting** consisting of two 30-minute searches within a 100 m by 100 m plot area.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys. • A total of 58.6 person hours of spotlighting. Survey timing, methodology and effort were consistent with the Commonwealth guideline[7] and the Queensland guideline[4]. Land-based searches/line transects were deemed not necessary as the study area exceeded 50 ha. This species was not detected.
Calidris ferruginea Curlew Sandpiper	CE, Mi	E	Unlikely	No species-specific guidelines, survey guidelines for EPBC Act threatened birds[7]: • **Observation surveys** overlooking suitable foraging or roosting habitat at appropriate periods of the tidal cycle.	Guideline[13]: • **Count surveys** to be undertaken to determine population sizes and potential habitats. • Tidal areas: Surveys should be undertaken during the	No species-specific guidelines, survey guidelines for birds[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May).	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September).

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	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
				• **Diurnal area searches** in appropriate habitat in and around the study area, including flushing surveys. • **Diurnal transect surveys** along suitable habitat areas.	months when shorebirds are present. • Non-tidal areas: surveys should be undertaken during the period that the majority of shorebirds are present. • Survey effort should consist of: o Four surveys for roosting shorebirds, four surveys for foraging shorebirds, and one survey during the northern hemisphere breeding season.	• Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 83 person hours of diurnal bird surveys. Survey timing, methodology and effort were consistent with the Commonwealth guidelines[7,13] and the Queensland guideline[4]. This species was not detected.
Mammals							
Dasyurus hallucatus Northern Quoll	E	LC	Unlikely	Guideline[14]: • **Cage trapping** and **Elliott trapping** surveys ideally undertaken between May and August. Trapping focused on suitable habitats. Traps to be set four a minimum of three nights. Minimum of four cage traps per trap configuration. • **Daytime searches** of potentially suitable habitat for signs including scats and tracks (can also utilise sand traps).	Guideline[15]: • **Reconnaissance surveys** consisting of motion sensing cameras with lures/baits, and active scat searches. Can be combined with other methods such as hair tubes, detection dogs or spotlighting. Survey should assess if suitable habitat is present; if present targeted surveys may be required:	No species-specific guidelines, survey guidelines for medium to large terrestrial mammals[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Incidental** detection of species unintentionally. • **Spotlighting** consisting of two 30-minute searches within a 100 m by 100 m plot area.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 58.6 person hours of spotlighting. • Camera trapping: 56 trap nights.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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				• **Remote cameras**, in potentially suitable habitat. • **Spotlight surveys**, of at least two 200 m transects per 5 ha site. Ideally undertaken over two separate nights. • Hair tube surveys.	• **Targeted surveys** consist of Elliot or cage trapping (to be undertaken between April and September) and additional supplementary techniques such as motion sensing cameras (able to be undertaken year-round).	• **Scat and sign searches** within two different 50 m by 50 m plots for two 30 person-minute searches. • **Camera trapping** consisting of camera per site, for a minimum of four nights. • **Hair tubes** to be deployed alongside other trapping sites and within suitable habitat for species, set for a minimum of four nights.	Survey timing, methodology and effort were consistent with the Commonwealth guidelines[15,16] and the Queensland guideline[4]. No suitable denning habitat was identified within the study area, as such targeted surveys utilising cage traps or hair tubes were deemed unnecessary in accordance with Commonwealth guideline[15].
Macroderma gigas Ghost Bat[#]	V	E	Unlikely	No species-specific guidelines, survey guidelines for EPBC Act threatened bats[17]: • General survey methods for microbats include harp traps, mist nets, echolocation call detection, roost surveys.	There is no specific guideline for this species.	Guideline[17]: • **Acoustic detection**, through the use of Anabat detectors or walking transects with handheld call detectors. Minimum effort of eight detector hours across four nights. • **Harp traps** to be deployed for a minimum of effort of eight trap nights across four nights. • **Mist nets** to be set for a minimum of effort of eight hours across four nights. • **Roost searches**, comprising of approximately two hours per survey day.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Thirteen systematic sites and three supplementary sites utilising Anabat recorders, six survey sites employing harp traps and four survey sites utilising mist nets were established during the surveys. • In total, 50 echolocation call detection nights across the surveys. • In total, 4 hours of mist netting. • In total, 30 trap nights of harp trapping. Survey timing, methodology and effort were consistent with the

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
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							Commonwealth guideline[16] and the Queensland guideline[4]. This species was not detected.
Phascolarctos cinereus Koala	V	V	Likely	No species-specific guidelines, survey guidelines for EPBC Act threatened mammals[15]: • Diurnal searches on foot with transects spaced 50 m to 100 m intervals in key habitat areas. These searches are to target the presence of shelter, fodder trees and scats; these values are to be identified, and their position recorded. • Spotlighting surveys utilising handheld lights. Surveys to comprise of two 200 m transects 100 m apart per 5 ha site (or longer transects for larger sites). Walking speed to be 10 m/minute. Surveys ideally repeated over two nights at each location, avoiding inclement weather.	Guideline[18]: This guideline does not prescribe survey effort standards for koala surveys[19]. The following methods are recommended: Direct observation methods should be undertaken between August and January. Suggested methods include: • Strip transects. • Spotlighting. • Call playback. • Remote sensor activated cameras. • Mark resight or mark recapture. • Detection dogs.	No species-specific guidelines, survey guidelines for arboreal and volant mammals[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • Incidental detection of species unintentionally. • Spotlighting consisting of two 30-minute searches within a 100 m by 100 m plot area. • Call playback consisting of two sessions of call playback of relevant species at the midpoint of survey site. • Scat and sign searches within two different 50 m by 50 m plots for two 30 person-minute searches. • Diurnal survey consisting of six 5-10-minute area searches within a 100 m by 100 m plot area.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Spring 2019 survey occurred during the identified direct observation survey window. • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 58.6 person hours of spotlighting. • A total of 11 person hours of call playback (including Koala call playback). • A total of 56 trap nights utilising remote sensor activated cameras. Survey timing, methodology and effort were consistent with the Commonwealth guideline[14] and the Queensland guideline[4]. Survey methods utilised included a range of methods identified within the EPBC Act referral guideline[18].

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				• Call playback consisting of two sessions of call playback of relevant species in each site (or stratification unit up to 200 ha). Call playback surveys can coincide with spotlight surveys.	Suggested indirect observation methods include: • Scratching searches. • Scat searches. o Spot Assessment Technique. o Regularised Grid Based Spot Assessment Technique, o Koala optimised Rapid Assessment Methodology, and o Faecal standing crop assessment.		This species was detected.
Pteropus poliocephalus Grey-headed Flying-fox#	V	LC	Unlikely	Guideline[16]: • **Desktop review** of known flying-fox camps within the region. • Daytime **field surveys** for flying-fox camps. • **Vegetation surveys,** assessing vegetation community structure and the availability of food plants for the species. • **Walking transects** (100m) searching for feeding and flying bats.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for flying-foxes[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Incidental** detection of species unintentionally.	• There are no known Grey-headed Flying Fox camps within the region. Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 58.6 person hours of spotlighting. Survey timing, methodology and effort were consistent with the

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
						• **Roost searches** for flying-foxes, roosts can be identified by walking transects during the day within the survey area, watching for flying bats and listening for their distinctive calls. • **Spotlighting** consisting of two 30-minute searches within a 100 m by 100 m plot area. • **Vegetation assessment,** assess the presence of plant species known to be consumed by flying-foxes.	Commonwealth guideline[16] and the Queensland guideline[4]. This species was not detected.
Greater Glider *Petauroides volans*	V	V	Likely	No species-specific guidelines, survey guidelines for EPBC Act threatened mammals[15]: • **Diurnal searches** on foot with transects spaced 50 m to 100 m intervals in key habitat areas. These searches are to target the presence of shelter, fodder trees and scats; these values are to be identified, and their position recorded.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for arboreal and volant mammals[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Incidental** detection of species unintentionally. • **Spotlighting** consisting of two 30-minute searches within a 100 m by 100 m plot area.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of habitat searches. • A total of 58.6 person hours of spotlighting. • A total of 11 person hours of call playback (utilising owl/predatory call playback).

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
				• **Spotlighting surveys** utilising handheld lights. Surveys to comprise of two 200 m transects 100 m apart per 5 ha site (or longer transects for larger sites). Walking speed to be 10m/minute. Surveys ideally repeated over two nights at each location, avoiding inclement weather. • **Call playback** consisting of two sessions of call playback of relevant species in each site (or stratification unit up to 200 ha). Call playback surveys can coincide with spotlight and stag watch surveys. • **Stag watch** surveys to occur at locations of potential den trees. Surveys to occur 30 minutes before dusk for a total of 60 minutes.		• **Call playback** consisting of two sessions of call playback of relevant species at the midpoint of survey site. • **Scat and sign searches** within two different 50 m by 50 m plots for two 30 person-minute searches.	Survey timing, methodology and effort were consistent with the Commonwealth guideline[14] and the Queensland guideline[4]. Stag watch surveys were deemed not necessary as spotlighting and call playback surveys were deemed sufficient as they occurred in proximity to potential den trees. This species was detected.
Chalinolobus dwyeri Large-eared Pied Bat	V	V	Unlikely	Guideline[16]: • **Unattended bat detectors,** 16 detector nights over a minimum of four nights. • Targeted survey.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for microbats[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May).	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Thirteen systematic sites and three supplementary sites

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
				• Attended bat detectors, six detector hours over minimum of three nights. Trapping with harp traps and mist nets and roost searches in caves, mines, rock overhangs etc. could be undertaken to confirm presence or roosting. **Harp traps and/or Mist nets** for a total of 16 trap or net nights over a minimum of four nights.		• Three replicate generic survey sites established per assessment unit. • **Call detection**, one detector to be placed at each sampling site for a minimum of three nights. • Targeted survey: • Attended bat detectors and roost searches at prospective roost sites • **Harp traps** to be set for a minimum of two nights per sampling site. **Mist nets** to be set for a minimum three to four hours.	utilising Anabat recorders, six survey sites employing harp traps and four survey sites utilising mist nets were established during the surveys. • In total, 50 echolocation call detection nights across the surveys. • In total, 4 hours of mist net trapping. • In total, 30 trap nights of harp trapping. Survey timing, methodology and effort were consistent with the Commonwealth guideline[16] and the Queensland guideline[4].
Nyctophilus corbeni Corben's Long-eared Bat[#]	V	V	Unlikely	Guideline[16]: • **Harp traps** to be set for a total of 20 trap nights over a minimum of five nights. • **Mist nets** to be set for a total of 20 trap nights over a minimum of five nights.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for microbats[4]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Incidental** detection of species unintentionally. • **Acoustic detection**, can be used to identify the presence of *Nyctophilus* spp. but cannot be used to identify to a species	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Thirteen systematic sites and three supplementary sites utilising Anabat recorders, six survey sites employing harp traps and four survey sites utilising mist nets were established during the surveys. • In total, 50 echolocation call detection nights across the surveys.

Species	Status		Species Likelihood Determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
						level, one detector to be placed at each sampling site for a minimum of three nights. • **Roost searches** for microbats assessing the availability of habitats, at prospective roost sites survey effort should be undertaken to assess the utilisation of the site (observation surveys, acoustic detection). • **Harp traps** to be set for a minimum of two nights per sampling site. • **Mist nets** to be set for a minimum three to four hours.	• In total, 4 hours of mist net trapping. • In total, 30 trap nights of harp trapping. Survey timing, methodology and effort were consistent with the Commonwealth guideline[16] and the Queensland guideline[4]. The *Nyctophilus* genus was detected through Anabat recorders, across the surveys. Specialist Greg Ford attributed these indistinguishable calls to either *Nyctophilus gouldi* or *N. geoffroyi* and not the threatened species *N. corbeni.*

Appendix H Relevant Survey Guidelines and Survey Effort Implemented for Migratory Species

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Pandion cristatus (Pandion haliaetus) Eastern Osprey	Mi	SLC	Unlikely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: Can be detected directly by sight or call; or indirectly by signs of occupancy such as nests or prey remains. Osprey survey techniques: • Observations from vantage points to detect birds in flight over suitable habitat • Area searches on foot to detect birds or signs of occupancy in suitable habitat	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. • This species was not detected.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					• Transect surveys from vehicles to detect birds or nests in large survey areas Transect surveys from boats along suitable coastal or riparian habitat Aerial surveys to detect birds or nests in large survey areas		
Apus pacificus Fork-tailed Swift	Mi	SLC	Likely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: • No standard survey techniques, can be identified from elevated viewpoints and through distinctive call vocalisation.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. This species was not detected.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Cuculus saturatus Oriental Cuckoo#	Mi	SLC	Unlikely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: Survey over standardised timed periods and can be identified through distinctive call vocalisation.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. • This species was not detected.
Gelochelidon nilotica Gull-billed Tern	Mi	SLC	Potential	There is no specific guideline for this species.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
						minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Queensland guideline[2]. This species was not detected.
Hydroprogne caspia Caspian Tern	Ma, Mi	SL	Likely	There is no specific guideline for this species.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Queensland guideline[2]. This species was not detected.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Monarcha melanopsis Black-faced Monarch	Mi	SLC	Potential	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: Consider habitat (and specific locations) that is suitable and important for migration passage.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11– 21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. This species was not detected.
Symposiachrus trivigartus Spectacled Monarch	Mi	SLC	Unlikely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird*	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					surveys undertaken for their environmental impact assessment at a site. Guidance: Consider habitat (and specific locations) that is suitable and important for migration passage.	• **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. • This species was not detected.
Myiagra cyanoleuca Satin Flycatcher	Mi	SLC	Likely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species; however, this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: • Consider habitat (and specific locations) that is suitable and important for migration passage.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. This species was not detected.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Rhipidura rufifrons Rufous Fantail	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: • **Area searches** during breeding season over 2 ha for 20 minutes. • **Area searches** during migration seasons primarily focusing on habitat that is important for migration passage.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2]. This species was not detected.
Actitis hypoleucos Common Sandpiper	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May).	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys,

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
					• Assessment of potential habitat.	• Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2]. This species was not detected.
Calidris acuminata Sharp-tailed Sandpiper	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March. • Assessment of potential habitat.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2].

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
							This species was not detected.
Calidris melanotos Pectoral sandpiper[#]	Mi	SLC	Unlikely	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March. • Assessment of potential habitat.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September - mid November), Autumn (March - mid May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2]. • This species was not detected.
Calidris ruficollis Red-necked Stint	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March. • Assessment of potential habitat.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type.

<table>
<tr><th rowspan="2">Species</th><th colspan="2">Status</th><th rowspan="2">Species likelihood determination</th><th colspan="2">Commonwealth</th><th rowspan="2">Queensland survey guidelines</th><th rowspan="2">Survey Timing, Effort and Methodology</th></tr>
<tr><th>EPBC Act</th><th>NC Act</th><th>Survey guidelines</th><th>EPBC Act referral guidelines</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>Diurnal bird survey consisting of six 5-10-minute area searches within a 100 m by 100 m plot area.
Incidental detection of species unintentionally.</td><td>A total of 75 person hours of active searching including within areas of potential habitat.
A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat.
Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2].
This species was not detected.</td></tr>
<tr><td>Gallinago hardwickii
Latham's Snipe</td><td>Mi</td><td>SL</td><td>Likely</td><td>Guideline[4]:
Surveys undertaken between October–February during the day.
Area searches or line transects in suitable habitat.</td><td>Guideline[3]:
Surveys to be conducted when habitat conditions are suitable.
September to March.
Assessment of potential habitat.</td><td>No species-specific guidelines, survey guidelines for birds[2]:
Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May).
Three replicate generic survey sites established per assessment unit.
Diurnal bird survey consisting of six 5–10 minute area searches within a 100 m by 100 m plot area.
Incidental detection of species unintentionally.</td><td>Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September).
Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type.
A total of 75 person hours of active searching including within areas of potential habitat. 41 person hours of active searching occurred during October to February survey window.
A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. 41 person hours of diurnal bird surveys occurred during October to February survey window.
Survey timing, methodology and effort consistent with the Commonwealth guidelines[3,4] and the Queensland</td></tr>
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Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
							guideline[2]. This species was not detected.
Tringa nebularia Greenshank	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March. • Assessment of potential habitat.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2]. This species was not detected.
Tringa stagnatilis Marsh Sandpiper	Mi	SL	Potential	There is no specific guideline for this species.	Guideline[3]: • Surveys to be conducted when habitat conditions are suitable. • September to March. • Assessment of potential habitat.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
						• **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guidelines[3] and the Queensland guideline[2]. This species was not detected.
Plegadis falcinellus Glossy Ibis	Ma, Mi	SL	Likely	There is no specific guideline for this species.	There is no specific guideline for this species.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. • **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Queensland guideline[2]. This species was not detected.

Species	Status		Species likelihood determination	Commonwealth		Queensland survey guidelines	Survey Timing, Effort and Methodology
	EPBC Act	NC Act		Survey guidelines	EPBC Act referral guidelines		
Yellow Wagtail[#] *Motacilla flava*	Mi	SLC	Unlikely	There is no specific guideline for this species.	Guideline[1]: No formal survey guidelines exist for the species, however this document provides some guidance: *Actions proposed within the distribution of these species and in important habitats should allocate appropriate effort and consideration to detecting these migratory species as part of bird surveys undertaken for their environmental impact assessment at a site.* Guidance: Across appropriate habitat between November and March, can be identified from elevated viewpoints and through distinctive call vocalisation.	No species-specific guidelines, survey guidelines for birds[2]: • Brigalow Belt Bioregion timing Spring to Early Summer (September–mid-November), Autumn (March–mid-May). • Three replicate generic survey sites established per assessment unit. • **Diurnal bird survey** consisting of six 5-10-minute area searches within a 100 m by 100 m plot area. **Incidental** detection of species unintentionally.	• Surveys in autumn 2019 (11–21 March 2019), spring 2019 (6–19 November 2019), autumn 2020 (23–25 March 2020; 1–8 April 2020), autumn 2021 (14–22 April 2021) and spring 2021 (6–10 September). • Fourteen systematic survey sites were established during the surveys, with at least three survey sites in each habitat type. • A total of 75 person hours of active searching including within areas of potential habitat. • A total of 83 person hours of diurnal bird surveys, including within areas of potential habitat. Survey timing, methodology and effort consistent with the Commonwealth guideline[1] and the Queensland guideline[2.] • This species was not detected.

Appendix I Flora Species List

Appendix J Fauna Species List

Appendix K Landscape Fragmentation and Connectivity Tool Output

Landscape Fragmentation and Connectivity (LFC) Tool Version 1.4 Project Site LOGFILE

Department of Environment and Heritage Protection (DEHP)
Landscape Fragmentation and Connectivity (LFC) Tool version 1.4 LOGFILE
Process started at 23-03-2022 11:32:36 AM
Python version: 2.7.18 (v2.7.18:8d21aa21f2, Apr 20 2020, 13:19:08) [MSC v.1500 32 bit (Intel)]
Arcpy version: 10.8.1
Username: Andrew

INPUT PARAMETERS
Output Workspace: Q:\Jellinbah Resources\Bowen Basin Coal\Meadowbrook Project\GIS\ArcGIS\Landscape Fragmentation
Threshold lookup table:
C:\Users\Andrew\Desktop\Cracow\LFCtool\LFC_data.gdb\tbl_Regional_frag_local_threshold
Remnant cover layer: Regulated_vegetation_management_map
Remnant cover layer edited: False
Regional buffer extent: 20 kilometres
Local buffer extent: 5 kilometres
Impact layer: Disturbance
layer projection: GDA2020_MGA_Zone_55
Raster cell resolution for analysis: 10 metres
Edge Width: 50 metres
(The distance from non-remnant landscapes through to the core ecosystem - the edge of remnant ecosystems)
Default projection: c:\program files (x86)\arcgis\desktop10.8\ArcToolbox\Toolboxes\scripts\QLD Albers Equal Area Conic.prj

11:32:36 Checking out the spatial analyst tool - required for LFC

11:32:36 ____________BEGINNING LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS___________

11:32:36 This tool will categorise the landscape into:
{0: 'non-rem', 1: 'patch', 2: 'edge', 3: 'perforated', 4: 'core (< 100 hectares)', 5: 'core (100-500 hectares)', 6: 'core (> 500 hectares)', 7: 'water'}

11:32:40 Q:\Jellinbah Resources\Bowen Basin Coal\Meadowbrook Project\GIS\ArcGIS\Landscape Fragmentation\lyr_file does not exist, creating it now.
11:32:40 Copying across impact site feature(s) and calculating area in hectares (AreaHA)
11:32:41 Making a local copy of the impact site
11:32:42 Preparing remnant cover layer for analysis
11:32:48 Created regional scale buffer of 20 kilometres
11:32:55 Created local scale buffer of 5 kilometres
11:33:00 Clipped the remnant cover to the regional buffer extent
11:33:02 Unioned the pre impact remnant layer with the impact site
11:33:05 Attributed the impact area as not RVM Cat B
11:33:05 Area of RVM Cat B clearing is 114.47 hectares
11:33:05 SQL selection used is "RVM_CAT" = 'B' and "Cover" = 'Not RVM Cat B' on shapefile Q:\Jellinbah Resources\Bowen Basin Coal\Meadowbrook Project\GIS\ArcGIS\Landscape Fragmentation\main_output\clip_remcover_post.shp

11:33:07 Categorised the cover attributes in clip_remcover_pre.shp ready for raster conversion
11:33:31 Converted clip_remcover_pre.shp to raster

11:33:33 Categorised the cover attributes in clip_remcover_post.shp ready for raster conversion
11:33:57 Converted clip_remcover_post.shp to raster

11:33:57 Run Landscape fragmentation analysis on the pre impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 37.1 MINUTES)

12:11:01 Run Landscape fragmentation analysis on the post impact regional landscape

REGULATED VEGETATION TYPES BEING EXTRACTED FROM LAND COVER
IDENTIFICATION OF CORE, PATCH, EDGE AND PERFORATIONS
COMBINING FRAGMENTATION CLASSES
CLASSIFYING CORE FOREST PATCHES BY AREA
COMPOSING FINAL FRAGMENTATION MAP
COMPOSING FINAL FRAGMENTATION MAP
(FRAGMENTATION CALCULATION TIME WAS 58.5 MINUTES)

Extracting a local subset of lfc_regional_pre_impact
Extracting a local subset of lfc_regional_post_impact

Collating pre and post impact statistics and trigger assessment
13:15:43 Summarising area statistics for: lfc_localmsk_pre_impact
13:15:44 Summarising area statistics for: lfc_localmsk_post_impact
13:15:45 Summarising area statistics for: lfc_regional_pre_impact
13:15:50 Summarising patch count for lfc_localmsk_pre_impact
13:16:32 Summarising patch count for lfc_localmsk_post_impact

Analysing impact on Connectivity Areas

SIGNIFICANCE TEST ONE

The regional total area is 201607.13
The regional extent of core remnant is 61946.73
The regional extent of core remnant is 30.73 percent
This level of regional fragmentation sets a local impact threshold of: 10.0 percent

The table below lists the local impact thresholds for categories of regional core remnant extent:

REGIONAL CORE CATEGORY	LOCAL IMPACT THRESHOLD
< 10	2.0
10 - 30	5.0
30 - 50	10.0
50 - 70	20.0
70 - 90	30.0
>90	50.0

Area of core at the local scale (pre impact): 7430.91
Area of core at the local scale (post impact): 7221.87
Percent change of core at the local scale (post impact): 2.81 percent

SIGNIFICANCE TEST TWO

The number of core remnant areas occurring on the site: 3
The number of core remnant areas remaining on the site post impact: 3
(Only core polygons greater than or equal to 1 hectare are included)

RESULT

13:17:58 This analysis has determined any impact on connectivity areas is NOT significant
(A significant reduction in core remnant at the local scale is False OR a change from core to non-core remnant at the site scale is False)

The significance table has been written to: ..\main_output\lfc_significance_assessment.csv
The local scale summary table has been written to: ..\main_output\lfc_local_scale_summary.csv
The site scale summary table has been written to: ..\main_output\lfc_site_scale_summary.csv
GIS layer files copied into folder \lyr_file within the project folder.
View layers in ArcMAP using..\Q:\Jellinbah Resources\Bowen Basin Coal\Meadowbrook Project\GIS\ArcGIS\Landscape Fragmentation\lyr_file\lyr_file\Connectivity Area Impact Assessment.lyr

Please scrutinise the output tables and spatial layers to confirm the desktop modelling of connectivity area impact

This analysis used an unedited copy of the Regulated Vegetation layer.

13:44:05 ____________COMPLETED LANDSCAPE FRAGMENTATION AND CONNECTIVITY ANALYSIS___________