

Central Queensland Coal Project

Chapter 14 – Terrestrial Ecology

Supplementary Environmental Impact Statement





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CDM Smith Australia Pty Ltd
ABN 88 152 082 936
Level 4, 51 Alfred Street
Fortitude Valley
Qld 4006
Tel: +61 7 3828 6900
Fax: +61 7 3828 6999



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14 Terrestrial Ecology

This chapter describes the existing terrestrial flora and fauna values within and surrounding the Central Queensland Coal Project (the Project). The assessment is based on desktop literature reviews of existing background information and site-specific field assessments.

The investigation focuses on habitats within the Project area and wider surrounds, considers seasonal variation, and targets threatened species. Field surveys have been carried out over a number of years and were designed to encapsulate seasonal variation in species' detectability. Survey sites were selected in representative locations of the key vegetation communities and habitat types present. The Project area together with additional sites visited surrounding the Project area represent the ecological Study area, as referred to in this chapter.

The following chapter assesses the likely impacts of the Project on terrestrial flora and fauna Environmental Values (EVs). This chapter collates the results of several fauna and flora technical reports (refer Appendix A9a – Terrestrial Fauna Reports and A9b – Flora and Vegetation Assessment respectively) and provides the results of an updated desktop review and additional targeted fauna surveys (refer Appendix A9c – Ecological Desktop Search Results and A9d – Ecological Field Survey Results respectively).

Specific objectives of the terrestrial ecology assessment were to:

- Review the relevant background information including databases, mapping and literature;
- Describe the main vegetation communities within the Study area and confirm Regional Ecosystem (RE) mapping, known Environmentally Sensitive Areas (ESA) (as listed under the *Environmental Protection Act 1994* (EP Act)) and vegetation mapped as Essential Habitat for conservation significant species under the *Vegetation Management Act 1999* (VM Act);
- Confirm the likely presence / absence of flora and fauna (and associated habitats) listed under Queensland's *Nature Conservation Act 1992* (NC Act) and the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Record the presence of introduced pest flora and fauna;
- Discuss potential direct and indirect impacts to terrestrial ecological values because of the Project; and
- Propose mitigation measures to protect or enhance terrestrial ecological values within the Project area.

The Draft Project Terms of Reference (ToR) were published for public review and comment by the Queensland Department of Environment and Science (DES) (formerly known as the Department of Environment and Heritage Protection) on 10 April 2017. The ToR were finalised by DES 4 August 2017. As per the ToR the Project's impacts on Matters of National Environmental Significance (MNES) as listed under the EPBC Act are addressed in detail in Chapter 16 - MNES.

Matters raised in submission to the Environmental Impact Statement (EIS) relating to Chapter 14 – Terrestrial Ecology were predominantly focused on:

- Information regarding detail and intensity of fauna and flora survey effort; and
- Impacts to groundwater values associated with groundwater drawdown from Project activities.

The following provides updated information to that provided in the EIS and SEIS, in response to the submissions relating to SEIS Chapter 14 - Terrestrial Ecology as well as additional on-site ecological works and groundwater sampling.

Appendix A13 includes the full details of all submissions received for the Project.

14.1 Project Overview

Central Queensland Coal Proprietary Limited (Central Queensland Coal) and Fairway Coal Proprietary Limited (Fairway Coal) (the joint Proponents), propose to develop the Central Queensland Coal Mine Project (the Project). As Central Queensland Coal is the senior proponent, Central Queensland Coal is referred to throughout this Supplementary Environmental Impact Statement (SEIS). The Project comprises the Central Queensland Coal Mine where coal mining and processing activities will occur along with a train loadout facility (TLF).

The Project is located 130 km northwest of Rockhampton in the Styx Coal Basin in Central Queensland. The Project is located within the Livingstone Shire Council (LSC) Local Government Area (LGA). The Project is generally located on the “Mamelon” property, described as real property Lot 11 on MC23, Lot 10 on MC493 and Lot 9 on MC496. The TLF is located on the “Strathmuir” property, described as real property Lot 9 on MC230. A small section of the haul road to the TLF is located on the “Brussels” property described as real property Lot 85 on SP164785.

The Project will involve mining a maximum combined tonnage of up to 10 million tonnes per annum (Mtpa) of semi-soft coking coal (SSCC) and high-grade thermal coal (HGTC). The Project will be located within Mining Lease (ML) 80187 and ML 700022, which are adjacent to Mineral Development Licence (MDL) 468 and Exploration Permit for Coal (EPC) 1029, both of which are held by the Proponent. It is intended that all aspects of the Project will be authorised by a site specific environmental authority (EA).

Development of the Project is expected to commence in 2019 with initial early construction works and extend operationally for approximately 20 years until the depletion of the current reserve, and rehabilitation and mine closure activities are successfully completed.

The Project consists of two open cut operations that will be mined using a truck and shovel methodology. The run-of-mine (ROM) coal will ramp up to approximately 2 Mtpa during Stage 1 (2019 - 2023), where coal will be crushed, screened and washed to SSCC grade with an estimate 80% yield. Stage 2 of the Project (2023 - 2038) will include further processing of up to an additional 4 Mtpa ROM coal within another coal handling and preparation plant (CHPP) to SSCC and up to 4 Mtpa of HGTC with an estimated 95% yield. At full production two CHPPs, one servicing Open Cut 1 and the other servicing Open Cut 2, will be in operation. Rehabilitation works will occur progressively through mine operation, with final rehabilitation and mine closure activities occurring between 2036 to 2038.

A new TLF will be developed to connect into the existing Queensland Rail North Coast Rail Line. This connection will allow the product coal to be transported to the established coal loading infrastructure at the Dalrymple Bay Coal Terminal (DBCT).

Access to the Project will be via the Bruce Highway. The Project will employ a peak workforce of approximately 275 people during construction and between 100 (2019) to 500 (2030) during operation, with the workforce reducing to approximately 20 during decommissioning. Central Queensland Coal will manage the Project construction and ongoing operations with the assistance of contractors.

This SEIS supports the EIS by responding to the submissions that were made during the public notification period regarding the original EIS and identifies the material changes to the Project.

14.2 Relevant Legislation and Policies

Environmental protection of existing terrestrial wildlife and habitats is governed by several legislative Acts, policies and guidelines which are described in Chapter 1 - Introduction. Those with relevance to terrestrial and aquatic values are outlined below.

14.2.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act regulates activities that may have an impact upon Matters of National Environmental Significance (MNES). The Project has the potential to impact upon MNES including listed threatened species, communities and migratory birds and, therefore has been designated as a Controlled Action under the Act. This chapter does not assess the potential impacts on MNES as prescribed under the EPBC Act. As per the Project ToR impacts to MNES are described separately within Chapter 16 – MNES.

14.2.2 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) provides for the protection and management of native wildlife and habitat that supports native species with regard to:

- The clearing of plants protected under the NC Act;
- A clearing permit or an exemption under the NC Act;
- Activities that may cause disturbance (that is tamper, damage, destroy, mark, move or dig up) to animal breeding places; and
- The taking of fauna.

Subordinate legislation lists protected species and areas to which the regulatory provisions of the NC Act apply including:

- Nature Conservation (Wildlife) Regulation 2006: this Regulation lists terrestrial and aquatic plant and animal species presumed extinct, endangered, vulnerable, rare, common, international or prohibited. It recommends management objectives for the protection and maintenance of these species in Queensland, as appropriate; and
- Nature Conservation (Protected Plants) Conservation Plan 2000: this Plan provides protection and management of native flora.

14.2.3 Environmental Protection Act 1994

The EP Act and subordinate legislation provide regulatory provisions for the protection and management of EVs in relation to mining activities. The Act defines Category A, B and C ESAs and specifies limitations of mining activities on those areas.

14.2.4 Environmental Offsets Act 2014

The *Environmental Offsets Act 2014* (EO Act), *Environmental Offsets Regulation 2014* and the Queensland Government Environmental Offsets Policy provide a streamlined framework for environmental offset requirements. Offsets are required where there is an unavoidable impact on significant EVs. In addition, an environmental offset can only be required if impacts from a prescribed activity constitute a significant residual impact as identified through the following guidelines:

- The State guideline that provides guidance on what constitutes a significant residual impact for Matters of State Environmental Significance (MSES);
- The Commonwealth Significant Impact Guidelines for what constitutes a significant residual impact on MNES; and
- Any relevant local government significant impact guideline for Matters of Local Environmental Significance (MLES).

To avoid duplication with offsets required under the EPBC Act, the policy provides that the administering agency must consider other relevant offset conditions for the same or substantially the same prescribed impact. If duplicating conditions are imposed, it allows the proponent to remove the duplication.

14.2.5 Vegetation Management Act 1999

The VM Act regulates the conservation and management of vegetation communities and provides protection for regional ecosystems (REs) classified as 'endangered', 'of concern' or 'least concern' under the VM Act. The clearing of native vegetation for the Project will be exempt from the provisions of the VM Act under Schedule 21 Part 1, Item 1 (6) of the Planning Regulation 2017 where clearing occurs within the Project's ML for a mining activity.

Off-lease development and activities that require the clearing of remnant vegetation will require approval under the VM Act before clearing can commence.

14.2.6 Biosecurity Act 2014

The *Biosecurity Act 2014* (Biosecurity Act) provides legislative measures to manage pests and weeds, diseases and environmental contaminants, to address the impacts they have on the economy, environment, agriculture, tourism and society. The Act commenced on 1 July 2016 and supersedes a range of separate legislative implements previously used to manage biosecurity. This includes the *Land Protection (Pest and Stock Route Management) Act 2002* which previously provided legislative measures to manage damaging pests and weed species.

The Act provides statutory powers to prohibit or restrict the introduction and spread of declared plant and animal pests within Queensland. Weeds and pests pose one of the most significant threats to flora and fauna and agriculture within the study area. Accordingly, a range of management measures will be implemented to restrict the introduction and / or spread of pest species as a means of protecting the viability of local cattle grazing activity.

14.2.7 Planning Act 2016

The *Planning Act 2016* (Planning Act) establishes a new planning system for the state and replaces the *Sustainable Planning Act 2009*. The Act is Queensland's principal planning legislation and comprises of three main elements: plan making, development assessment and dispute resolution. The reform has consolidated similar matters and rearranged provisions to create a more streamline legislative framework for development in Queensland.

The State Planning Policy (SPP) is a statutory instrument prepared under the Planning Act that relates to matters of Queensland interest. The SPP applies to a range of circumstances under the Planning Act, including for development assessment and when proposed new planning schemes are made or amended. The SPP is applicable to assessable development within Queensland. The provisions of the SPP may also be considered under the standard criteria of the EP Act which includes ecological matters of State interest including:

- Biodiversity - MSES - Regulated vegetation and MSES - Regulated vegetation (intersecting a watercourse) and waterway barriers; and
- Water Quality - Climatic regions - stormwater management design objectives.

In relation to additional ecologically related approvals, Section 4A of the *Mineral Resources Act 1989* precludes the application of the Planning Act to activities undertaken for purposes of the mining tenure where those activities occur within the ML.

14.3 Environmental Objectives and Performance Outcomes

In accordance with the EP Act (Section 125), generally there are three key areas to be identified and addressed through the Environmentally Relevant Activity (ERA) application process regarding land and the associated ecological values:

- Identify the EVs of the site, including any significant flora and fauna associated with the land;
- Identify the possible impacts due to the proposed activity and all associated risks to the EVs; and
- Identify the strategies to mitigate the identified risks to the EVs.

Performance outcomes for the related EVs identified within the Project area include:

- Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimises adverse effects on the EVs of land;
- Areas disturbed by Project activities will be rehabilitated to achieve sites that are stable, safe to wildlife and able to sustain an appropriate land use for EVs; and
- The activity will be managed to prevent or minimise adverse effects on the EVs of land due to unplanned releases or discharges.

Any EA applications that have the potential to impact land must describe how environmental objective and performance outcomes for the ERA will be achieved.

14.4 Nomenclature

Flora nomenclature within this chapter follows taxonomy accepted by the Queensland Herbarium and Queensland Museum. Fauna nomenclature follows the Birdlife Australia Rarities Committee checklist (for birds) and DES' WildNet database taxonomy (for all other fauna), unless otherwise noted. All flora and fauna in this chapter will be referred to initially by both their common and scientific names and then for ease of reading only by the common name.

14.5 Study Methodology

The methodology for the terrestrial and aquatic ecology assessment and stygofauna assessment involved a combination of desktop and field based assessment methods, including:

- A desktop review of relevant literature, published ecological studies and Commonwealth and State databases. The desktop review specifically identified vegetation communities, and flora and fauna species which are known to exist, are likely to occur, or which have the potential to occur within the Project area;
- Review of field data and recent aerial imagery to refine existing mapping at the property scale; and
- Field surveys to assess and confirm the presence of listed species and vegetation communities identified during the desktop review.

14.5.1 Desktop Review

14.5.1.1 Terrestrial Ecology Desktop Review

Desktop studies were undertaken prior to field assessments. The desktop review was used to obtain background information relating to the potential presence and distribution of species and ecological communities (including connectivity across the regional landscape), particularly those listed under the VM Act and NC Act. Desktop studies involved database searches and review of:

- Current publicly available RE mapping - V10.0 (Queensland Herbarium 2017) and sensitive area mapping [Department of Natural Resources, Mines and Energy (DNRME)];
- Commonwealth EPBC Act Protected Matters Search Tool [Department of the Environment and Energy (DotEE)] (to confirm current legislative status of listed species);
- DES WildNet (Wildlife Online) database and Species Profile Search results (DES 2018b);
- Atlas of Living Australia species database (ALA 2018);
- Mapping for the Protected Plants Trigger Survey Map (DES 2018), MSES, and Biodiversity Planning Assessment (BPA) (DES 2018a);
- Styx Coal: Flora and Vegetation Assessment (OBS 2011); and
- Reporting of three seasonal fauna assessments for Central Queensland Coal:
 - A preliminary assessment of faunal values within and adjacent to EPC 1029, Styx Basin, central-east Queensland (Meyer 2011a)
 - September 2011 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2011b)
 - February 2012 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2012).

Database searches were undertaken over a 50 km radius for State databases and 25 km radius for Commonwealth databases using the central portion of the Project area as a reference point. The EPBC protected matters search tool, whilst based on some species records, primarily relies on modelling of suitable habitats (with mapped boundary constraints accounted for) and is largely a predictive tool. As such, given the site's location (close to the coast) a smaller search radius was used for the search tool in order to avoid the inclusion of marine / coastal species not applicable to the Project area.

Wildlife Online database records are based on records of species from a wide variety of observers and although the records are generally accurate in terms of spatial location, not all records have been verified. Records from DES' Species Profile Search are generally restricted to sightings from Queensland Government department activities and are considered spatially accurate. Atlas of Living Australia records are largely verified and include specimen records from museum collections across Australia. The database search results for fauna and flora species are provided in Appendix A9c – Ecological Desktop Search Results.

14.5.1.2 Protected Plants Flora Trigger Survey Map

DES maintains mapping showing high risk areas for the occurrence of protected plants. The mapping is for guidance on determining the necessity for detailed flora surveys and clearing permit requirements for a particular location. Areas mapped as 'high risk' are subject to specific requirements under the *Nature Conservation (Wildlife Management) Regulation 2006*.

14.5.1.3 Matters of State Environmental Significance

DES maintains a mapping database of MSES as a guide to assist the planning and development decision-making process. Queensland's SPP includes a biodiversity interest that states, 'Significant impacts on matters of National or State environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised, and residual impacts offset'.

The SPP defines matters of state environmental significance as:

- Protected areas under the NC Act;
- 'Marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zones under the *Marine Parks Act 2004*;
- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;
- A designated precinct, in a strategic environmental area under the Regional Planning Interests Regulation 2014, schedule 2, part 5, s15(s);
- Wetlands in a wetland protection area (including a 500 m buffer area) or wetlands of high ecological significance shown on the map of referable wetlands under the Environmental Protection Regulation 2008;
- Wetlands and watercourses in high ecological value waters identified in the Environmental Protection (Water) Policy 2009, Schedule 1;
- Legally secured offset areas as defined under the EO Act;
- Threatened wildlife under the NC Act and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Marine plants under the *Fisheries Act 1994* (excluding marine plants in an urban area);
- Waterways that provide for fish passage under the *Fisheries Act 1994* (excluding waterways provided for fish passage in an urban area);
- High risk area on the flora survey trigger as described by the Environmental Offsets Regulation 2014, schedule 2, part 6(1);
- Regulated vegetation under the VM Act that is:
 - a) category B areas on the regulated vegetation management map, that are ‘endangered’ and ‘of concern’ regional ecosystems
 - b) category C areas on the regulated vegetation management map that are ‘endangered’ and ‘of concern’ regional ecosystems
 - c) category R areas on the regulated vegetation management map
 - d) areas of essential habitat on the essential habitat map for an animal that is ‘endangered wildlife’ or ‘vulnerable wildlife’ or a plant that is ‘endangered wildlife’ or ‘vulnerable wildlife’ prescribed as ‘endangered wildlife’ or ‘vulnerable wildlife’ under the NC Act
 - e) category A, B, C, R areas that are located within a defined distance from the defining banks of a relevant watercourse identified on the vegetation management watercourse and drainage feature map
 - f) category A, B, C, R areas that are located within 100 metres from the defining bank of a wetland identified on the vegetation management wetlands map.

14.5.1.4 Matters of Local Environmental Significance

The Livingstone Shire Council was re-established in 2014 following a successful referendum on de-amalgamation from Rockhampton Regional Council (formed in 2008). Public comments on the draft *Livingstone Planning Scheme* (the ‘Draft plan’) are currently being evaluated by Council. The Draft plan identifies MLES and associated assessment provisions under Part 8.2.3 of the Draft plan – ‘Biodiversity overlay code.’ Biodiversity overlay mapping identifies both MSES and MLES. Within the Project area all vegetation listed as ‘Least Concern’ under the VM Act is mapped as a MLES – habitat and vegetation.

However, the Project area remains covered under the *Planning Scheme 2005 – Reprint 6* (the Scheme) and does not refer to MLES. ‘Locally significant vegetation’ is identified in small patches of Endangered vegetation (under the VM Act) to the north of the Bruce Highway within the Project area. Much of the continuous habitat that intersects the southern portion of the ML is also considered as ‘locally significant vegetation.’ The scheme identifies Tooloombah Creek Conservation Park as a ‘protected area.’ The eastern boundary of this area lies less than 1 km west of the Project. The Scheme outlines management outcomes related to development on or adjacent to a ‘protected area’ ensuring no significant adverse effects occur including: fire risk management; changes to natural drainage; disposal of waste and sources of pollution; managing public access and pest and weeds; and impacts to fauna activity such as through the use of fencing or lighting.

14.5.1.5 Biodiversity Planning Assessment

DES has prepared a Biodiversity Planning Assessment (BPA) for a number of Queensland bioregions in order to provide broad scale ecological data to advise a range of planning and decision-making processes. The BPA process employs the Biodiversity Assessment and Mapping Methodology (BAMM) (EHP 2014) to determine the relative biodiversity significance of habitats and landscapes in relation to:

- Threatened ecosystems or taxa;
- Tract size of habitats;
- Ecosystem diversity;
- Landscape context and connection; and
- Buffers to wetland or other types of habitat important for the maintenance of biodiversity or ecological processes.

This is based largely on remnant vegetation mapping data generated under the VM Act, significant flora and fauna records, and expert panel determinations. The BAMM assigns three levels of Biodiversity Significance:

- State Significance – areas assessed as being significant for biodiversity at the Bioregional or State scales. They also include areas assessed by other studies / processes as being significant at national or international scales;
- Regional Significance – areas assessed as being significant for biodiversity at the sub-bioregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance; and
- Local Significance and Other Values – areas assessed as not being significant for biodiversity at State or Regional scales. Local values are of significance at the local government scale.

The BPA methodology uses seven diagnostic criteria: habitat for significant taxa, ecosystem value, tract size, relative size of RE, condition, ecosystem diversity, and context and connection to determine the relative biodiversity significance of habitats and landscapes. The BPA methodology also uses the advice of convened 'expert panels' to refine the mapping-based results and identify specific areas of value.

14.5.2 Field Surveys

A number of ecological field surveys have been undertaken for this Project to ground-truth desktop information and identify any additional flora and fauna values not identified through the desktop study. These include studies carried out for the former incarnation of the Central Queensland Coal Project which encompassed a much larger area (EPC 1029). Field surveys comprised:

- Comprehensive flora surveys including:
 - Summer (late wet season) flora survey of EPC 1029 (five days) 21 to 25 March 2011 by Oberonia Botanical Services (OBS 2011)
 - Spring (dry season) flora survey of EPC 1029 (five days) 25 to 29 September 2011 by Oberonia Botanical Services (OBS 2011)

- Summer (wet season) flora survey of ML 80187 and immediate surrounds (three days) 8 to 10 February 2017 by Terrestria (led by Dr Andrew Daniel – Terrestria); and
- Vegetation mapping, habitat quality assessments and GDE-associated sampling measurements on Project associated impact sites (ML 80187), and habitat quality assessments on proposed offset sites (wider Mamelon property) in July and August 2018 by David Stanton (3D Environmental);
- Comprehensive fauna surveys including:
 - Detailed summer (wet season) fauna survey of EPC 1029 (five days) 21 to 25 March 2011 by Ed Meyer (ecological consultant)
 - Detailed spring (dry season) fauna survey of EPC 1029 (five days) 25 to 29 September 2011 by Ed Meyer (ecological consultant)
 - Targeted threatened fauna survey of EPC 1029 (four days) 7 to 10 February 2012 by Ed Meyer (ecological consultant)
 - Detailed summer (wet season) fauna survey of ML 80187 and immediate surrounds (six days) 8 to 13 February 2017 by CDM Smith (led by Brett Taylor) and
 - Supplementary fauna data obtained during water quality sampling events on ML 80187 and the wider surrounds from May 2017 to January 2018. Activities included remote camera surveys, bird surveys / nest searches, herpetofauna searches and spotlighting;
- Aquatic ecology surveys including:
 - Comprehensive winter (dry season) aquatic ecology survey of EPC 1029 (six days) 1 to 6 June 2011 by ALS Water Sciences
 - Stygofauna pilot survey (four days) 21 to 24 November 2011, by ALS Water Sciences and
 - Detailed summer (wet season) aquatic ecology survey of ML 80187 and immediate surrounds (six days) 11 to 13 February 2017 by CDM Smith (led by Brett Taylor);

Surveys were designed to encapsulate seasonal variation in species' detectability, and survey sites were selected in locations representing the key threatened vegetation communities and dominant habitat types present in the Project area and surrounds. All surveyed areas within the Project area were visited at least once during the site studies. Although there is some overlap between survey sites between 2011 and 2017, these sites are focussed within the boundaries of the ML, and there is limited vegetation to sample on the site. Surveys clearly focussed on areas of remnant vegetation, and as a result of surveys (together with aerial imagery analysis), the overall area of vegetation on the property has increased above that predicted by the State's RE mapping (by approx. 45 ha). All representative communities were surveyed. Additional surveys were carried out in July and August 2018 (17-20 July and 6-10 August) to inform offsetting activities. These surveys included areas of vegetation around the broader property, including areas potentially influenced by groundwater drawdown.

Weather conditions for each survey period as recorded at Saint Lawrence (located 37 km north of the Project) are presented in Table 14-1.

Table 14-1 Weather conditions during Project surveys

Survey	Temperatures during study	Rainfall and comments
March 2011	Minimum: 21.9°C Maximum: 34.6°C (source: Meyer 2011a)	23 mm rain recorded during survey. Heavy falls recorded in area in week prior to survey (145 mm). Survey undertaken following an exceptionally wet summer with well-above-average rainfall over most of coastal eastern Queensland. December 2010 rainfall totals were especially high with Marlborough recording over 560 mm of rain.
September 2011	Minimum: 10.8°C Maximum: 26.8°C (source: Meyer 2011b)	Except for August 2011 monthly rainfall totals for Marlborough (to the near south of EPC 1029) were close to average in the six months prior to surveys. Little rain was recorded at Marlborough in the month preceding surveys and no rain was recorded during the survey period.
February 2012	Minimum: 21.8°C Maximum: 33.2°C (source: Meyer 2012)	Rainfall in the months preceding surveys was generally at or below average. With significant rainfall in late January and storms on the 7th and 8th of February surface water was plentiful in low-lying parts of the Study area.
February 2017	Minimum: 21.9°C Maximum: 35.6°C (source: BoM 2017)	Conditions during the February 2017 survey were very hot and dry. Excepting a single day in January on which 212 mm was recorded at St Lawrence (located 74 km north of the Project area), mean rainfall in the area was below average in the months preceding the survey and across the entirety of February. How the January rain event affected the Project site is uncertain as no rain was recorded in Rockhampton on the same day.
May 2017	Minimum: 14.8°C Maximum: 29.1°C (source: BoM 2017)	In March 2017, a low-pressure system, associated with tropical cyclone Debbie, resulted in significant rainfall of up to 145.4 mm. The recent rainfall events were evident at the site with flow in Deep and Tooloombah Creeks observed. Conditions were dry with 0 mm recorded during the field survey.
August 2017	Minimum: 6.7°C Maximum: 27.6°C (source: BoM 2017)	The site was significantly drier than the May 2017 field survey. Approximately 62 mm had fallen since the last ecological survey in May 2017. Conditions during the survey were dry and cool with no rain recorded at the Strathmuir weather station during this survey.
September 2017	Minimum: 13.9°C Maximum: 30.6°C (source: BoM 2017)	During this field survey the site was dry. 0 mm of rainfall had been recorded at the Strathmuir station since the last field survey. Mean monthly rainfall during August and September 2017 were below average for these months. The mean monthly average recorded in August 2017 at the Strathmuir weather station was 5.5 mm compared to a historic monthly average of 16 mm.
November 2017	Minimum: 16.8°C Maximum: 31.1°C (source: BoM 2017)	Small amount of rain recorded prior to the survey (one day of 9 mm of rain). During the field survey one day of 6 mm of rain was recorded at the Strathmuir weather station.
December 2017	Minimum: 19.9°C Maximum: 31.6°C (source: BoM 2017)	The site visit occurred in late December. At the beginning of December 152 mm of rain fell over six days. During the site visit no rainfall was recorded at the Strathmuir weather station; however, the site was noticeably overgrown and green. Despite the recent rainfall no flow in creeks was recorded.
January 2018	Minimum: 18.4°C Maximum: 32.4°C (source: BoM 2018)	The survey occurred mid-January. During the beginning of January 93 mm of rain was recorded over three days. No rain was recorded during the site visit.

With exceptional rainfall in the months and weeks leading up to the March 2011 survey, site access was greatly restricted. With conditions already wet and the prospect of further significant rainfall, pitfall trapping was not undertaken during the baseline fauna assessment. Site conditions during subsequent surveys were more favourable and did not restrict the assessment methods used.

14.5.2.1 Terrestrial Vegetation Assessment

Terrestrial vegetation surveys were undertaken to assess the vegetation communities present within the Study area, to assess the quality of vegetation communities, and to assess whether vegetation communities mapped in the latest RE mapping (Queensland Herbarium 2017) were represented by communities which were actually present within the Project area. Initial surveys of

the ML were undertaken to broadly characterise vegetation communities within the Study area and confirm the accuracy of existing RE mapping for remnant and regrowth vegetation.

In relation to the appropriateness of the timing of the survey periods, Eyre et al. (2015) notes:

“The best time for assessment is at the end of the summer rainfall growing season, when plant diversity is greatest. For the majority of Queensland, this is often from late March to late May, but is dependent on local seasonal conditions. As a general rule of thumb, site assessment north of the Tropic of Capricorn should generally be conducted after the wet season, ideally between March and May, to ensure adequate sampling of ground cover species.”

The site is north of the Tropic of Capricorn. The 2011 wet season survey was carried out in March which is a suitable time period as described above. The September 2011 survey was carried out in the dry season in the area. The 2017 survey was carried out in February, which is aligned to the wet season, and focused on the assessment of vegetation communities present within the current Project area boundaries.

Further information was required where RE mapping was found to be inconsistent with the onsite vegetation. These sites were marked by waypoints on a hand-held Global Positioning System (GPS) and accompanied by photographic evidence and site proformas / observations. Tertiary level information gathered at these sites was complemented by Quaternary level sites taken throughout the site traverse. Quaternary sites were used to confirm vegetation community types, vegetation community boundaries, land zones, and occurrence of creek lines.

The vegetation surveys also focussed toward confirming the presence / absence of listed flora species through a series of observational assessments and targeted searches within key habitat types identified through desktop searches.

The 2017 field assessment was conducted in accordance with the Queensland Herbariums' Methodology for Survey and Mapping of REs and Vegetation Communities in Queensland, Version 3.1 (Neldner *et al.*, 2017). Where discrepancies were identified in the field between existing RE mapping and field observations, areas were traversed by foot to confirm the extent of the change. Field surveys used standard floristic survey methods to describe vegetation type, structure and composition are outlined below. The locations of flora assessment survey sites are shown in Figure 14-1.

There is overlap of sites between 2011 and 2017 as the previous survey site information was not available prior to the 2017 survey being carried out and sites often are located near access points / tracks. The 2017 flora site visit was focused within the boundary of the ML and potential infrastructure. There is limited vegetation to sample within the site, and remnant vegetation has been targeted. Further sites have been sampled in July and August 2018 during surveys regarding the project offset requirements. Ground-truthing (together with aerial imagery analysis) has increased the overall area of vegetation on the property above that predicted by the State's RE mapping (by approx. 45 ha).

Secondary Assessments

Secondary assessments involve sampling plots of at least 50 m by 10 m in size, within each defined vegetation community. This methodology was; however; subject to the size of the vegetation community, with additional sites surveyed in vegetation communities covering large areas, and a reduction in the number of sites surveyed in small communities.

Tertiary Assessments

Tertiary site assessments were used for classification and detailed descriptions of REs and vegetation communities. Data collected included location, environmental and overall structural information as well as a full species list, estimates of stem density, estimates of basal area (of woody stems using the Bitterlich stick method) and a measure of percentage cover.

Quaternary Assessments

Quaternary site assessments were used to rapidly assess REs and vegetation communities, using linear transects. Data were collected at regular intervals along each transect and where REs and vegetation communities change in structure and composition.

Regional Ecosystem Code Sites

Regional Ecosystem Code Sites were used during the February 2017 survey and are used to aid in classification and detailed descriptions of regional ecosystems and vegetation communities and provide 'enhanced' Tertiary level information. Data collected include location, and environmental information such as land zone. Structural information such as height and covers are estimated for all structural layers. Generally, only the dominant or conspicuous species that characterise each layer are recorded. Plots are not laid out using a tape, site dimensions are restricted to a commonly occurring vegetation type and condition.

Opportunistic Observations

In addition to the detailed survey plots, opportunistic flora data were collected while traversing roads and tracks and whilst travelling between the more detailed survey sites. These data were used to assist in confirmation of RE mapping and to check relationships between classificatory units (such as vegetation associations, REs, photo-patterns) and landscape features.

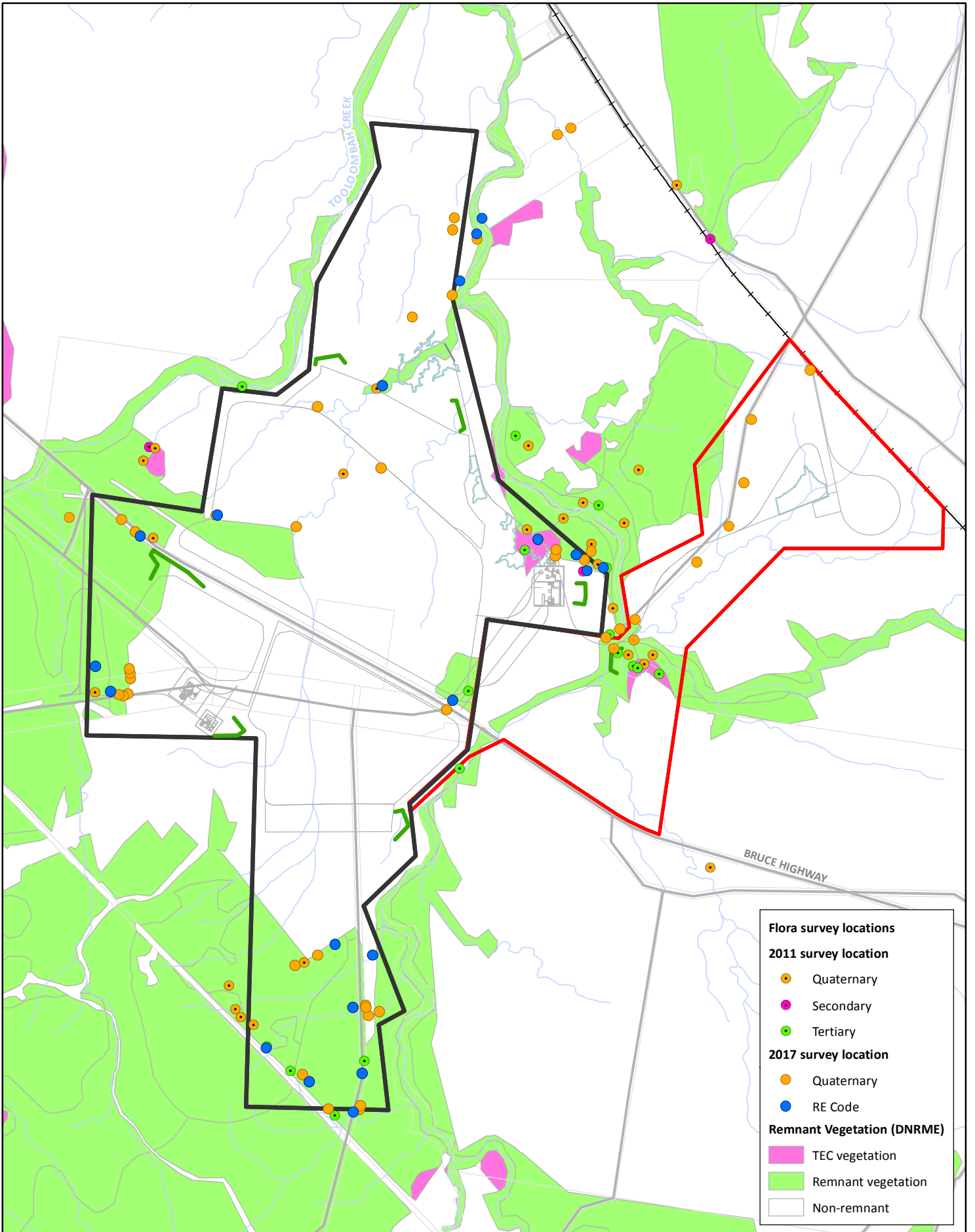
Field Data Analysis

Ground-truthed data along with contemporary aerial imagery were used to determine:

- Potential presence / absence of Threatened Ecological Communities (TEC);
- Known or potential habitat for listed species (NC Act and EPBC Act);
- Accuracy of RE mapping (VM Act); and
- Potential presence of pest flora species (Biosecurity Act).

14.5.2.2 Vegetation Assessment - Leaf Water Potential Measurement

A number of targeted onsite measurements and sampling methods were carried out on vegetation communities potentially impacted by drawdown of groundwater in order to ascertain their potential use of groundwater. These included leaf water potential (LWP) measurements, stable isotope analysis and soil coring to root depth. This was carried out as part of wider investigations of the occurrence of groundwater dependent ecosystems (GDEs) in the area. The sampling protocols for these methods are summarised in Section 15.5.2.3 of Chapter 15 – Aquatic Ecology. Further information on the targeted GDE sampling methods is provided in Section 5.2 of Appendix A6 – Groundwater Technical Report.



Flora survey locations

2011 survey location

- Quaternary
- Secondary
- Tertiary

2017 survey location

- Quaternary
- RE Code

Remnant Vegetation (DNRME)

- TEC vegetation
- Remnant vegetation
- Non-remnant



0 0.5 1 km

Scale @ A4 1:50,000
 Date: 01/11/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Cadastral boundary
- Main road
- North Coast Rail Line
- Watercourse
- Dam

Figure 14-1
 Flora survey locations on current
 DNRME vegetation mapping

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



14.5.2.3 Terrestrial Fauna Assessment

A detailed summer fauna assessment of the wider area (EPC 1029) was carried out over five days from 21 to 25 March 2011 inclusive. A second early spring, or dry season assessment, was carried out over five days from 19 to 23 September 2011. A total of four detailed survey sites were established for both survey periods with eight separate survey sites established overall. A third detailed assessment was carried out in February 2017 establishing an additional four sites.

Survey sites were selected based on RE mapping, land access and the integrity of the habitat to support local fauna species. Although the 2011 surveys covered a much wider study area than the present Project area, five of the detailed survey sites were located on or within 500 m of the boundary of ML 80187, two further sites were located within 2.5 km of the ML boundary, and the final site was located 5 km north of the ML. Locations of detailed survey sites are depicted in Figure 14-2 and descriptions of the trapping sites are provided in Table 14-2.

The 2011 and 2017 fauna surveys used generalised methods to sample all fauna groups potentially present. Each systematic survey site was subject to a fauna trapping regime carried out over five days and four nights. Supplementary assessments were also carried out across the entirety of the study area and included bird surveys, herpetofauna searches, microbat call recording and spotlighting searches. Locations of the 2011 supplementary sites are detailed in the fauna assessment technical reports (Appendix A9a – Terrestrial Fauna Reports). Further details of survey methodology techniques are provided in Table 14-3.

The fauna surveys carried out in February 2012 and throughout 2017 used survey methods designed to target conservation significant fauna species (listed under NC Act and the EPBC Act). Surveys were undertaken at an intensity considered sufficient to maximise detection of the main target species (with regard to EPBC Act threatened fauna survey guidelines) potentially present.

Supplementary Fauna Survey Data

Additional fieldworks (associated with ground and surface water quality sampling activities) were carried out by CDM Smith, within and surrounding the ML, in the following time periods in 2017: May 1 - 5; August 7 - 10; September 18 - 22; and November 7 - 12. Additional works were carried out from January 15 - 19 in 2018. Each survey event included an experienced ecologist from CDM Smith. Ecological works were carried out in addition to scheduled water quality sampling (groundwater and surface waters) associated with the Project during these times. Overall survey methods and effort for the Project is described in Table 14-3. Ecological works carried out following the February 2017 baseline fauna survey included the following methods:

- Timed 20 minute bird surveys across a 2 ha area carried out opportunistically around bore sites and targeted surveys throughout the ML, particularly targeting dams / wetland areas for Australian Painted Snipe (*Rostratula australis*), and riparian zones for potential nesting Red Goshawk (*Erythrotriorchis radiatus*).

Total of an additional 59 x 20 minute bird surveys;

- Spotlighting surveys carried out on foot and in vehicle within the ML targeting dams, wetlands and gilgai/Brigalow (*Acacia harpophylla*) providing potential habitat for Ornamental Snake (*Denisonia maculate*) or targeting wooded areas for Koala (*Phascolarctos cinereus*) and Greater Glider (*Petauroides Volans*). Tracks employed during spotlighting surveys for the Project are depicted in Figure 14-2.

Total of an additional 19.5 person hours of spotlighting; and

- Remote passive infrared cameras were set at 10 sites located within or close to the southern boundary of the ML. Cameras were set adjacent to rocky habitat assessed as potentially suitable for Northern Quoll den sites (five per site in March 2011 and two per site in September 2011). Cameras were located 3 – 5 m in front of a station baited with a combination of oats, peanut butter, macadamia oil and sardines. Camera traps were set at five sites from 29th September until 10th November. The cameras were moved to five new sites and rebaited on the 11th November. Cameras were collected, and photos downloaded on the 19th December (refer Figure 14-2 for all sites).

Total of an additional 400 camera trap nights.

Although the fauna assessment program is considered robust, CDM Smith have adopted a conservative approach when considering conservation significant fauna species within the impact assessment for this Project. As such, all species with the potential to occur in the Project area have been assumed to be present unless evidence exists to suggest absence. Further details of survey methods used to target conservation significant fauna identified from the desktop review are provided in Table 14-3.

Four categories were used to classify the likelihood of a threatened flora and fauna species being present within the Project area based on the desktop research and onsite observations. Categories were defined as:

- Known (confirmed during field assessments);
- Likely (known distribution, records within or around the Project area, and suitable habitat observed during field assessments);
- Potential (known distribution, limited records of the species occurring in the wider area and possibility of suitable habitat occurring); and
- Unlikely (no suitable habitat or not known to occur within the local region).

The presence or potential presence of a species, and species habitat was used to inform assessment of the potential risk of impacts from the Project on identified ecological values.

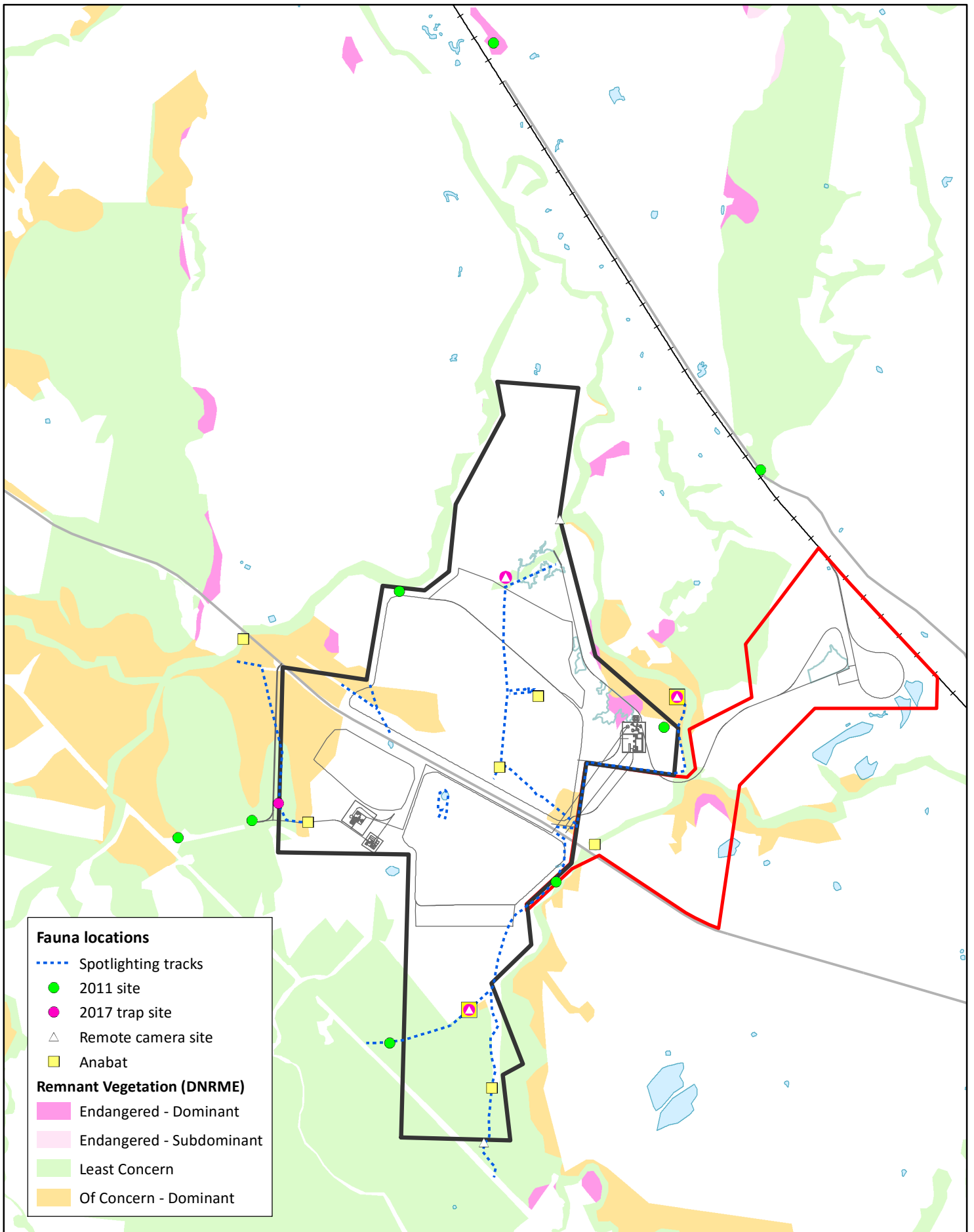



Figure 14-2
Fauna survey locations 2011/2012 and 2017


 0 0.5 1 km
 Scale @ A4 1:65,000
 Date: 21/11/18
 Drawn: J Parnwell

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Main road
- North Coast Rail Line
- Reservoir
- Dam

DATA SOURCE
 QLD Department of Environment and
 Heritage Protection, 2016;
 QLD Spatial Catalogue (QSpatial), 2017

**CDM
Smith**

Table 14-2 Description of fauna trapping sites – 2011 and 2017 surveys

Trap site	Location and coordinates	Habitat description
March 2011		
Site 1	-22.66886 149.69475	Remnant Narrow-leaved Ironbark (<i>Eucalyptus crebra</i>) woodland with sparse shrub layer and dense cover of native grasses. Located approximately 2.5 km east of northern extent of Project area
Site 2	-22.61894 149.65978	Remnant gilgaied Brigalow woodland, near Ogmoo. Located approximately 4.5 km north of Project area.
Site 3	-22.718 149.66964	Remnant riparian open forest / woodland along Deep Creek, south of the Bruce Highway. Located on eastern boundary of Project area.
Site 4	-22.71356 149.62136	Remnant Narrow-leaved Ironbark / Queensland Peppermint (<i>E. exserta</i>) woodland / open forest with a mid-dense shrubby understory of Spear Wattle (<i>Acacia rhodoxylon</i>), adjacent to Mt Bison Road, south of the Bruce Highway. Located approximately 1.3 km west of Project area.
September 2011		
Site 5	-22.66886 149.69475	Narrow-leaved Ironbark woodland with dense grassy understory, upslope from watercourse. Located approximately 300 m west of Project area.
Site 6	-22.61894 149.65978	Mixed eucalypt woodland / open forest on hill slope with sparse shrub layer and sparse grass cover, on sandy soil with small areas of exposed rock. Located approximately 200 m west of southern extent of Project area.
Site 7	-22.718 149.66964	Semi-evergreen vine thicket with emergent Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Moreton Bay Ash (<i>Corymbia tessellaris</i>) fringing Tooloombah Creek. Located within northwest extent of Project area.
Site 8	-22.71356 149.62136	Remnant gilgaied Brigalow woodland with dense to mid-dense shrub layer dominated by Currant Bush (<i>Carissa ovata</i>), to the near east of Deep Creek. Located within eastern extent of Project area.
February 2017		
Site 1	-22.7093 149.63409	Remnant Poplar Gum (<i>E. platyphylla</i>) woodland with very sparse shrub layer (RE11.5.8a). Native grasses sparse at time of survey due to very dry conditions and ongoing cattle presence. Located uphill from large ephemeral wetland area on western edge of Project area.
Site 2	-22.73334 149.65887	On edge of remnant Narrow-leaved Ironbark / Poplar Box (<i>E. populnea</i>) dominated woodland (RE11.10.7). Dense understorey dominated by the introduced Lantana (<i>Lantana camara</i>) and Red Ash (<i>Alphitonia exselsa</i>). Located within southern portion of Project area.
Site 3	-22.68213 149.6625	Thin riparian Forest Red Gum open forest strip adjacent to dense regrowth Brigalow (RE11.3.25). Dense but patchy lower shrub layer. Small pools of water present in creek. Located within northern portion of Project area.
Site 4	-22.69589 149.68464	Remnant mixed gum woodland (RE11.3.4) with patchy shrub layer dominated by the introduced Lantana. Ground layer also patchy with some dense areas of sedges in low drainage channel bisecting site. On eastern edge of Project area.

Table 14-3 Fauna trapping methods

Survey method	Description	Target listed species (as identified in desktop surveys)
Trap sites (all)		
Elliott trapping	20 baited Elliott A and B traps located 10 m apart along a single transect at each site. Traps baited with a standard mixture of peanut butter, oats and vegetable oil. Trapping carried out at 12 sites comprising 940 trap nights (2011 and 2017).	<ul style="list-style-type: none"> ▪ Northern Quoll (<i>Dasyurus hallucatus</i>); and ▪ Yakka Skink (<i>Egernia rugosa</i>) (around potential colonies).
Pitfall / funnel trapping	A pitfall line at each site comprising 4 x 20 L pitfall buckets, 30 m fence and 4 x funnel traps paired at each end of fence line. Positioned where suitable habitat structure occurs (woody debris, shrubby vegetation). No pitfall trapping was possible in March 2011. Trapping carried out at eight sites comprising 32 trap nights (September 2011 and 2017).	<ul style="list-style-type: none"> ▪ Ornamental Snake; ▪ Dunmall's Snake (<i>Furina dunmalli</i>); and ▪ Collared Delma (<i>Delma torquate</i>).
Infrared camera traps	Infrared camera set at each trap site (5 per site in March 2011 and 2 per site in September 2011). Cameras set at four trap sites in 2017 in front of bait station. Cameras set at 10 sites adjacent to rocky habitat (potentially favouring presence of Northern Quoll) from late September – December 2017. Bait stations set with mixture of peanut butter, oats, vegetable oil and sardines (400 nights total). Trapping carried out at 22 sites comprising a total of 530 camera trap nights.	<ul style="list-style-type: none"> ▪ Northern Quoll.
General methods (across Project area including trap sites)		
Diurnal bird census	Two 20 minute bird surveys across a 2 ha area at each trap site and opportunistically throughout Study area. Birds identified by direct observation and / or by call. 115 timed surveys over approximately 38.5 hrs across Project area and surrounds.	<ul style="list-style-type: none"> ▪ All bird species.
Diurnal searches for herpetofauna	Searches for frogs and reptiles under leaf litter, debris, logs and rocks. Carried out at each trap site and throughout Study area where appropriate habitat factors occurred (i.e. presence of suitable vegetation, woody debris, leaf litter and/or soil cracks). Approximately 42 hr of searches over 42 ha were conducted across Project area.	<ul style="list-style-type: none"> ▪ Ornamental Snake; ▪ Dunmall's Snake; ▪ Collared Delma; and ▪ Yakka Skink.
Anabat microbat call recording	Passive recording of microbat calls overnight (6 pm to 6 am) using Anabat recording system. Carried out at each trap site and throughout Study area where appropriate habitat factors occurred. Anabat surveys carried out over 17 nights at sites across Project area.	<ul style="list-style-type: none"> ▪ Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>); and ▪ South-eastern Long-eared Bat (<i>Nyctophilus corbeni</i>).

Survey method	Description	Target listed species (as identified in desktop surveys)
Spotlighting surveys	<p>Minimum ½ hour (hr) spotlighting in early evening (two people) at each trap site for nocturnal mammals and herpetofauna. Ornamental Snake targeted where cracking clay soils occurred.</p> <p>Also surveying tracks at night and throughout Study area where appropriate habitat factors occurred. Creeklines (e.g. Deep Creek) were targeted for non-trapping fauna survey effort (spotlighting surveys) on multiple occasions due to potential presence of listed species (Koala, Greater Glider).</p> <p>Call playback surveys for nocturnal bird species carried out where considered suitable.</p> <p>Approximately 45 person hours conducted over 2011 and 2017 survey periods.</p>	<ul style="list-style-type: none"> ▪ Koala; ▪ Ornamental Snake; ▪ Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>); and ▪ Greater Glider
Terrestrial habitat assessment	Habitat assessed for suitability to provide resources for terrestrial fauna. Habitat characters assessed include: tree hollow abundance, evidence of nesting, leaf litter, large woody debris and weed invasion.	Assessments included searches for Koala and signs of habitat use (tree scratches and scats).
Incidental records	<p>Fauna observations were ongoing throughout the site and all survey periods where an experienced ecologist was present.</p> <p>Includes opportunistic vehicle-based surveys undertaken throughout Project area and surrounds (up to a 10 km radius of the Project area) throughout 2017/2018. Based on 2 hrs per day travelling between survey sites (fauna, flora and water quality sampling) over 30 days (60 hrs).</p>	N/A

14.6 Existing Environmental Values

The Project is largely located within the Marlborough Plains subregion, one of the 13 subregions of the Brigalow Belt North bioregion. The southern portion of the ML occurs in the adjacent Nebo-Connors Ranges subregion. The Project area is located close to the boundary of the Brigalow Belt South bioregion located to the south. Vegetation within the Marlborough Plains subregion is dominated by alluvial plains and colluvial slopes, usually supporting woodlands characterised by Poplar Gum, Ghost Gum (*Corymbia dallachiana*), Forest Red Gum and paperbarks (*Melaleuca* spp.) with low rises supporting Narrow-leaved Ironbark.

Large sections of the Brigalow Belt North bioregion have been cleared of remnant native vegetation for grazing, agriculture and mining. Remaining vegetation is generally confined to rockier hilly areas, linear strips of roadside vegetation, riparian vegetation and relatively small isolated remnants. Thus, clearing over the past 150 years has resulted in a highly fragmented landscape with remnant vegetation patches separated by large expanses of cleared land.

Areas to the north and east of the Project area have been substantially impacted by vegetation clearing associated with cattle grazing activity. Connectivity between remaining tracts of vegetation is tenuously maintained by thin strips of riparian vegetation along creek lines such as Tooloombah Creek and Deep Creek which border the Project. Nevertheless, woodland and open forest habitat remaining in the south and east of the site remains contiguous with an extensive tract of remnant vegetation, which includes Tooloombah Creek Conservation Park. To the west of the Project remains extensive tracts of remnant forest associated with the nearby Broadsound Range.

Vegetation within the Project area and immediate surrounds comprises:

- Heavily disturbed habitats that have previously undergone significant clearing for cattle production. Where this habitat occurs north of the Bruce Highway it is often dominated by patches of regrowth Brigalow;
- Substantial areas of less disturbed eucalypt woodland; and
- Smaller pockets of relatively closed canopy (open forest) vegetation generally with a dense weedy shrub layer. These are largely associated with the creek systems adjacent to the Project (mine ML) boundary.

The mine area and TLF is situated within the lower catchments of Tooloombah Creek and Deep Creek, which are sub-catchments within the Styx River catchment. Both creeks feed directly into the Styx River (2 km north of the Project area) which discharges into the Broad Sound area approximately 8 km north of the Project. The haul road to the TLF crosses Deep Creek and Barrack Creek. Tooloombah Creek and Deep Creek are non-perennial or ephemeral, and only flow following rainfall events.

14.6.1 Terrestrial Flora – Desktop Results

14.6.1.1 Threatened Ecological Communities

The Protected Matters Search Tool identified five listed TECs as having potential to occur in the Project area:

- Brigalow (*Acacia harpophylla* dominant and co-dominant) – Endangered;
- Broad Leaf Tea-tree (*Melaleuca viridiflora*) woodlands in high rainfall coastal north Queensland – Endangered;
- Coolibah (*Eucalyptus coolabah*) - Black Box (*Eucalyptus largiflorens*) Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions – Endangered;
- Natural Grasslands of the Queensland Central Highlands and the northern Fitzroy Basin – Endangered; and
- Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (north and south) and Nandewar Bioregions – Endangered.

Current RE mapping indicates there is one RE present within the overall Project area that may be considered a Brigalow TEC (RE11.4.9).

14.6.1.2 Regional Ecosystems

Assessment of current DNRME RE mapping (Version 10.0) identified nine REs occurring on six land zones within the Project area: alluvial river and creek flats (land zone 3); Cainozoic clay plains (land zone 4); Cainozoic sand plains (land zone 5); Cainozoic lateritic duricrust (land zone 7); coarse-grained sedimentary rocks (land zone 10); and deformed and metamorphosed sediments and interbedded volcanics (land zone 11) (Neldner *et al.*, 2014). The proposed mine area incorporates land holdings currently used for cattle grazing. Due to historical and current farming practice, the mine ML has been substantially cleared with 79.2% of the Project area mapped as non-remnant. The TLF is also located on lands currently used for cattle grazing of which 89.2% has been cleared.

Table 14-4 provides a brief description of all REs considered to occur within the Project area and Table 14-5 describes the extent of REs within each section, within a 10 km radius of the Project area, and within the Marlborough Plains and Nebo-Connors Range subregions.

Table 14-4 Project area – Regional Ecosystem descriptions

RE	VM Act status	EP Act status	Description*
11.3.4	Of Concern	Of Concern	<i>Eucalyptus tereticornis</i> and / or <i>Eucalyptus</i> spp. woodland on alluvial plains
11.3.25	Least Concern	Of Concern	<i>E. camaldulensis</i> or <i>E. tereticornis</i> open forest to woodland. Occurs on fringing levees and banks of major rivers and drainage lines of alluvial plains throughout the region. Soils are very deep, alluvial, grey and brown cracking clays
11.4.2	Of Concern	Of Concern	<i>Eucalyptus</i> spp. and / or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains
11.4.9	Endangered	Endangered	<i>Acacia harpophylla</i> shrubby woodland with <i>Terminalia oblongata</i> on Cainozoic clay plains
11.5.8a	Least Concern	No Concern	<i>Melaleuca</i> spp., <i>Eucalyptus crebra</i> , <i>Corymbia intermedia</i> woodland on Cainozoic sand plains / remnant surfaces
11.7.2	Least Concern	No Concern	<i>Acacia</i> species woodland on Cainozoic lateritic duricrust
11.10.1	Least concern	No Concern	<i>Corymbia citriodora</i> woodland on coarse-grained sedimentary rocks
11.10.7	Least concern	No Concern	<i>Eucalyptus crebra</i> woodland on coarse-grained sedimentary rocks
11.11.15a	Least Concern	No Concern	<i>Eucalyptus crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics

*Source: QLD Herbarium, 2017

Table 14-5 Currently mapped Regional Ecosystems within the Project area

RE code	VM Act status	EP Act biodiversity status	Total within Project area (ha)	Total within a 10 km radius of Project (ha)	Total within Marlborough Plains subregion (ha)	Total within Nebo-Connors Ranges subregion (ha)
ML80187						
Non-remnant	-	-	1,801.6	37,232.3	543,487.3	176,257.7
11.3.4	Of Concern	Of Concern	9.78	925.5	10,042.1	4,287.6
11.3.25	Least Concern	Of Concern	16.03	1,332.4	2,955.8	8,981
11.4.2	Of Concern	Of Concern	174.92	2,058.6	6,121.3	1,822.1
11.4.9	Endangered	Endangered	12.7	182.7	517.2	129.1
11.5.8a / 11.7.2	Least Concern	No Concern at present	25.38	362.6	1,840	362.6
11.10.7	Least Concern	No Concern at present	29.11	513.5	88.4	513.5
11.10.7 / 11.10.1	Least Concern	No concern at present	80.58	1,484.2	772.7	711.5
11.11.15a	Least Concern	No concern at present	125.52	1,090.6	20,698.4	1,949.1
ML700022						
Non-remnant	-	-	675.66	37,232.3	543,487.3	176,257.7
11.3.4	Of Concern	Of Concern	9.64	925.5	100,42.1	4,287.6
11.3.25	Least Concern	Of Concern	26.04	1,332.4	2,955.8	8,981
11.4.2	Of Concern	Of Concern	19.74	2,058.6	6121.3	1,822.1
11.4.9	Endangered	Endangered	7.14	182.7	517.2	129.1
11.11.1	Least Concern	No concern at present	4.18	2,619.5	3,270.6	576.7
11.11.15	Least Concern	No concern at present	9.72	1,090.6	20,698.4	1,949.1

Data source: DNRME, 2017

14.6.1.3 Protected Plants Flora Survey Trigger Map

The Project area does not intersect any area considered to be 'high risk' under the flora survey trigger mapping. An area mapped as 'high risk' occurs approximately 1 km directly north of the Project boundary.

14.6.1.4 Matters of State Environmental Significance

Current mapping of MSES for the ML indicates the presence of the following features:

- 3.4 ha of lands considered to be MSES under 'Criteria 5: High Ecological Significance wetlands on the map of Referable Wetlands';
- 195.5 ha of lands considered to be MSES under 'Criteria 8a: Category B remnant vegetation considered to be Endangered or Of Concern under the VM Act';
- 12.6 ha of lands considered to be MSES under 'Criteria 8d: Essential habitat'. The lands are generalised to RE 11.49 which is considered as essential habitat for Ornamental Snake;
- 18.9 ha of lands considered to be MSES under 'Criteria 8f: within 500 m of a Vegetation Management Wetland'; and
- There are also 25.2 km of watercourse vegetation considered to be a MSES under 'Criteria 8e: watercourses shown on the Vegetation Management Watercourse and Drainage Feature Map.' This is considered very likely to be an overestimate as both banks (rather than the centreline) of larger watercourses where present are mapped by the State, increasing the extent of linear features. The final extent of watercourse vegetation considered to be a MSES under 'Criteria 8e on the ML is discussed in Section 14.12 Offsets.

There are no other features considered to be MSES within the ML.

14.6.1.5 Biodiversity Planning Assessment

DES has prepared a BPA for the Brigalow Belt North bioregion in order to provide broad scale ecological data and advise a range of planning and decision-making processes. The results of the online search results are summarised in the following subsections.

Biodiversity Significance

BPA analyses identified the majority of remnant vegetation within the ML as being of Regional significance. Two small patches of vegetation communities (12.4 ha total) identified as Endangered under the VM Act are considered of State significance. A small area of vegetation in the south of the ML is considered as locally significant (Figure 14-3).

Wildlife Corridors

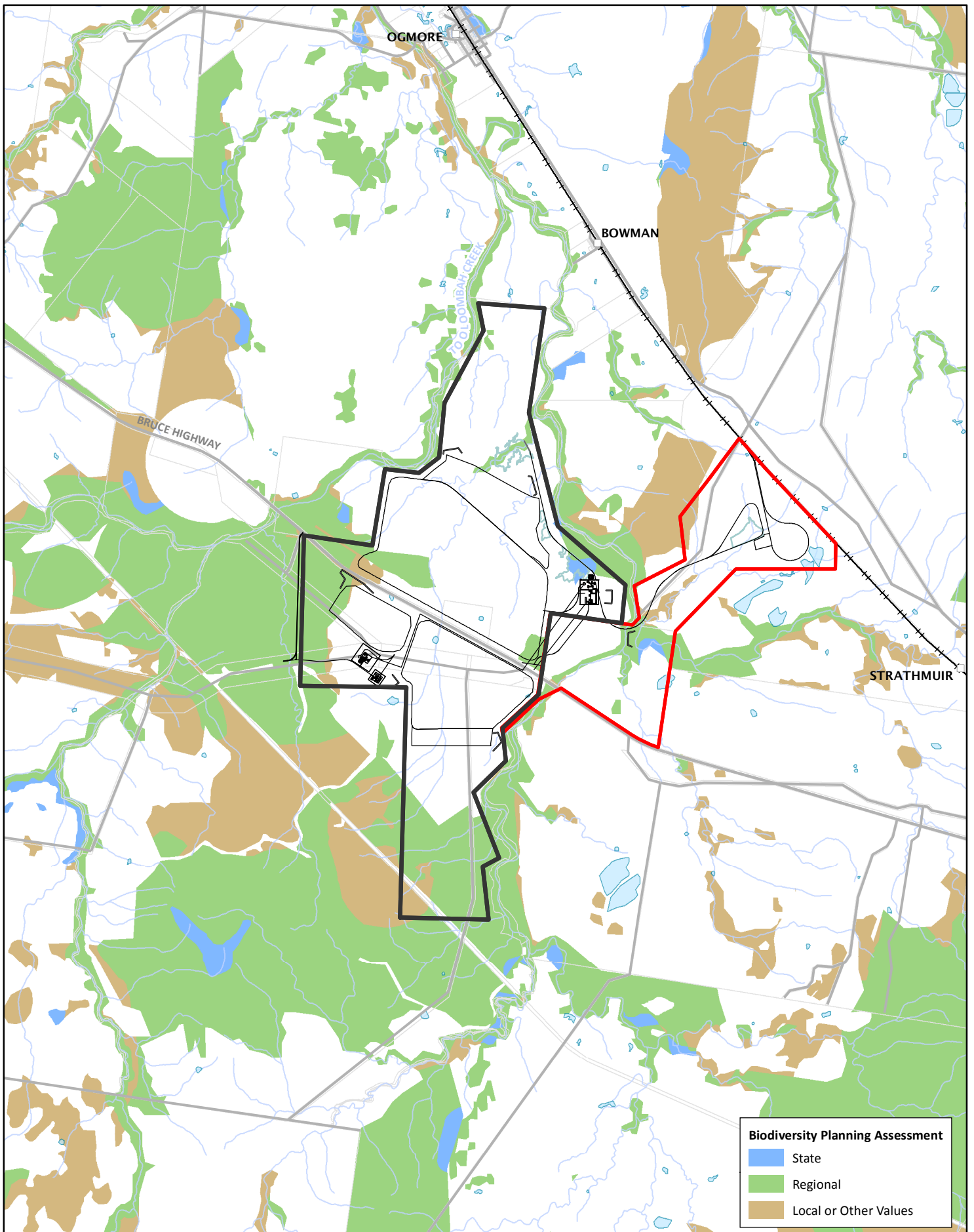
Wildlife corridors are a key component to regional biodiversity as they have the potential to facilitate the movement and dispersal of both flora and fauna from one area to another, maintain genetic diversity and population numbers. Current BPA mapping identifies no corridor of any significance within or surrounding the ML.

14.6.1.6 Environmentally Sensitive Areas

ESA mapping identified a Category B ESA within the ML (Figure 14-4). This Category B ESA is associated with remnant vegetation listed as Endangered under the VM Act. A number of Category A, B and C ESAs are located within the wider locality (within 25 km of the Project area), including various protected areas and nature refuges (Table 14-6). Tooloombah Creek Conservation Park (Category A) is located less than 1 km west of the ML boundary. The Great Barrier Reef World Heritage Area and Marine Park boundaries and Broad Sound Fish Habitat Area overlap (all Category B) and are located 8 km north of the Project. Waters associated with the Styx River are also designated as a 'coastal management district' which is also a Category C ESA.

Table 14-6 Environmentally Sensitive Areas within 25 km of the Project area

Environmentally Sensitive Area	Category	Approximate distance to Project area (km)
		Mine area
Tooloombah Creek Conservation Park	Category A	0.8
Great Barrier Reef World Heritage Area	Category B	8.0
Bukkula Conservation Park	Category A	16.9
Marlborough State Forest	Category C	16.5
Eugene State Forest	Category C	19.0
Mt Buffalo State Forest	Category C	25.0
Develin Nature Refuge	Category C	19.0
Burwood Nature Refuge	Category C	19.3
Great Barrier Reef Marine Park – general use area	Category B	8.0
Fish Habitat Area – Broad Sound	Category B	8.0
Endangered remnant vegetation	Category B	Within 25 km radius
Marine Plants	Category B	7.5 (north – associated with Styx River estuarine plain)
Coastal Management District	Category C	2.0 (north – associated with Styx River)



Biodiversity Planning Assessment

- State
- Regional
- Local or Other Values



0 1 2 km

Scale @ A4 1:80,000
 Date: 31/10/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Cadastral boundary
- Main road
- North Coast Rail Line
- Watercourse
- Reservoir
- Dam

Figure 14-3
 Biodiversity Planning Assessment mapping – biodiversity significance

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018
 QLD Department of Environment
 and Heritage Protection, 2016



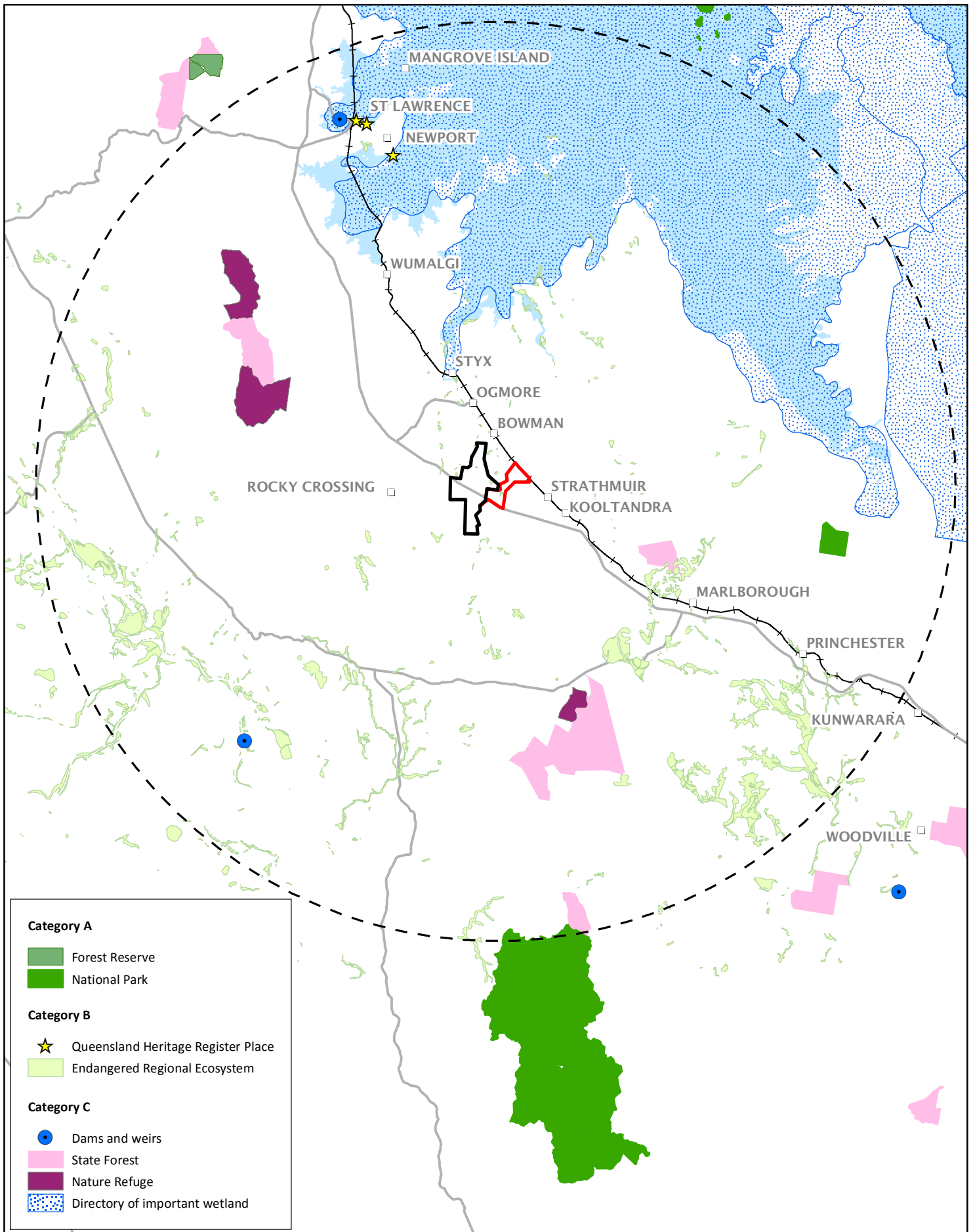


Figure 14-4
 Location of Environmentally Sensitive Areas
 within 50 km of the Project Area

Scale @ A4 1:540,000
 Date: 27/11/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Project Area 50 km buffer
- North Coast Rail Line
- Main road
- Estuary

DATA SOURCE
 QLD Department of Environment and
 Heritage Protection, 2016
 QLD Open Source Data, 2018

14.6.1.7 Declared Weed Species

According to the EPBC protected matters search tool, the following eight Weeds of National Significance (WoNS) have the potential to occur in the Project area:

- Rubber Vine (*Cryptostegia grandiflora*);
- Olive Hymenachne (*Hymenachne amplexicaulis*);
- Bellyache Bush (*Jatropha gossypifolia*);
- Lantana;
- Prickly Pears (*Opuntia* spp.);
- Parkinsonia (*Parkinsonia aculeata*);
- Parthenium (*Parthenium hysterophorus*); and
- Prickly Acacia (*Vachellia nilotica*, form. *Acacia nilotica*).



All of the above species are also listed as Restricted Matters under the Biosecurity Act. Database searches of the wider area encountered records of 153 introduced species, including all eight species listed as WoNS above, and seven other species listed as Restricted Matters under the Biosecurity Act:



- Mother-of Millions (*Bryophyllum delagoense* and *Bryophyllum x houghtonii*);
- Heart Seed Vine (*Cardiospermum grandiflorum*);
- Cat's Claw Creeper (*Dolichandra unguis-cati*);
- Harrisia Cactus (*Harrisia martinii*);
- Rat's Tail grasses (*Sporobolus jacquemontii*); and
- Indian Jujube (*Ziziphus mauritania*).



14.6.2 Terrestrial Flora – Field Survey Results



Twelve vegetation communities were identified within the Project area during field surveys. Detailed descriptions of these communities are provided in the following table based on flora data collected in February 2017 and July 2018. The Flora Technical Report for the 2011 site works including a full list of site species encountered is provided in Appendix A9b – Flora and Vegetation Assessment. Note that Appendix A9b – Flora and Vegetation Assessment references the original proponent; Styx Coal Pty Ltd, and the original Project name, Styx Coal Mine Project; however, the Central Queensland Coal Pty Ltd is the new Proponent for the Project and the Project has been renamed as Central Queensland Coal Project to better reflect the change of Proponent. This proponent and title change does not affect the technical studies.



Table 14-7 Project vegetation community descriptions



RE 11.3.4	
Forest Red Gum (<i>Eucalyptus tereticornis</i>) woodland on alluvial plains	
VM Act status: Of Concern	EP Act Biodiversity status: Of Concern
Description of community onsite	Site cover: ML700022 – 11.6 ha
<p>This community occurs in patches across the eastern portion of the ML where it is associated with the alluvial plains adjacent to Deep Creek. This community occurs on shallow black self-mulching clays.</p> <p>This vegetation community is characterised by a canopy of Forest Red Gum, Poplar Gum with Carbeen (<i>Corymbia tessellaris</i>). An understorey is often present and comprised of species such as Swamp Box (<i>Lophostemon suaveolens</i>) and Red Ash. The lower shrub layer tends to be dominated by Lantana, although native species present include Coffee Bush (<i>Breynia oblongifolia</i>) and Boonaree (<i>Alectryon diversifolius</i>). The ground layer tends to be dense and dominated by grasses such as <i>Bothriochloa</i> spp., Kangaroo Grass (<i>Themeda triandra</i>) and Black Spear Grass (<i>Heteropogon contortus</i>).</p> <p>This community is in a variable condition with evidence of past tree clearing or thinning for cattle grazing purposes particularly in the southern portion of the ML. An understorey of Lantana is common throughout.</p> <p>No Endangered, Vulnerable and Near Threatened (EVNT) flora species were observed or expected.</p>	
RE 11.3.11	
Semi-evergreen vine thicket on alluvial plains	
VM Act status: Endangered	EP Act Biodiversity status: Endangered
Description of community onsite	Site cover: ML80178 - 2.2 ha
<p>This community occurs as two patches on the edge of the western boundary of the ML (north of the highway) and is associated with alluvial terraces along Tooloomba Creek where several patches occur in the localised area but outside of the ML.</p> <p>This vegetation community is characterised by a relatively low canopy (7 – 10 m) comprising a variety of species including Python Tree (<i>Gossia bidwillii</i>), Red Kamala (<i>Mallotus philippensis</i>), Peanut Tree (<i>Sterculia quadrifida</i>), White Cedar (<i>Melia azedarach</i>), Tuckeroo (<i>Cupaniopsis anacardioides</i>) among other taxa. Forest Red Gum and Carbeen occur as occasional emergents. A varied understorey with abundant vines is present and comprised of species such as Chain Fruit (<i>Alyxia ruscifolia</i>), Queensland Ebony (<i>Diospyros geminata</i>), Sandpaper Fig (<i>Ficus opposita</i>), Broad-leaved Cherry (<i>Exocarpos latifolius</i>), and Velvet Mock-orange (<i>Notelaea microcarpa</i>) and Currant Bush.</p> <p>This community is in a reasonable condition given evidence of past tree clearing for cattle grazing purposes. Rubber Vine is commonly present on the edge of this community.</p> <p>No EVNT flora species were observed or expected.</p>	



RE 11.3.25	
Forest Red Gum (<i>Eucalyptus tereticornis</i>) woodland fringing drainage lines	
VM Act status: Least Concern	EP Act Biodiversity status: Of Concern
Description of community onsite	Site cover: ML80178 - 26.2 ha, ML700022 – 18.9
<p>Occurs along riparian areas of drainage lines. including a tributary of Deep Creek which crosses the ML north of the Bruce Highway.</p> <p>Restricted to the immediate bed and banks of watercourses this woodland community is dominated by Forest Red Gum and Weeping Tea Tree (<i>Melaleuca leucadendra</i>). Along Deep and Tooloombah Creeks a mid-dense lower tree and upper shrub layer is characterised by River She-oak (<i>Casuarina cunninghamiana</i>), Weeping Bottlebrush (<i>Melaleuca viminalis</i>) as well as White Cedar and Red Ash. Tooloombah Creek and sections of Deep Creek feature a range of dry rainforest species along the banks. Lantana is a common and often dense understorey species.</p> <p>Within the ML the sub-canopy of this community includes Carbeen, Brigalow and Northern Swamp Mahogany (<i>L. grandiflorus</i>). The lower shrub layer includes <i>Hibiscus heterophyllus</i>, <i>Capparis loranthifolia</i>, Wilga (<i>Geijera parviflora</i>), Sandpaper Fig, Currant Bush and Lantana.</p> <p>Within the ML this habitat is restricted to a narrow strip in poor condition heavily impacted by past clearing of adjacent communities. Cattle are largely excluded from Deep and Tooloombah Creeks and this community is in good condition (although suffering extensive weed invasion). No EVNT flora species observed or expected.</p>	 <p style="text-align: center;">Community along Barrack Creek</p>  <p style="text-align: center;">Community along drainage line in north of ML</p>

RE 11.3.27	
Freshwater wetlands	
VM Act status: Least Concern	EP Act Biodiversity status: Of Concern
Description of community onsite	Site cover: ML80178 - 3.4 ha
<p>Occurs as four discrete patches, two small permanent wetlands close to the Bruce Highway in the western portion of the ML, and two ephemeral wetlands located in depressions in the east of the ML.</p> <p>The permanent wetlands are characterised by open water with a variety of floating and aquatic emergent plants including sedges, lotus species, Swamp Lily and Water Snowflake. Olive Hymenachne also present. The wetland is surrounded by a narrow strip of Forest Red Gum.</p> <p>The ephemeral examples of this community include Forest Red Gum and Swamp Box in a sparse canopy. The ground layer includes <i>Cyperus</i> spp. and some native grasses such as <i>Paspalideum distans</i> and <i>Urochloa mutica</i> but was dominated by dessicated Olive Hymenachne at the time of survey.</p> <p>Cattle disturbance observed. No EVNT flora species were observed or are expected.</p>	 <p style="text-align: center;">Mapped VM Act wetland on west side of ML</p>  <p style="text-align: center;">Ephemeral wetland depression on east side of ML</p>

11.3.35	
<i>Eucalyptus platyphylla</i>, <i>Corymbia clarksoniana</i> woodland on alluvial plains	
VM Act status: Least Concern	EP Act Biodiversity status: Least Concern
Description of community onsite	Site cover: ML80178 - 28.7 ha
<p>Occurs on an upper alluvial terraces associated with Deep Creek to the north and south of the Bruce Highway.</p> <p>Dominated by Poplar Gum, <i>Corymbia clarksoniana</i> with scattered Carbeen. A sparse shrub layer includes Red Ash, Turkey Bush (<i>Grewia retusifolia</i>), Coffee Bush and <i>Acacia salicina</i>. Lantana is sparsely present as an understorey species. A relatively dense ground layer includes native grass species including <i>Cymbopogon refractus</i>, <i>Eriachne glabrata</i>, <i>Leptochloa decipiens</i>.</p> <p>This community is heavily impacted by cattle grazing. No EVNT flora species observed.</p>	
RE 11.4.2	
<i>Eucalyptus</i> spp. and/or <i>Corymbia</i> spp. grassy or shrubby woodland on Cainozoic clay plains	
VM Act status: Of Concern	EP Act Biodiversity status: Of Concern
Description of community onsite	Site cover: ML80178 - 206.9 ha, ML700022 – 40.4 ha
<p>Dominant remnant community remaining on the plains within the ML, mainly north of the Bruce Highway but also occurs in the south on the lower slopes of the hills.</p> <p>Dominated by Polar Box and Narrow-leaved Ironbark as well as Poplar Gum, Pink Bloodwood (<i>Corymbia intermedia</i>) and Carbeen. The relatively open canopy of this community is evident over the sparse shrub layer and grassy understorey. Shrub species include Currant Bush, Wilga, Boonaree and Turkey Bush. Where it borders regrowing Brigalow communities species such as Brigalow and Belah (<i>Casuarina cristata</i>) occur. Ground layer tends to be characterised by grasses such Kangaroo grass, Black Spear Grass, <i>Eragrostis</i> spp. and <i>Bothriochloa</i> spp.</p> <p>No EVNT flora species were observed and none are expected.</p>	

RE 11.4.9	
Brigalow (<i>Acacia harpophylla</i>) shrubby woodland on Cainozoic clay plains	
VM Act status: Endangered	EP Act Biodiversity status: Endangered
Description of community onsite	Site cover: ML80178 - 0.54 ha, ML700022 – 3.37 ha
<p>This community occurs as an isolated remnant patch within the eastern portion of the mine ML. Much of the ML north of the Bruce Highway comprises dark cracking clays with extensive low regrowth of this community. A larger patch is located to the east of Deep Creek in the southern portion of the TLF ML.</p> <p>This community is characterised by an open forest canopy of Brigalow with occasional Poplar Box. Upper and lower shrub layers are mid-dense comprising False Sandalwood (<i>Eremophila mitchellii</i>), Currant Bush, Boonaree and Queensland Ebony. The ground layer is sparse and tends to be dominated by introduced pasture grasses.</p> <p>This community is heavily impacted by cattle grazing. No EVNT flora species observed. May provide low quality habitat for <i>Solanum elaeagnifolium</i> (Endangered - NC Act).</p>	
RE 11.3.12	
Melaleuca viridiflora woodland on alluvial plains	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML80178 - 4.16 ha
<p>Occurs as an isolated area in a natural depression in the western portion of the site north of Mt Bison Road. Water present during 2011 surveys. No water present in February 2017 (depicted) but filled in April 2017.</p> <p>This community is characterised by a central patch of Broad-leaved Paperbark with a variety of sedges and a sparse cover of hydrophytes (including <i>Ottelia ovalifolia</i>) present in 2011 and 2018. Dry margins of wetland with sparse to dense cover of low sedges and forbs. Surrounded by mixed eucalypt woodlands (RE 11.4.2 and 11.5.8a).</p> <p>Impacted by cattle grazing. Cattle observed to be present in community throughout 2017 and 2018 surveys. Feral Pigs also observed to be present. No EVNT flora species were observed or are expected.</p>	

RE 11.5.8a	
<i>Eucalyptus platyphylla, Corymbia intermedia</i> woodland on Cainozoic sand plains / remnant surfaces	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML80178 - 33.4 ha
<p>This community occurs as extensive remnants along the western boundary of the ML (south of the Bruce Highway) on colluvial and residual deposits.</p> <p>Characterised by emergent eucalypts such as Pink Bloodwood and Queensland Peppermint, as well as Poplar Gum and Ghost Gum. The sparse to mid-dense lower tree layer is a mix of co-dominant species including: Red Ash, Quinine Bush (<i>Petalostigma pubescens</i>) and a variety of <i>Acacia</i> spp. Shrubs include <i>Canthium buxifolium</i>, Orange Box Thorn (<i>Denhamia celastroides</i>) and scattered Lantana. Species common in the ground layer include Black Spear Grass, <i>Aristida</i> spp., <i>Bothriochloa</i> spp. and Kangaroo grass.</p> <p>Cattle present in this habitat during February 2017 survey. Some limited impacts from tree thinning evident.</p> <p>No EVNT flora species were observed or expected.</p>	
RE 11.10.3	
<i>Acacia shirleyi</i> open forest on coarse-grained sedimentary rocks - crests and scarps	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML80178 - 36.6 ha
<p>Restricted to rocky elevated habitat in the southeast corner of the ML.</p> <p>The mid-dense canopy layer is dominated by Lancewood (<i>Acacia shirleyi</i>) with emergent Pink Bloodwood. There is a lower tree layer including Quinine Bush, <i>Canthium buxifolium</i> and <i>Melaleuca nervosa</i>. Lower shrub and ground layers are often sparse on the rocky substrate. Shrubs include Medicine Bush (<i>Pogonolobus reticulatus</i>) and Bitterbark (<i>Alstonia constricta</i>). Grasses present include perennial species such as Wiry Panic (<i>Entolasia stricta</i>), <i>Eragrostis elongatus</i> and <i>Bothriochloa pertusa</i>.</p> <p>This community is in good condition and is likely less attractive to cattle for browsing, impacts due to grazing are limited. No EVNT flora species were observed. May provide habitat for <i>Cycas ophiolitica</i> (EPBC Act and NC Act – Endangered) and <i>Lissanthe brevistyla</i> (NC Act – Vulnerable).</p>	

RE 11.10.7	
<i>Eucalyptus crebra</i> woodland on coarse-grained sedimentary rocks	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML80178 - 76.4 ha
<p>Restricted to lower slopes of elevated habitat in the southeast of the ML.</p> <p>The canopy is dominated by Poplar Gum and Clarkson's Bloodwood (<i>Corymbia clarksonia</i>). A shrub layer ranges from mid-dense to sparse and is characterised by the presence of Red Ash, Quinine Bush, <i>Acacia longispicata</i> and Red Kamala. Lantana is dominant in the lower shrub layer and often in high density.</p> <p>This community has been variably impacted by cattle grazing with some evidence of previous tree clearing (few mature trees present).</p> <p>No EVNT flora species were observed and none are expected.</p>	
RE 11.11.1	
<i>Eucalyptus crebra</i> +/- <i>Acacia rhodoxylon</i> woodland on old sedimentary rocks	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML 700022 – 5.1 ha
<p>This community occurs along the western boundary of the haul road/TLF ML as derived from vegetation mapping carried out in 2011 and 2012.</p> <p>The ecologically dominant layer is characterised by Narrow-leaved Ironbark and/or Silver-leaved Ironbark (<i>E. melanophloia</i>) over a well-developed understorey of Rosewood (<i>Acacia rhodoxylon</i>). A shrub layer is often present and may include <i>Hibiscus divaricatus</i>, <i>Erythroxylon</i> sp., Yellow-berry Bush (<i>Maytenus cunninghamii</i>), and Currant Bush. The ground layer is typically dense and characterised by various grass species.</p> <p>No EVNT flora species are expected.</p>	
RE 11.11.15a	
<i>Eucalyptus crebra</i> woodland on deformed and metamorphosed sediments and interbedded volcanics	
VM Act status: Least Concern	EP Act Biodiversity status: No Concern at Present
Description of community onsite	Site cover: ML80178 - 88.3 ha, ML 700022 – 10.7 ha
<p>This community occurs along the western boundary of the haul road/TLF ML as derived from vegetation mapping carried out in 2011 and 2012.</p> <p>This woodland community is dominated by a mixture of Poplar Gum and Narrow-leaved Ironbark with a range of less dominant eucalypts including Carbeen and Ghost Gum. The lower tree and shrub layers tend to be sparse including Red Ash, Broad-leaved Paperbark, Beefwood (<i>Grevillea striata</i>) and Quinine Bush. Lantana is also present in scattered and sparse patches. Ground cover comprises a mix of native grass species including Black Spear Grass, <i>Bothriochloa</i> spp., Kangaroo Grass and <i>Panicum</i> spp.</p> <p>No EVNT flora species are expected.</p>	

14.6.2.1 Discrepancy in Regional Ecosystem Mapping

The 2017 and 2018 field surveys within the Project area identified several inconsistencies between the current RE mapping and onsite vegetation communities. The amount of listed Of Concern vegetation communities increased by approximately 32 ha and Endangered vegetation communities decreased substantially down to 2.6 ha. The majority of the Project area (approximately 78.3%) remains cleared of remnant vegetation. Ground-truthing identified the Project area is dominated by remnant eucalypt woodland communities on clay soils (RE 11.4.2)

mainly north of the Bruce Highway, and rocky or coarse volcanic soils in the south of the ML (RE 11.11.15a, 11.10.3 and 11.10.7). The TLF is located in cleared lands. The proposed haul road will cross Deep Creek and Barrack Creek and will thereby impact riparian (RE 11.3.25) and adjacent communities (

Figure 14-5). A 'Regional Ecosystem assessment request' including vegetation data, GIS data (ESRI shapefiles), and site photographs has been lodged with DES regarding amendments to the vegetation mapping associated with the Mamelon property (refer Appendix A19 for request letter and site data).

Table 14-8 Discrepancies with DNRME RE mapping – ML 80178

RE	VM Act status	Extent of current RE mapping (ha) – ML80178	Extent of ground-truthed mapping (ha) – ML80178	Total within a 10 km radius of Project (ha)	Total within Marlborough Plains subregion (ha)
11.3.4	Of Concern	9.78	-	925.5	10,042.1
11.3.11	Endangered	Not mapped	2.2	5.22	112.9
11.3.12	Least Concern	Not mapped	4.2	-	-
11.3.25	Least Concern	16.03	26.2	1,332.4	2,955.8
11.3.27	Least Concern	0.5 ha (VM Act wetland mapping only)	3.4		575.8
11.3.35	Least Concern	Not mapped	28.7		98.8
11.4.2	Of Concern	174.92	206.9	2,058.6	6,121.3
11.4.9	Endangered	12.7	0.4	182.7	517.2
11.5.8a	Least Concern	Mapped as mixed polygon with RE 11.7.2	33.4	636	4783.9
11.10.3	Least Concern	Not mapped	36.6	-	-
11.10.7	Least Concern	29.11	76.4	362.6	1,840
11.11.15a	Least Concern	125.52	88.3	513.5	88.4

14.6.2.2 Threatened Flora Species

Habitat requirements for flora species listed under the NC Act and / or EPBC Act were considered during the flora surveys. Table 14-10 lists species that were identified through desktop searches and their potential to occur within the Project area based on mapped vegetation types and field surveys.

A total of 245 native plant species were identified within the Project area (Appendix A9b – Flora and Vegetation Assessment). No flora species listed as Endangered, Vulnerable or Near Threatened (EVNT) under the NC Act were observed within the Study area during field assessments. Surveys recorded *Eleocharis blakeana* which was listed as Near Threatened in 2011. This species is no longer listed under the NC Act.

A number of listed species (seven) were identified as having some potential to occur, based on the onsite observations including six species listed as threatened under the NC Act (Table 14-10). None are considered likely to occur. Three of the species may have potential to occur in the rocky, elevated habitat in the southern portion of the ML (RE11.10.3 and RE11.10.7). No cycads were observed growing in this area during site traverses in the vicinity of tracks. It is noted the southern vegetated portion mostly lies outside the Project footprint.

The remaining three species have a low potential to occur on the cracking clay soils that dominate the ML to the north of the Bruce Highway. Much of this area has been heavily impacted by clearing, weed invasion and cattle grazing.

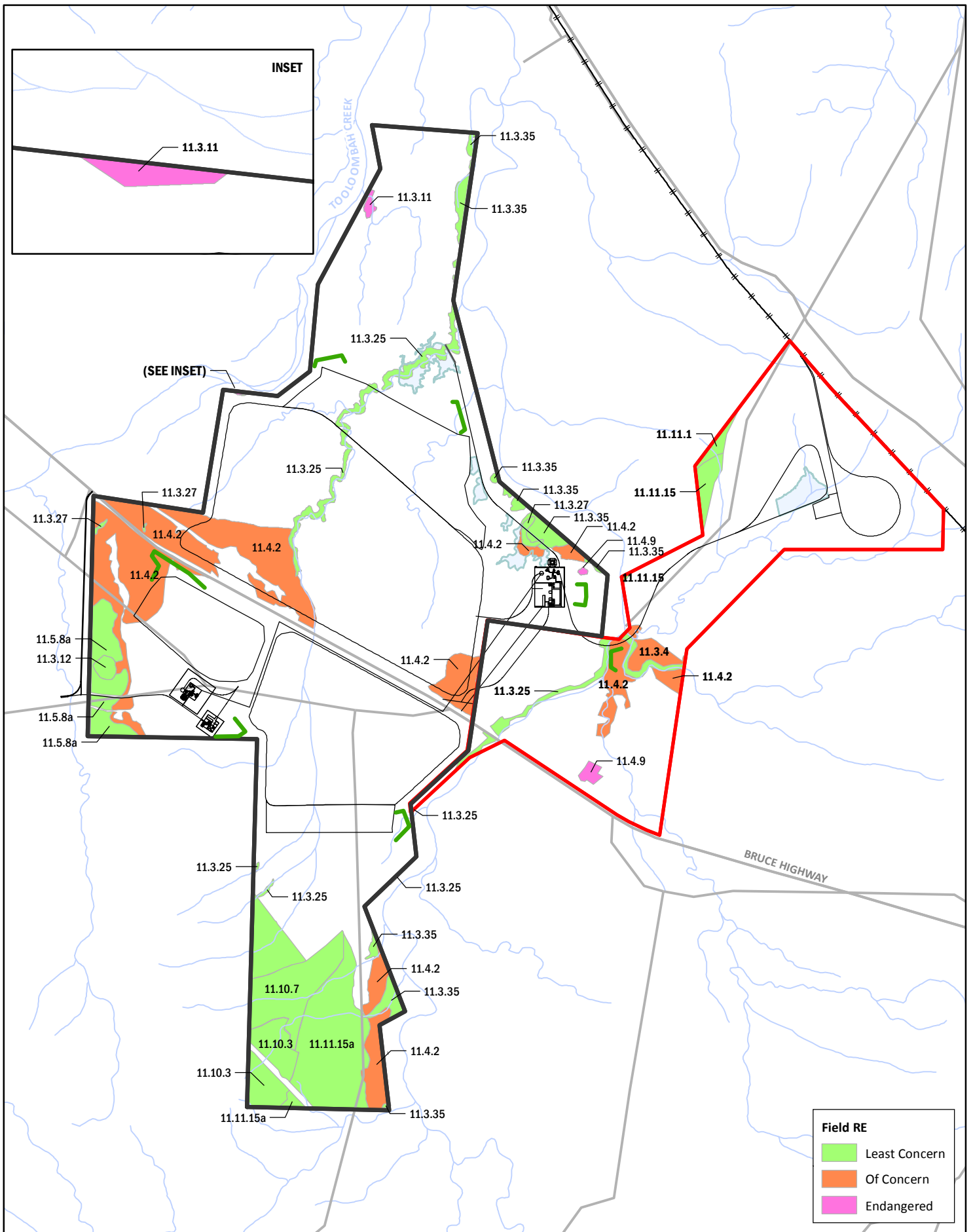


Figure 14-5
Ground-truthed RE mapping within
ML following site surveys



DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018



0 0.5 1 km

Scale @ A4 1:50,000
Date: 09/10/18
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Main road
- North Coast Rail Line
- Watercourse
- Dam

14.6.2.3 Declared Weed Species

Fifty-three introduced weed species were identified within the Project area during the onsite surveys (refer to Appendix A9b – Flora and Vegetation Assessment). Of the 53 weed species identified, ten are classified as Category 3 ‘Restricted Matters under the Biosecurity Act, and six are also declared as Weeds of National Significance (Table 14-9). The site surveys in February 2017 identified seven species including an additional species of Prickly Pear (*Opuntia tomentosa*) not identified previously.

According to the Act, under a Category 3 restriction ‘a person who has, or has a thing infested with, the ‘Restricted Matter’ in the person’s possession or under the person’s control must not distribute or dispose of the restricted matter unless the distribution or disposal is carried out via the methods set out in the Biosecurity Act.’

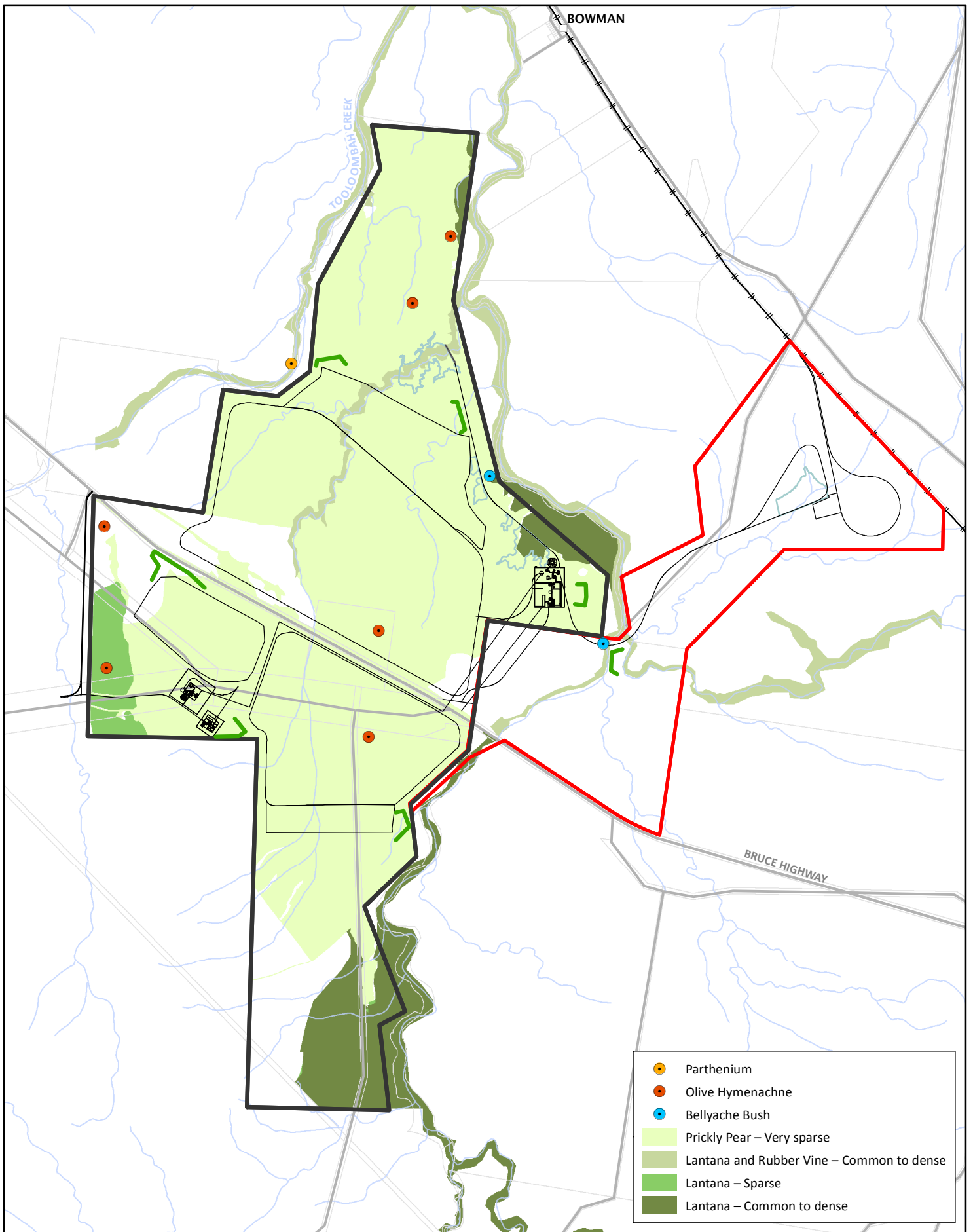
The occurrence of the listed weed species is consistent with distributions shown in the latest Biosecurity Queensland Annual Pest Distribution Survey data.

Table 14-9 Declared weed species identified within Project area

Species name	Common name	Biosecurity Act category	Weeds of National Significance	2011 surveys	2017 surveys
<i>Aristolochia elegans</i>	Dutchman’s Pipe	Category 3	No	X	
<i>Bryophyllum delagoense</i>	Mother-of millions	Category 3	No	X	X
<i>Cryptostegia grandiflora</i>	Rubber-vine	Category 3	Yes	X	X
<i>Harrisia martinii</i>	Harrisia Cactus	Category 3	No	X	
<i>Hymenachne amplexicaulis</i>	Olive Hymenachne	Category 3	Yes	X	X
<i>Jatropha gossypifolia</i>	Bellyache Bush	Category 3	Yes	X	X
<i>Lantana camara</i>	Lantana	Category 3	Yes	X	X
<i>Opuntia stricta</i> <i>Opuntia tomentosa</i>	Prickly Pear species	Category 3	Yes	X	X X
<i>Parthenium hysterophorus</i>	Parthenium	Category 3	Yes	X	X
<i>Sporobolus fertilis</i>	Giant Paramatta Grass	Category 3	No	X	

In general, weed species were abundant within the ML and particularly along drainage lines such as Deep Creek and Tooloombah Creek (Figure 14-6). The ground layer of cleared areas within the northern section of the ML is dominated by the introduced Buffel Grass (*Cenchrus ciliaris*) where cracking clays occur. Bellyache Bush occurs patchily along the margins of both creeks. Rubber Vine is common along both creeks (sometimes forming dense infestations) and also occurs along the minor drainage located within the ML to the north of the Bruce Highway. Lantana occurs in varying density throughout much of the remnant vegetation in the area, and in non-remnant areas located in the vicinity of creek lines. High densities were noted in the south of the ML around fauna trap site 2, in the floodplain vegetation adjacent to Deep Creek such as fauna trap site 4 (refer Figure 14-2) and along the creek lines themselves. Rubber Vine occurs throughout with some dense infestations observed along the creek lines.

Olive Hymenachne is a semi-aquatic species and was recorded in the northern extent of the ML at a farm dam (February 2017) and in a water-filled gilgai (May 2017). Surveys in December 2017 and January 2018 recorded Olive Hymenachne in several further waterbodies. Parthenium was only observed along Tooloombah Creek and not within the ML itself. Prickly Pear is sparsely distributed throughout the ML although mainly occurs on the heavy clay soils north of the Bruce Highway within the regrowth Brigalow communities.



- Parthenium
- Olive Hymenachne
- Bellyache Bush
- Prickly Pear – Very sparse
- Lantana and Rubber Vine – Common to dense
- Lantana – Sparse
- Lantana – Common to dense



0 0.5 1 km

Scale @ A4 1:50,000
 Date: 01/11/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Cadastral boundary
- Main road
- North Coast Rail Line
- Watercourse
- Dam

Figure 14-6
 Listed (Biosecurity Act) weed species
 distribution across the Project Area

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



Table 14-10 Potential for listed flora species to occur within the Project area and surrounds

Scientific name	Common name	Status		Description and preferred habitat	Potential to occur in Project area
		NC Act	EPBC Act		
<i>Bursaria reevesii</i>		V		A multi-stemmed shrub to 3 m tall. Grows along drainage lines and creek beds in silty loams derived from serpentine rocks. Associated species and vegetation include Red Ironbark (<i>Eucalyptus fibrosa</i>) / Glen Geddes Bloodwood (<i>Corymbia xanthope</i>) open woodlands.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 11 Wildlife online database records from wider area.
<i>Capparis humistrata</i>		E		A spreading shrub to 1.5m tall. Grows in eucalypt woodland with a shrubby understorey, on stony hard ridges and serpentinite soil. It also occurs on the margins of Brigalow forest on sandy soil.	Potential. Suitable habitat may occur within the Project area as stony ridges occur in the south of the ML. Regrowth Brigalow forest may occur adjacent to sandy soils in several areas north of the Bruce Highway. Seven Wildlife online database records from wider area.
<i>Capparis thozetiana</i>		V	V	Spiny shrub endemic to central Queensland in the Marlborough–Rockhampton region where it is confined to serpentinite hills and adjacent undulating colluvial aprons. The species grows on mostly shallow skeletal serpentinitic soils in woodland communities dominated by Red Ironbark and Glen Geddes Bloodwood.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 20 Wildlife online database records from wider area.
<i>Cerbera dumicola</i>		NT		Shrub or small tree growing to 4 m high. Occurs across a range of habitats in central and southern Queensland. Associated vegetation and species include: sandstone hills; on plateaus, in woodland of Lancewood with Long-fruited Bloodwood (<i>Corymbia dolichocarpa</i>); semi-deciduous notophyll-microphyll vine forest on rhyolite hillslopes; open-woodland of Silver-leaved Ironbark (<i>E. melanophloia</i>) with occasional Lancewood, Poplar Box and Brown's Box (<i>E. brownie</i>); and in Carbeen.	Potential. Suitable habitat occurs in southern portion of site. Two Wildlife online database records from wider area.
<i>Corymbia xanthope</i>	Glen Geddes Bloodwood	V	V	Occurs in woodlands with Red Ironbark on ridges or hill slopes on serpentinite geology with sandy soils. This community is recognised as a distinct regional ecosystem (RE 11.11.7 <i>E. fibrosa</i> subsp. <i>fibrosa</i> , Glen Geddes Bloodwood woodland on serpentinite).	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 16 Wildlife online database records from wider area.
<i>Cycas megacarpa</i>	Trunked Cycad	E	E	Trunked Cycad grows to 5 m tall. Is endemic to southeast Queensland from Bouldercombe in the north, to near Woolooga in the south, in woodland or open woodland dominated by eucalypts, usually on rocky substrate.	Unlikely. Two Wildlife online database records from wider area to the south. Species is not known to occur this far north.

Scientific name	Common name	Status		Description and preferred habitat	Potential to occur in Project area
		NC Act	EPBC Act		
<i>Cycas ophiolitica</i>	Marlborough Blue	E	E	Occurs from Marlborough in the north, to the Fitzroy River near Rockhampton in the south, in woodland or open woodland dominated by eucalypts, often on serpentinite substrates. Plants occur along hilly outcrops and in lower regions near creek systems.	Unlikely. No suitable habitat occurs and no cycads recorded. 23 Wildlife online database records from wider area.
<i>Dichanthium setosum</i>	Bluegrass	V	V	Associated with heavy basaltic black soils and stony red-brown hard setting loams with clay subsoil. Found in moderately disturbed areas such as cleared woodlands, grassy roadside remnants, grazed land and highly disturbed pastures.	Unlikely. No suitable habitat in Project area. No database records. EPBC Online search only.
<i>Eucalyptus raveretiana</i>	Black Ironbox	C	V	Grows along watercourses on alluvial flats or open woodland. Associated with RE 11.3.25a and occasionally 11.3.11.	Unlikely. Single Wildlife online database record from wider area (25 km to south of ML). Suitable habitat within ML (RE11.3.25) is heavily degraded. Better habitat occurs along Deep Creek, however no individuals have been recorded for this species within the region and not recorded during site surveys.
<i>Hakea trineura</i>		V	V	Occurs on serpentinite-derived soil mostly on gravelly ridges and slopes, often with Red Ironbark and Glen Geddes Bloodwood woodland over hummock grassland on hills.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 13 Wildlife online database records from wider area.
<i>Lissanthe brevistyla</i>		V		A spreading shrub growing to 1.5 m tall. Confined to steep hillsides in eucalypt woodlands, on red gravelly soil or on loose stony slopes.	Potential. Low quality habitat for this species occurs in the southern part of the ML where rocky elevated habitat occurs. 14 Wildlife online database records from wider area.
<i>Macrozamia serpentina</i>		E		Occurs from Marlborough in the north, to the Fitzroy River near Rockhampton in the south. Grows at altitudes between 80 – 160 m in low woodland with a mixed grassy and shrubby understory in red clay loams over serpentinites. Associated canopy species include Glen Geddes Bloodwood and Red Ironbark.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 24 Wildlife online database records from wider area.
<i>Marsdenia brevifolia</i>		V	V	Erect or loosely scrambling sub-shrub up to 1 m tall. Plants occurring north of Rockhampton grow on serpentinite rock outcrops or on black crumbly soils derived from serpentinite in woodland dominated by Glen Geddes Bloodwood and Red Ironbark. Despite this close association with serpentinite, the species is not a serpentinite endemic. Also grows in woodland on granite soils dominated by Granite Ironbark (<i>Eucalyptus granitica</i>), Yellow Jacket (<i>Corymbia leichhardtii</i>) and White Mahogany.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 17 Wildlife online database records from wider area.

Scientific name	Common name	Status		Description and preferred habitat	Potential to occur in Project area
		NC Act	EPBC Act		
<i>Myrsine serpenticola</i>		E		Shrub to small tree dark green glossy sub-opposite leaves. Known from gallery rainforest on serpentinitic soils. Often associated with low woodlands of Glen Geddes Bloodwood and Red Ironbark.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 12 Wildlife online database records from wider area.
<i>Neoroepera buxifolia</i>		V	V	Shrub or small tree growing to 6 m high. Known from two small areas between Marlborough and Yaamba, and between Rockhampton and Yeppoon, in Queensland. This species occurs along creek banks or in creek beds on serpentinite soils (Henderson, 1992; Batianoff et al., 2000) in riparian vine thicket, vine forest, melaleuca or eucalypt woodland or open forest with rainforest species in the understorey.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 26 Wildlife online database records from wider area.
<i>Olearia macdonnellensis</i>		E	V	Viscid aromatic shrub to 1.2 m high. Occurs in eucalypt open forest in the Marlborough region of central Queensland, all records are from rocky serpentinite hills and ridges. Associated vegetation / species includes open forests of Glen Geddes Bloodwood and Red Ironbark.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. Six Wildlife online database records from wider area.
<i>Omphalea celata</i>		V	V	Known from three rocky sites in central east Queensland occurring in SEVT. Locations are Hazlewood Gorge, near Eungella; Gloucester Island, near Bowen; and Cooper Creek in the Homevale Station area, north-west of Nebo (TSSC, 2008).	Unlikely. Well outside of known range of species. No database records. EPBC Online search only.
<i>Phaius australis</i>	Lesser Swamp Orchid	E	E	Commonly associated with coastal wet heath / sedgeland wetlands swampy grassland or swampy forest and often where Broad-leaved Paperbark (<i>M. quinquinervia</i>) or Swamp Mahogany (<i>E. robusta</i>) is found (Sparshott and Bostock, 1993). It is restricted to the swamp-forest margins, where it occurs in swamp sclerophyll forest, swampy rainforest, or fringing open forest. Mostly found in southeast Queensland and further south. Isolated population in Byfield National Park.	Unlikely. No suitable habitat in Project area. No database records. EPBC Online search only.
<i>Pimelea leptospermoides</i>		NT	V	A shrub growing to 1 m high. Occurs from near Marlborough to Rockhampton in Queensland. Found in most serpentine soil vegetation communities, but not in riverine forest. Notably on black clays on stony hillsides and sandy clay in Red Ironbark and Glen Geddes Bloodwood open woodland. Also tall open forest, open forest and low open forest, all with a grassy and / or heathy understorey, and in woodland with a Black Tea-tree (<i>Melaleuca bracteata</i>) subcanopy layer where prolonged flooding occurs.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 44 Wildlife online database records from wider area.
<i>Pultenaea setulosa</i>		V	V	An erect shrub growing on serpentine substrates in Red Ironbark and / or Glen Geddes Bloodwood woodlands or open forests on ridges, hills and slopes.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 11 Wildlife online database records from wider area.

Scientific name	Common name	Status		Description and preferred habitat	Potential to occur in Project area
		NC Act	EPBC Act		
<i>Samadera bidwillii</i>	Quassia	V	V	Occurs in lowland rainforests or rainforest margins. Also found in other forest types, such as open forest and woodland. Usually found in areas adjacent to both temporary and permanent watercourses up to 510 m altitude. Commonly associated trees in open forest and woodlands include Lemon-scented Gum (<i>Corymbia citriodora</i>), Grey Gum (<i>Eucalyptus propinqua</i>), White Mahogany, Forest Red Gum, Pink Bloodwood, Northern Grey Ironbark (<i>E. siderophloia</i>), Gum-topped Box (<i>E. moluccana</i>), Gympie Messmate (<i>E. cloeziana</i>) and Red Ironbark.	Unlikely. No suitable species associations observed within the Project area. Two Wildlife online database records from wider area.
<i>Sannantha brachypoda</i>		V		There is little information available on this species. It has been recorded at Apis Creek west of Marlborough although the majority of the records are to the south of the Capricorn Highway (i.e. Precipice and Humboldt National Parks). Records suggest SEVT and riparian corridors within eucalypt woodlands as the preferred habitat.	Potential. Degraded and marginal habitat (drainage line north of the Bruce Highway) occurs within the ML for this species. Better habitat occurs along Tooloombah Creek. Two Wildlife online database records from wider area.
<i>Solanum adenophorum</i>		E		Perennial herb growing to 40cm high. Occurs mostly in brigalow woodland and on very gently inclined slopes. It also occurs in Gidgee (<i>Acacia cambagei</i>) scrub on deep cracking clay soils.	Potential. Highly degraded and marginal habitat (north of the Bruce Highway) occurs within the ML for this species. Single Wildlife online database records from wider area.
<i>Solanum elachophyllum</i>		E		Known only from limited collections in the Leichhardt pastoral district, occurring on fertile cracking clay soils associated with Brigalow, Belah, <i>Eucalyptus thozetiana</i> , or woodland of Narrow-leaved Ironbark and Narrow-leaved White Mahogany (<i>E. tenuipes</i>).	Potential. Suitable habitat may occur on cracking clay soil north of the Bruce Highway. Single Wildlife online database records from wider area.
<i>Stackhousia tryonii</i>		NT		Annual or perennial herb, stems striate and often woody near the base. Serpentine landscape often associated with low woodlands of Glen Geddes Bloodwood and Red Ironbark.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project area. 12 Wildlife online database records from wider area.

*Status abbreviations: NC Act - NT = Near Threatened, V = Vulnerable, and E = Endangered; EPBC Act - V = Vulnerable, and E = Endangered.

14.6.3 Terrestrial Fauna – Desktop Results

Altogether, 342 species of terrestrial vertebrate are known or predicted to occur within a 50 km radius of the Study area, comprising 15 frogs, 42 reptiles, 254 birds and 31 mammal species (see Appendix A9c - Ecological Desktop Search Results).

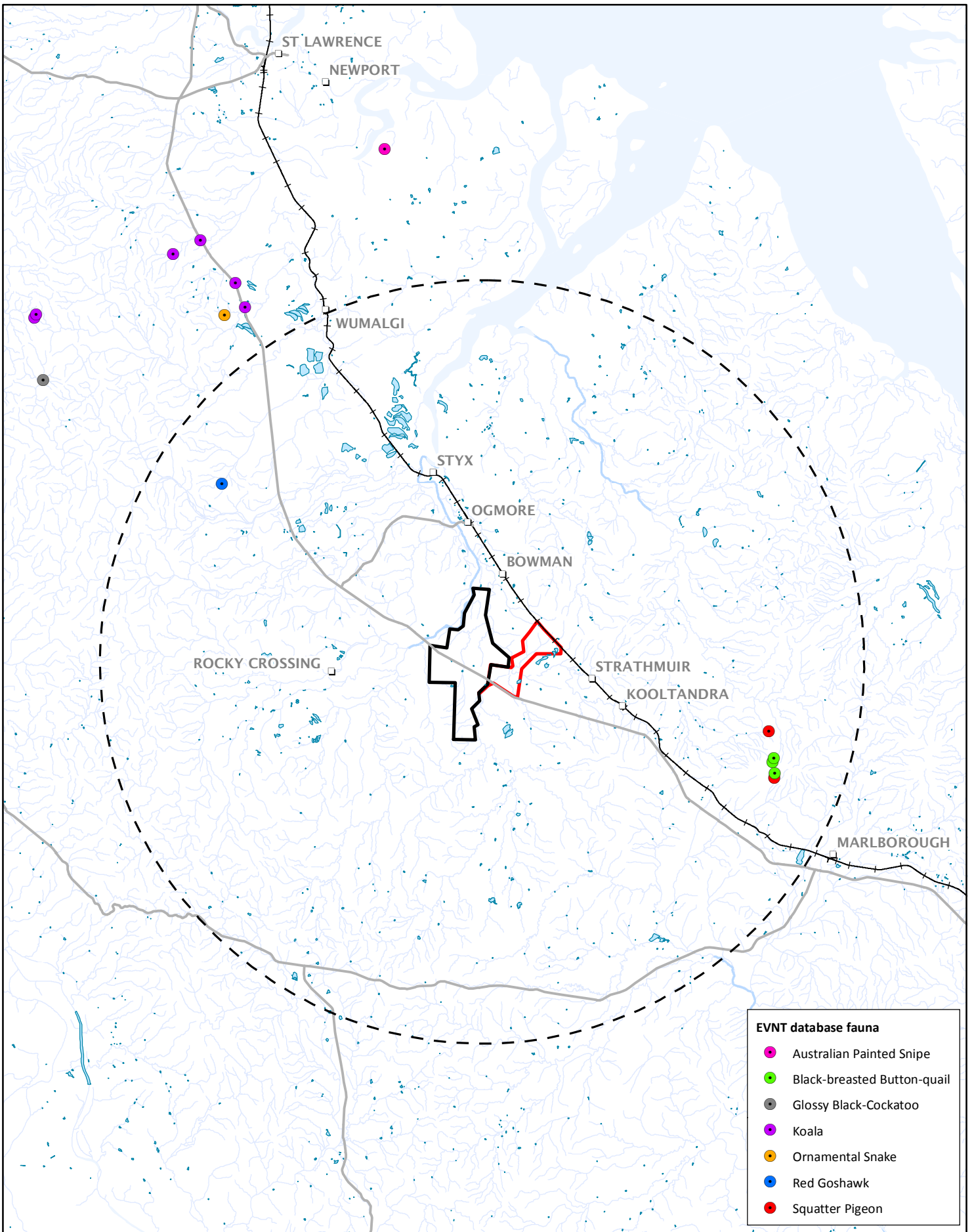
Fifty-seven conservation significant terrestrial vertebrate species are known or predicted to occur within a 50 km radius of the Study area based on the database searches. This includes 32 species listed as Endangered, Vulnerable or Near Threatened under the NC Act and / or EPBC Act. The remaining species include one reptile and 24 birds listed as Migratory species under the EPBC Act. The full list of conservation significant species is provided in Table 14-12.

One further significant species (but not listed as EVNT) predicted to occur is the Short-beaked Echidna (*Tachyglossus aculeatus*) which is listed as Special Least Concern (culturally significant) under the NC Act.

The EPBC Act Protected Matters Online Search also identified a further 17 threatened and / or migratory marine fauna species and five pelagic bird species as potentially occurring in the or near the Project area (refer Appendix A9c). As the Project is located inland and as no impacts are predicted to downstream marine ecosystems these species have not been considered further in this assessment.

There are several records of threatened fauna species in the wider area surrounding the Project area. Five fauna species listed as EVNT were recorded on the DES or ALA database within a 25 km buffered radius of the Project area including:

- One old record (1905) of Red Goshawk located 17 km northwest of the MLs;
- Two records of Squatter Pigeon (southern) (*Geophaps scripta scripta*) located approximately 18 km east of the Project area;
- Three 1996 records of Black-breasted Button-quail (*Turnix melanogaster*) located 18 km east of the Project area located on the edge of hilly country;
- A single record of Ornamental Snake 24 km northwest of the ML; and
- A single record of Koala 24 km northwest of the ML. There are five additional records of Koala between 25 and 33 km to the northwest in the same general area (Figure 14-7). There is also a single record of Australian Painted Snipe 30 km to the north and a single record of Glossy Black-cockatoo (*Calyptorhynchus lathami*) over 30 km north-west of ML 80187.



- EVNT database fauna**
- Australian Painted Snipe
 - Black-breasted Button-quail
 - Glossy Black-Cockatoo
 - Koala
 - Ornamental Snake
 - Red Goshawk
 - Squatter Pigeon

Figure 14-7
Database records of EVNT fauna within 25 km of Project Area



0 2.5 5 km

Scale @ A4 1:325,000
Date: 19/07/17
Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Project Area 25 km buffer
- +— North Coast Rail Line
- Main road
- Major watercourse
- Minor watercourse
- Reservoir

DATA SOURCE
Geofabric v2.x, Bureau of
Meteorology (BoM), 2017
QLD Spatial Catalogue (QSpatial), 2017



14.6.3.1 Declared Pest Fauna Species

Database searches of the wider area encountered records of eight introduced fauna species. Four of these species are also listed as Restricted Matters under the Biosecurity Act (Table 14-11). Under the Act a person who has control over a 'Restricted Matter' must not do the following:

- Category 3 – A person who has, or has a thing infested with, the 'Restricted Matter' in the person's possession or under the person's control must not distribute or dispose of the restricted matter unless the distribution or disposal is carried out via the methods set out in the Biosecurity Act;
- Category 4 – move the 'Restricted Matter', or cause or allow to be moved;
- Category 5 – keep in the person's possession or under the person's control; and
- Category 6 – give food to the 'Restricted Matter.'

Table 14-11 Introduced fauna species known from the Project area and surrounds

Species name	Common name	Biosecurity Act category
<i>Rhinella marina</i>	Cane Toad	
<i>Streptopelia chinensis</i>	Spotted Turtle-dove	
<i>Passer Domesticus</i>	House Sparrow	
<i>Bos sp.</i>	Cattle	
<i>Canis lupus familiaris</i>	Dog	Category 3, 4, 6
<i>Felis catus</i>	Cat	Category 3, 4, 6
<i>Oryctolagus cuniculus</i>	Rabbit	Category 3, 4, 5, 6
<i>Sus scrofa</i>	Pig	Category 3, 4, 6

14.6.4 Terrestrial Fauna – Field Survey Results

Overall, 266 terrestrial vertebrate species have been recorded across all surveys associated with the Project. This includes 234 terrestrial vertebrate species recorded during the 2011 and 2012 field surveys carried out across EPC 1029. The February 2017 baseline survey (focused on ML 80187) and subsequent site visits (carried out across the broader area in May 2017 to January 2018) recorded 198 species including 12 frog, 24 reptile, 134 bird and 28 mammal species, including 32 species not recorded in the earlier surveys. An updated list of species recorded during all surveys is provided in Appendix A9c – Ecological Desktop Search Results. The faunal community observed appears typical for a woodland landscape subject to cattle grazing. The total number of species recorded is likely to be an overestimation of that existing within the ML due to the wider ranging extent of the majority of the site studies.

14.6.4.1 Herpetofauna

Twelve frog species have been recorded within or near the ML across all site surveys. All are relatively widespread and common. The suite of frog species (nine in total) recorded in February 2017 was likely restricted in number and abundance due to the very dry conditions observed during the survey, where frog activity was largely restricted to wetlands / farm dams. The only species encountered at trap sites were Cane Toad (*Rhinella marina*) and Scarlet Pobblebonk (*Limnodynastes terraereginae*) (Plate 14-1).

A total of 29 reptile species were recorded within or near the ML over the surveys, with a further 11 species recorded across the wider region indicating the presence of a relatively diverse fauna, largely of common species. The community included three gecko species, 13 snakes, 13 skinks, four dragons, one pygopodid (legless lizard) (Plate 14-2), one blind snake and four freshwater turtles

(also refer to Chapter 15 – Aquatic Ecology). Eucalypt woodlands dominate the remnant vegetation within the Project area overall and most reptiles were observed or trapped in this habitat type. Sixteen species were recorded during the February 2017 survey of the ML. Most species were recorded on one or two occasions only. Bynoe's Gecko (*Heteronotia binoei*) was the only species commonly recorded throughout the area during habitat searches. Keelback or Freshwater Snake (*Tropidonophis mairii*) was commonly observed hunting around waterholes during spotlighting and during the day.



Plate 14-1: Scarlet Pobblebonk - trap site 2 (February 2017)



Plate 14-2: Brigalow Scaly-foot (*Paradelma orientalis*) - trap site TH3 (February 2012)

14.6.4.2 Birds

In general, the bird fauna assemblage observed during the surveys is typical of drier habitats, along with a range of wetland species that periodically use the abundant wetlands available across the wider area following wet periods. The bird fauna across the Project area is dominated by common and widespread species. The artificial grasslands dominating the MLs were relatively species poor during the February 2017 survey, but nevertheless supported species attracted to grasslands including Brolga (*Grus rubicunda*) and Australian Pipit (*Anthus australis*). The tall canopy and heavy understorey provided by creek line vegetation along Deep Creek and Tooloombah Creek provided a higher localised bird diversity within the landscape with a number of species not recorded elsewhere including Varied Triller (*Lalage lesuerii*), Little Bronze-cuckoo (*Chalcites minutilis*) and Lewin's Honeyeater (*Meliphaga lewinii*).

The site visit in early May 2017 followed heavy rainfall in March. This resulted in increased numbers of waterbirds in the area and more abundant bird life in general, with an additional 17 species recorded in the area that were not present in February including Great Egret (*Ardea modesta*), Australian Pelican (*Pelecanus conspicillatus*) and Eurasian Coot (*Fulica atra*). This also included species using the area during winter migration including Australian Reed-warbler (*Acrocephalus australis*) and Grey Fantail (*Rhipidura albiscapa*).

14.6.4.3 Mammals

Thirty-six mammal species were recorded on or near the MLs across all the site surveys. Macropods were generally abundant, particularly in the vicinity of remnant vegetation close to Deep Creek, where Agile Wallaby (*Macropus agilis*) and Swamp Wallaby (*Wallabia bicolor*) (Plate 14-4) were commonly encountered due to the shrubby cover provided. Remote cameras recorded six macropod species using woodland habitat in south of the ML. Eastern Grey Kangaroo (*Macropus giganteus*) were common in cleared habitat. No small ground mammals were trapped during the February 2017 survey although species such as Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*) and Common Planigale (*Planigale maculata*) were recorded during the September 2011 survey. Echidna

scats were commonly recorded at several sites during the 2011 surveys and several individuals were recorded on remote cameras in the south of the ML from September to December 2017 (Plate 14-3). Spotlighting surveys in 2017 recorded a range of species including Rufous Bettong (*Aepyprymnus rufescens*) and Water Rat (*Hydromys chrysogaster*) at farm dams, and two conservation significant arboreal species were encountered: Central Greater Glider and Koala.

The microbat fauna was relatively diverse with 15 species recorded during microbat call recording. No flying-fox species were recorded during the February 2017 survey likely due to the lack of flowering gums at the time. Both Little Red Flying-fox (*Pteropus scapulatus*) and Black Flying-fox (*Pterops alecto*) were recorded during the 2011 site surveys. No flying-fox species were recorded onsite.



Plate 14-3: Short-beaked Echidna captured on remote camera (November 2017)



Plate 14-4: Swamp Wallaby captured on remote camera (February 2017)

14.6.4.4 Conservation Significant Species Observed

From the 266 fauna species encountered across all surveys, 10 species are listed as conservation significant under the NC Act and / or EPBC Act, as outlined in Table 14-12:

- Ornamental Snake (Vulnerable NC Act and EPBC Act);
- Latham's Snipe (*gallinago hardwickii*) (Special Least Concern NC Act, Migratory EPBC Act);
- Squatter Pigeon (southern) (Vulnerable NC Act and EPBC Act);
- Oriental Cuckoo (*Cuculus orientalis*) (Special Least Concern NC Act, Migratory EPBC Act);
- Fork-tailed Swift (*Apus pacificus*) (Special Least Concern NC Act, Migratory EPBC Act);
- White-throated Needletail (*Hirundapus caudacutus*) (Special Least Concern NC Act, Migratory EPBC Act);
- Rufous Fantail (*Rhipidura rufifrons*) (Special Least Concern NC Act, Migratory EPBC Act);
- Koala (Vulnerable NC Act and EPBC Act);
- Greater Glider (Vulnerable NC Act); and
- Short-beaked Echidna (Special Least Concern NC Act).

Of these, six species are known to have been recorded within or close to the Project area: Squatter Pigeon, White-throated Needletail, Koala, Greater Glider, Latham's Snipe and Short-beaked Echidna. Locations of observations are provided in Figure 14-8.

Ornamental Snake was recorded 3.5 km west of the Project area in remnant Brigalow open forest during the 2011 survey. It has not been recorded within the ML despite targeted surveys in the 2012 fauna survey or over several site visits in 2017, although suitable habitat occurs. As such, this species is treated as 'likely to occur' in the Project area rather than 'known' to occur.

Glossy Ibis (*Plegadis facinellus*) is listed as Migratory (under the EPBC Act) and was recorded in estuarine / wetland habitat north of the current Project area during the 2011 / 2012 surveys. This species is considered as 'likely to occur' within the ML given the suitable wetland / dam habitat occurring in the Project area and local surrounds.

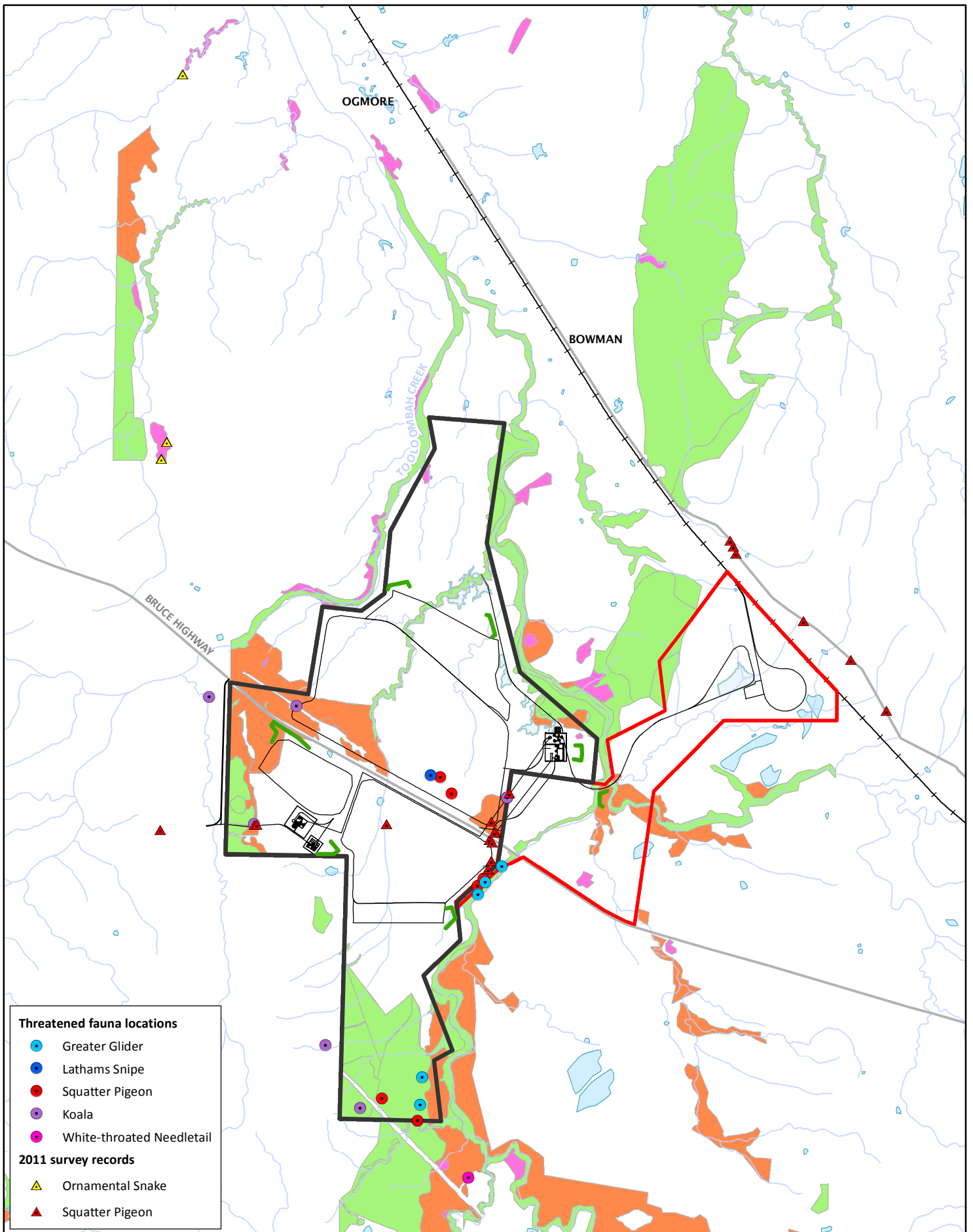
A further five species listed as conservation significant were recorded during the 2011 / 2012 site surveys in estuarine wetland habitat associated with the Styx River / Broad Sound area 14 km to the north of the ML:

- Eastern Curlew (*Numenius madagascariensis*) (Vulnerable NC Act, Critically Endangered and Migratory EPBC Act);
- Whimbrel (*Numenius phaeopus*) (Special Least Concern NC Act, Migratory EPBC Act);
- Bar-tailed Godwit (*baueri*) (*Limosa lapponica baueri*) (Special Least Concern NC Act, Vulnerable and Migratory EPBC Act);
- Gull-billed Tern (*Gelochelidon nilotica*) (Special Least Concern NC Act, Migratory EPBC Act); and
- Caspian Tern (*Hydroprogne caspia*) (Special Least Concern NC Act, Migratory EPBC Act).

There is no suitable estuarine habitat (mangroves or salt pans) for these species within or near the Project. The tern species may also occur over larger inland wetlands / dams but suitable sites do not occur within either ML as observed in February and May 2017. As such these species are not treated as 'known' or 'likely to occur' in the Project area and they are not considered further in this document. These species are discussed further in Chapter 16 - Matters of National Environmental Significance.

Descriptions of the above species are provided in the following sections where considered applicable.

CDM Smith has approached the predicted occurrence of conservation significant fauna species using a conservative approach. As such, analysis of impact has been based on the assumption that significant fauna species which have good quality habitat within the Project area and localised sighting records are present unless evidence to the contrary exists. An additional 18 conservation significant species listed under the NC Act and / or EPBC Act are considered to have some potential to occur sporadically within the study area (Figure 14-8). These species are; however, not considered to have core habitat in the Project area and as such are not expected to be impacted by the Project and are therefore not considered further.



- Threatened fauna locations**
- Greater Glider
 - Latham's Snipe
 - Squatter Pigeon
 - Koala
 - White-throated Needletail
- 2011 survey records**
- ▲ Ornamental Snake
 - ▲ Squatter Pigeon



0 0.5 1 km

Scale @ A4 1:70,000
 Date: 09/10/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Main Road

- North Coast Rail Line
- Watercourse
- Reservoir
- Dam

Field RE

- Least Concern
- Of Concern
- Endangered

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018
 QLD Department of Environment
 and Heritage Protection, 2016

Figure 14-8

Threatened fauna records –
 Project area survey results



Table 14-12 Likelihood of occurrence of conservation significant and migratory fauna

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Known				
Latham's Snipe (<i>Gallinago hardwickii</i>)	S	M	Occurs on swamp and marsh margins and in wet pasture (Pringle 1987).	Known. Up to 15 individuals observed at farm dam within the proposed mine area in February 2017. Single individual observed at large dam to the south of Project in September 2017. Single Wildlife Online record.
Oriental Cuckoo (<i>Cuculus optatus</i>)	S	M	Rainforest, vine thickets, wet sclerophyll forest and open forest and woodland (Higgins 1999).	Known. Recorded on March 2011 survey although sighting location unknown. May be occasional visitor to denser woodlands (such as riverine and adjacent woodland) in the Project area.
Squatter Pigeon - southern subspecies (<i>Geophaps scripta scripta</i>)	V	V	Dry grassy eucalypt woodlands and open forests, also Callitris and Acacia woodlands. Most birds live in sandy sites near permanent water (Frith 1982; Blakers et al. 1984; and Crome and Shields 1992). Often around cattle yards and other disturbed areas.	Known. Species observed on most surveys including within the ML. Species is relatively common in the wider area and there are 23 Wildlife Online database records.
Fork-tailed Swift (<i>Apus pacificus</i>)	S	M	An aerial non-breeding summer visitor, may occur over any habitat type, including cleared land and infrastructure.	Known. Recorded during the September 2011 survey although well to the northwest of the ML. Wide ranging aerial species which migrates from the northern hemisphere to Australia. May be occasional aerial visitor to the Project area in the summer months. Single Wildlife Online record from wider area.
White-throated Needletail (<i>Hirundapus caudacutus</i>)	S	M	An aerial non-breeding summer visitor may occur over any habitat type, including cleared land and infrastructure.	Known. Recorded on November 2017 survey adjacent to the southern ML. Wide ranging aerial species which migrates from the northern hemisphere to eastern Australia. May occur over the Study area in the summer months. No database records from wider area. EPBC Online search only.
Rufous Fantail (<i>Rhipidura rufifrons</i>)	S	M	Generally occur in dense vegetation, mainly in rainforests, but also in wet sclerophyll forests and other dense vegetation such as mangroves, drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	Known. Recorded on March 2011 survey although sighting location unknown. May occur throughout the Project area including regrowth Brigalow. Six database records from wider area. More likely in denser woodlands such as riverine and adjacent woodland.

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Greater Glider (<i>Petauroides Volans</i>)	C	V	May occur in a range of eucalypt dominated habitats from coastal areas to ranges. Needs large hollow-bearing trees for daytime roosting. Favours habitats with a diversity of eucalypt species (Kavanagh 1984).	Known. Two individuals recorded in woodland habitat (RE11.11.15a) in south of ML in February 2017. One individual recorded in riparian habitat (RE11.3.25) along Deep Creek south of the highway in November 2017. A further two individuals recorded in same area in June 2018. Also noted in February 2012 survey but no location provided. No database records from wider area. EPBC Online search only. Nearest records from mainland adjacent to Shoalwater Bay. Suitable habitat in southern and eastern extent of ML where continuous forest with large hollows remain.
Koala (<i>Phascolarctos cinereus</i>)	V	V	Feed almost entirely on eucalypts (Martin et al. 2008); most likely in riverine and riparian habitats.	Known. Scats recorded in both 2011 surveys. Species recorded on six occasions within ML in 2017 including Poplar Box (<i>Eucalyptus populnea</i>) woodland (RE11.4.2) (February and September 2017 and June 2018 surveys), Poplar Gum (<i>Eucalyptus platyphylla</i>) woodland (RE11.5.8a) (November survey) and on camera in Lancewood (<i>Acacia shirleyi</i>) woodland (October 2017) and Narrow-leaf Ironbark (<i>E. crebra</i>) woodland (RE 11.10.7). Forest Red Gum along creeks likely the most favoured habitat for this species although species evidently occurs in low population density throughout the area. Eleven Wildlife Online record from wider area.
Short-beaked Echidna (<i>Tachyglossus aculeatus</i>)	S		Occurs throughout Australia in almost all terrestrial habitats except for intensively managed farms. It shelters in logs, crevices, burrows and leaf litter (Menkhorst and Knight 2004; Augee 2008).	Known. Scats of this species observed at several sites within ML during 2011 surveys. Recorded in wider area in September 2017. Recorded within southern ML on several occasions on remote cameras (September to December 2017). Common and widespread species. Five Wildlife Online database records from wider area.
Likely				
Ornamental Snake (<i>Denisonia maculata</i>)	V	V	Occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands, such as Brigalow, and in riverine habitats, and lives in soil cracks and under fallen timber (Ehmann 1992; and Wilson 2015). Potential habitat is associated with REs 11.3.3, 11.4.3, 11.4.6, 11.4.8, 11.4.9 and 11.5.16 or where they occurred before clearing. (DSEWPac 2011).	Likely. Species has not been recorded within ML despite extensive targeted searches throughout 2017. Recorded on three occasions during the 2011 / 2012 fauna surveys. All specimens recorded in areas associated with remnant RE 11.4.9 outside of the current Project area: two records 3.5 km west and one record 5.8 km north-west of the ML. No Wildlife Online records from the wider area. A single ALA record located approximately 24 km north of the Project area. Soils in the Project area are generally suitable and gilgai habitat is widespread in the ML north of the Bruce Highway.

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Glossy Ibis (<i>Plegadis falcinellus</i>)	S	M	Terrestrial wetlands, preferring inland freshwater wetlands with abundant aquatic flora (Pringle 1985; and Marchant and Higgins 1990).	Likely. Recorded in 2011 north-west of the ML on estuarine sedge swamp. Seasonal wetlands and shallow dams in the Project area provide ephemeral habitat for this species. Single Wildlife online database record.
Potential				
Collared Delma (<i>Delma torquata</i>)	V	V	Occurs in soil cracks on heavy stoney soils west of Brisbane. Also recorded from Blackdown Tablelands west of Rockhampton. Known from REs on land zones 3, 9 and 10 including 11.3.2, 11.9.10, 11.10.1 and 11.10.4 (DotEE 2018).	Potential. No database records from wider area. EPBC Online search only. Nearest records from south of Rockhampton (approx. 145 km southeast of the Project) and Blackdown Tablelands. Project area lies on the northern edge of range where mapped as 'species or species habitat may occur' (DotEE 2018). Vegetation on land zone 10 occurs in the southern portion of the site (outside of Project footprint). Species is thought to be grazing sensitive as all Brigalow Belt records from ungrazed or rarely grazed areas (DERM unpubl data in DSEWPac 2011). The Project area has been subject to cattle grazing.
Yakka Skink (<i>Egernia rugosa</i>)	V	V	Occurs in dry forests, woodlands and rocky areas (Wilson 2015). Variety of drier forests and woodlands (usually on well drained, coarse gritty soils) including Poplar Box on alluvial soils, low ridges, Callitris on sands, Belah (Ehmann 1992; Cogger 2000; and Wilson 2015). Also occur in highly degraded sites and where there are log piles and rabbit warrens (EPA 2003).	Potential. Only sparse large woody debris is present in wooded habitat in the south of the ML and in habitat adjacent to Deep Creek in the vicinity of Site 4 (2017). No database records in near vicinity. Nearest record in Blackwater region approximately 100 km southwest of Project. EPBC online search only.
Dunmall's Snake (<i>Furina dunmalli</i>)	V	V	Rarely encountered. Occurs in a variety of habitats including forests to woodlands on sandy soils, cracking soils with Brigalow scrub, and dry vine scrub. Occurs in the Brigalow Belt in southeast inland Queensland.	Potential. No database records from wider area. EPBC Online search only. Species is on the northern edge of its range in this area. Nearest record to Project is from Mt Archer, Rockhampton and species previously recorded from Yeppoon (DotEE 2018). Most northerly record is from Clermont area over 400 km west of the Project. Suitable cracking clay substrate occurs in Project area although vegetation mostly cleared in this habitat.
Red Goshawk (<i>Erythrotriorchis radiatus</i>)	E	V	Endemic to northern and eastern Australia in coastal and subcoastal areas with large home ranges of up to 200km ² . Occurs in woodlands and forests and prefers mosaic habitats that hold a large population of birds and permanent water. Riparian areas are heavily favoured (Marchant and Higgins 1993).	Potential. Species has not been recorded within ML or local surrounds despite extensive searches throughout 2017. One ALA/Birdlife Australia database record (1999) from wider search area (18 km north-west of Project). Preferred riverine nesting habitat adjacent to Project area although local landscape is heavily cleared so generally unsuitable. Southern extent of ML remains well vegetated. Species may utilise Project area for foraging should it occur in the area.
Eastern Osprey (<i>Pandion cristatus</i>)	S	M	Mainly coastal habitats but can occur on inland rivers and lakes (Debus 2012).	Potential. Suitable habitat adjacent to Project area along Tooloombah Creek and Deep Creek. No database records. EPBC Online search only.

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Australian Painted Snipe (<i>Rostratula australis</i>)	V	E	Terrestrial shallow wetlands, ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, saltmarsh, dams, rice crops, sewage farms and bore drains (Marchant and Higgins 1993). Most likely in alluvial areas but could also occur in gilgaied areas.	Potential. Species has not been recorded within ML or local surrounds despite targeted searches at wetland/dam habitat throughout 2017. May be occasional visitor to dams in the Project area. Prefers shallow wetlands with adjacent vegetative cover for shelter. Very uncommon species that occurs erratically over eastern and northern Australia. Three database records from wider region recorded on wetlands to the north of Project area associated with the Broad Sound region (including St Lawrence wetlands) where the species is known to occur.
Curlew Sandpiper (<i>Calidris ferruginea</i>)	S	CE	All of these species are generally found on wetland habitat along the coast including tidal flats, salt pans and sewage ponds. They also occur on nearby coastal freshwater / brackish wetlands and less commonly on inland wetlands (Pizzey and Knight 2012).	Potential. There are limited database records from the wider area for all of these species (Species known from roost sites in western Broad Sound). Preferred estuarine habitat does not occur on or near the Project area, however these species occasionally occur on inland freshwater wetlands close to the coast, particularly during migration periods.
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	S	M		
Common Greenshank (<i>Tringa nebularia</i>)	S	M		
Marsh Sandpiper (<i>Tringa stagnatilis</i>)	S	M		
Red-necked Stint (<i>Calidris ruficollis</i>)	S	M		
Gull-billed Tern (<i>Gelochelidon nilotica</i>)	S	M	Similar to the above species. Generally coastal habitats but may occur well inland. As well as wetlands can be found on grasslands, crops and ploughed fields where it forages for insects.	Potential. Recorded on September 2011 survey although sighting location unknown. Dams / wetlands within the Project area are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas (known from Broad Sound).
Caspian Tern (<i>Hydroprogne caspia</i>)	S	M	Mostly coastal habitats but also inland terrestrial wetlands including lakes, reservoirs and large rivers (Higgins and Davies 1996).	Potential. Recorded on 2012 survey to the north of the Project area associated with estuarine habitat. Dams / wetlands within the Project area are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas (known from Broad Sound).
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	S	M	Satin Flycatchers are mostly found in coastal forest, favouring wet forests, moist gullies and watercourses (Higgins et al. 2006).	Potential. This species may occasionally utilise the Study area during autumn / spring migrations. No database records. EPBC online search only.

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
<p>Spectacled Monarch (<i>Symposiachrus trivirgatus</i>)</p> <p>Black-faced Monarch (<i>Monarcha melanopsis</i>)</p>	S	M	Both species generally occur mostly in dense vegetation, mainly in rainforests, but also in wet sclerophyll forests and other dense vegetation such as mangroves, drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	Potential. There are limited WildNet database records for these species from the wider area. In general, the habitat in the Project area is open, dry and unsuitable. More suitable (dense) habitat occurs along the adjacent creek lines. Species may utilise the Project area during autumn / spring migrations.
Northern Quoll (<i>Dasyurus hallucatus</i>)	C	V	Formerly occurred in a variety of habitats across northern Australia and Queensland. Now most common in rocky eucalypt woodland and open forest within 200 km of the coast (Menkhorst and Knight 2004).	<p>Potential. No Wildlife Online or ALA database records from the search area (EPBC Online Search only). Nearest records are 65 km west in the Middlemount area (1969 record) and in Stanage Bay 110 km and 130 km to the northeast (1929 record and 1990 record). The nearest recent records are in Homevale National Park (2011 records) 170 km to the northwest and the Mt Morgan area (2000 record) 120 km to the southeast.</p> <p>The south-west corner of the ML may provide suitable habitat where a rocky jump-up occurs providing potential den habitat in the form of rock crevices on crest of jump-up. Species requires access to permanent freshwater and none is nearby (nearest waterhole approximately 1.5 km). This area occupies approximately 25 ha within the ML boundary and adjoins a large area of contiguous woodlands that remain tenuously connected to more suitable habitat to the west (rocky ranges). Remote camera traps (baited) were located in this area from September to December 2017 (total of 400 trap nights) with no records of the species occurrence.</p>

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Grey-headed Flying-fox (<i>Petropus poliocephalus</i>)	C	V	Nomadic species that generally roosts at sites near water and within 50 km of the coast generally with rainforest, paperbark or casuarina species. Generally occurs further south but regular roost site found near Finch Hatton (Eungella area) in recent years (Roberts et al. 2008).	<p>Potential. No database records from the wider area. Little Red and Black Flying-fox have been recorded during the 2011 / 2012 surveys. Black Flying-fox was observed roosting at a large colony site in the township of Marlborough 50 km southeast of the Project. A survey of the colony found no other species resident at the time. There are no roost sites where the species is known to occur in the region surrounding the Project. Current DotEE (2018) data on monitored flying-fox roosts indicates that Finch Hatton (200 km north of the Project) is the nearest roost regularly utilised by the species. They have been recorded using a roost at Middlemount (96 km west of the Project) in 2014 but not during subsequent surveys. To the south the species has been recorded at roost sites in the Bundaberg area (approximately 350 km south of the Project).</p> <p>There is a low potential for the species to forage in the Project area during eucalypt flowering periods given the Project area lies in the northern extent of its accepted range. There is potential roost habitat adjacent to the Project area along Tooloombah Creek and Deep Creek although no camp sites were observed or are known from the wider area.</p>
Ghost Bat (<i>Macroderma gigas</i>)	V	V	One of the largest microbat species in the world. Roosts in shallow caves, abandoned mines and rock piles. Australia's only carnivorous bat (Churchill 2008).	<p>Potential. No database records from wider area. EPBC Online search only. Well known maternity colony known to occur at Mt Etna caves approximately 90 km southeast of Project area. No suitable habitat observed within mine disturbance area but jump-up at southern extent of ML may provide suitable rocky crevices for roosting.</p>
Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>)	V	V	Species has been recorded roosting in disused mine tunnels, rock overhangs, caves and Fairy Martin (<i>Petrochelidon ariel</i>) nests (Eyre et al. 1997; Thompson 2002). Appears to be closely associated with the presence of sandstone escarpment country for roost sites.	<p>Potential. No database records from search area. EPBC Online search only. Records from the 1990s to the east of the Project area associated with the mainland adjacent to Shoalwater Bay. No suitable habitat observed within mine disturbance area but jump-up at southern extent of ML may provide suitable rocky crevices for roosting.</p>
Unlikely				
Pale Imperial Hairstreak (<i>Jalmenus eubulus</i>)	V		Species is confined to vegetation communities containing mature Brigalow which the larvae feed on (Valentine and Johnson 2012).	<p>Unlikely. Suitable habitat for this species restricted to single small patch (0.61 ha) of mature Brigalow in mine area. Two database records from the wider area.</p>

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Southern Snapping Turtle (<i>Elseya albagula</i>)	E	CE	Occurs in Fitzroy, Mary and Burnett Rivers and associated drainages in southern coastal Queensland. Prefers flowing, clear well-oxygenated waters. Occurs in lower densities in rivers with intermittent flows (TSSC, 2014).	Unlikely. Styx River catchment is separated from the Fitzroy Basin. Two Wildlife Online records from wider area are located over 30 km south on Marlborough Creek and the Mackenzie River both of which are part of the Fitzroy Basin. Creek lines in the Styx River basin are largely ephemeral with only sporadic flow events following heavy rainfall. The species was incorrectly identified as occurring during aquatic ecology surveys throughout the wider area in 2011. Confirmed by Col Limpus (DES) as being incorrectly identified.
Fitzroy Turtle (<i>Rheodytes leukops</i>)	V	V	Known only from the Fitzroy Basin. The species prefers large pools and connecting flowing riffle habitats with clear water. It generally does not move far within its home range. It is known to feed on aquatic insect larvae, freshwater sponges and Ribbonweed (<i>Valisneria</i> spp.) (Tucker et al. 2001).	Unlikely. Uncertain whether species occurs in Styx catchment which is separated from the Fitzroy Basin. Five Wildlife Online records from wider area, all located in the Fitzroy Basin. Nearest records are located over 70 km south of the Project and associated with Marlborough Creek (part of the Fitzroy Basin).
Collared Delma (<i>Delma torquata</i>)	V	V	Occurs in soil cracks on heavy stoney soils west of Brisbane. Also recorded from Blackdown Tablelands west of Rockhampton. Known from REs on land zones 3, 9 and 10 including 11.3.2, 11.9.10, 11.10.1 and 11.10.4 (DotEE 2018).	Unlikely. No database records from wider area. Nearest record from south of Rockhampton. No suitable habitat within Project area. EPBC Online search only.
Grey Falcon (<i>Falco hypoleucos</i>)	V		Occurs sparsely in the interior and the north of the Australian mainland found in semi-arid and arid woodlands, grasslands and wooded watercourses (Debus 2012).	Unlikely. Single database record from wider area. Very likely to be vagrant record. Habitat is unsuitable and species does not occur in region.
Beach Stone-curlew (<i>Esacus magnirostris</i>)	V		Species inhabits sandy beaches, especially where sandflats, mudflats or reefs are exposed at low tide, and are often around river mouths (Marchant and Higgins 1993).	Unlikely. Four database records from wider area. However, there is no suitable habitat for this species on or near the Project area.
Eastern Curlew (<i>Numenius madagascariensis</i>)	V	CE, M	Mainly forage on intertidal mudflats and sandflats and occasionally ocean beaches, and roost on sandy spits and islets, in mangroves and saltmarsh, and along high water mark on beaches (Higgins and Davies 1996).	Unlikely. All three species recorded in western Broad Sound area well to north of the current Project during the 2011 / 2012 fauna surveys. Several Wildlife Online records from the wider area for all three species. There is no suitable estuarine / marine habitat for these species located within or near the current Project area.
Whimbrel (<i>Numenius phaeopus</i>)	S	M	Occurs on coastal mudflats, coral cays, estuaries, sewage ponds and sometimes flooded grasslands or paddocks. Roosts in mangroves (Pizzey and Knight 2012).	

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Bar-tailed Godwit (<i>baueri</i>) (<i>Limosa lapponica baueri</i>)	S	V, M	Mainly occurs in coastal habitats such as tidal flats, estuaries, lagoons, bays and harbours. Sometimes occurs on brackish wetlands, saline flats or sewage farms located near coast (Higgins and Davies 1996). May occur on larger waterbodies in inland areas.	
Western Alaskan Bar-tailed Godwit (<i>Limosa lapponica menzbieri</i>)	S	CE, M	Subspecies migrates from breeding grounds in North America. Same habitat as Bar-tailed Godwit (<i>baueri</i>) (which migrates from Siberian region). In Australia this subspecies occurs in north-western Australia.	Unlikely. No database records. EPBC Online search only. Species does not occur in this region of Australia.
Greater Sand Plover (<i>Charadrius leschenaultia</i>)	S	V	These are shorebird species that occur on intertidal habitats in sheltered coastal areas. Species such as Great Knot and Curlew Sandpiper may occasionally occur on inland wetlands. The extensive Broad Sound wetland area is known to support nationally important populations of several migratory shorebird species including Great Knot and Terek Sandpiper (Bamford et al. 2008).	Unlikely. There are database records for these species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km upstream of the northern boundary of the Project area. Preferred habitat does not occur on or near the Project area.
Lesser Sand Plover (<i>Charadrius mongolus</i>)	S	E		
Red Knot (<i>Calidris canutus</i>)	S	E		
Great Knot (<i>Calidris ferruginea</i>)	S	CE		
Grey Plover (<i>Pluvialis squatarola</i>)	S	M		
Terek Sandpiper (<i>Xenus cinereus</i>)	S	M		Unlikely. There are no database records for these species from the wider area. EPBC online search only. Preferred habitat does not occur on or near the Project area. Known from western Broad Sound.
Grey-tailed Tattler (<i>Tringa brevipes</i>)	S	M		
Crested Tern (<i>Thalasseus bergii</i>)	S	M	Largely coastal species that may also occur on tidal rivers and larger inland rivers (Pizzey and Knight 2012).	Unlikely. No database records. EPBC online search only. No suitable habitat present for this species (recorded in western Broad Sound downstream from Project area).

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
Little Tern (<i>Sternula albifrons</i>)	S	M	Coastal species that also occurs on coastal waterbodies such as brackish lakes, salt fields and sewage ponds (Pizzey and Knight 2012).	Unlikely. No database records. EPBC online search only. No suitable habitat present for this species (records from Turtle Island in Broad Sound downstream of Project area).
Black-breasted Button-quail (<i>Turnix melanogaster</i>)	V	V	Cryptic species that occurs in dry rainforest and vine-thickets with abundant leaf-litter. They have also been recorded in Brigalow, Belah and Bottle-tree scrubs, and in eucalypt forests with a dense understorey including Lantana (Marchant and Higgins 1993).	Unlikely. Three database records located 18 km east of Project area. No potential habitat within ML. Very marginal habitat along Tooloombah Creek where understorey of vine thicket occurs in a narrow band along steep creek bank. No evidence of presence (i.e. platelets) was observed during surveys.
Glossy Black-cockatoo (<i>Calyptorhynchus lathami</i>)	V		Feeds exclusively on the cones of she-oaks. In the Brigalow Belt the species feeds on Belah. Needs large hollows for nesting (Higgins and Davies 1996).	Unlikely. Preferred forage tree species occur along Deep Creek and Tooloombah Creek (River She-oak) but suitable habitat within the Project area is heavily disturbed and unsuitable. Single Wildlife Online record from wider area.
Yellow Chat (Dawson) (<i>Epthianura crocea macgregori</i>)	E	CE	Occurs on marine plain wetlands in the Fitzroy River Delta, Torilla Plains and Curtis Island in central Queensland (Houston et al. 2004; Jaensch et al. 2004). Requires grassland, dense beds of rush or sedge, bare mud and / or shallow water, and patches of Samphire (Houston et al. 2004).	Unlikely. 50 Wildlife Online database records from wider area. These records are likely to be associated with the extensive Torilla Plains located approximately 40 km east of the Project area. There is no suitable marine habitat in or near the Project area.
Black-throated Finch (southern) (<i>Poephila cincta cincta</i>)	E	E	Occurs in grassy open woodlands near water. Prefers areas of intact woodlands with a variety of native grasses for year-round feeding. Nests in large trees, sometimes in tree hollows and arboreal termite nests.	Unlikely. Suitable grassy woodland habitat exists however, Project area is southeast of the species current known range. No database records. EPBC online search only.
Star Finch (<i>Neochmia ruficauda ruficauda</i>)	E	E	Occurs mainly in dense, damp grasslands bordering wetlands and watercourses, as well as open grassy woodlands near permanent water. Forages for seeds in tall native grasses (Higgins et al. 2006).	Unlikely. Although once widespread this species is now very rare. Project area is south of the species current known range. No database records. EPBC online search only.
Yellow Wagtail (<i>Motacilla flava</i>)	S	M	Occurs on sort grass and bare ground on swamp margins, salt marshes and sewage ponds near coast (Pizzey and Knight 2012).	Unlikely. No database records. EPBC online search only. May occur on the edge of dams in Project area. Very occasional visitor to Queensland.

Species	Status*		Habitat preference	Likelihood of occurrence
	NC Act	EPBC Act		
South-eastern Long-eared Bat (<i>Nyctophilus corbeni</i>)	V	V	Occurs in a variety of dry forest habitats including River Red Gum, open woodland, mallee, brigalow and other arid and semi-arid habitats. The preferred habitat is Mallee and Callitris woodlands (Pennay et al 2011), and habitats that have a distinct canopy with a dense, cluttered understorey (Turbill and Ellis 2006). It roosts in tree hollows or under bark (NSW NPWS 2003). Surveys suggest the species requires large tracts of forest to occur (Turbill et al. 2008).	Unlikely. The Project area is located substantially north of its current known distribution. The nearest available records for this species (either DES or ALA records) are three records (in 2002 and 2014) located over 280 km to the south within open forest in Expedition Range NP and near the Dawson River. Churchill (2008) notes the distribution of the species is largely restricted to the Murray Darling Basin and western slopes of the GDR from south central Queensland. DotEE (2018) note the species is largely recorded in the Brigalow Belt South Bioregion in Queensland which lies well south of the Project area. No database records. EPBC Online search only.
Water Mouse (<i>Xeromys myoides</i>)	V	V	Occurs in mangroves, saltmarsh, sedge lakes near foredunes and coastal freshwater swamps. Requires relatively large areas of intertidal flats over which to forage (Gynther and Janetzki 2008).	Unlikely. No database records from wider area. No suitable habitat within or near Project area. EPBC Online search only.

*Status abbreviations: NC Act - C = Least Concern, S = Special Least Concern, NT = Near Threatened, V = Vulnerable, and E = Endangered; EPBC Act - Ex = Extinct, M = Migratory, V = Vulnerable, and E = Endangered.

14.6.4.5 Conservation Significant Fauna Species Profiles – Threatened Species

The following section provides an overview of the pertinent ecological information for each of the conservation significant species considered likely or known to occur within or near to the Project area.

Squatter Pigeon (southern) (*Geophaps scripta scripta*)



Plate 14-5: Squatter Pigeon recorded during Project surveys (March 2011)

Status: Vulnerable – NC Act and EPBC Act

Occurrence in the study area: Recorded during every site survey including within ML 80187, although mostly south of Bruce Highway (Figure 14-8, Plate 14-5). Although there appears abundant suitable habitat within the ML it is noted the species was encountered in the same locations during successive survey periods in 2017 and 2018. The species was mainly observed in pairs or as individuals but groups of up to six individuals recorded. The species is not associated with particular REs and was often recorded in cleared habitat.

Ecology and habitat: The Squatter Pigeon is largely terrestrial, foraging and breeding on the ground. The southern subspecies occurs mainly in dry grassy eucalypt woodlands and open forests (Frith, 1982; Crome and Shields, 1992). It also inhabits *Callitris* and *Acacia* woodlands and was reported from open plains in its historical southern range (Frith, 1982). Most birds live in sandy sites near permanent water (Blakers et al., 1984). Squatter Pigeons dust-bathe and are often encountered on dirt tracks and in areas of bare soil denuded of ground cover by livestock (Frith, 1982; Higgins and Davies, 1996). Although they remain common in heavily grazed country in tropical Queensland (Reis 2012) they are typically more common in ungrazed land compared to grazed land (Woinarski and Ash, 2002; Reis 2012). This species is largely granivorous although insects are seasonally important in the diet and some insects (Reis 2012).

Distribution and breeding: This subspecies was historically found from the Dubbo region in New South Wales north to the Burdekin River area in Queensland. There have been no official records in New South Wales since the 1970s. Although the species has declined greatly in southern Queensland in the past it appears this decline has slowed, and the species now persists over a wide area and can be locally abundant in central Queensland (Garnett et al. 2011) where groups of up to 30 individuals can still be seen (Reis 2012).

Breeding is poorly known but does appear to be greatly influenced by rainfall. The nest is a shallow depression on the ground usually sheltered by a bush or log (Reis 2012). The total population size is estimated at 40,000 breeding birds and is thought to occur as a single continuous interbreeding population. This estimate is considered to be of low reliability. Numerous recent records from the Injune / Canarvon Range region suggest that individuals from this area are part of this population. South of this area and Tin Can Bay on the coast the subspecies has become fragmented (DotEE 2015).

Important populations of the Squatter Pigeon have been identified as those isolated and sparsely distributed sub-populations that occur south of the Carnarvon Ranges in central and southern Queensland including:

- Populations occurring in the Condamine River catchment and Darling Downs of southern Queensland;
- Populations occurring in the Warwick-Inglewood-Texas region of southern Queensland; and
- Any population that may potentially occur in NSW (Squatter Pigeon Workshop 2011).

No populations have been identified as being especially important to the long-term survival or recovery of the Squatter Pigeon (southern).

Threats: Much of the original habitat in Queensland has been replaced with pasture for livestock (Higgins and Davies 1996). Threats to existing populations include clearing and fragmentation of habitat, overgrazing by livestock and feral herbivores, trampling of nests by livestock and feral animals, predation by cats and foxes, and illegal shooting (NSW NPWS 2003).

Greater Glider (*Petauroides volans*)



Plate 14-6: Greater Glider (Source: Brett Taylor 2017)

Status: Vulnerable – EPBC Act only.

Occurrence in the study area: Two individuals were recorded during spotlighting surveys of the site in February 2017. The individuals were recorded in the continuous tracts of eucalypt woodland that characterise the southern portion of ML 80187 and well to the south of the closest disturbance area. Another individual was observed in riparian Forest Red Gum on Deep Creek in December 2017

which remains connected to the woodlands further south. Two individuals were recorded in the same area in June 2018 (see Figure 14-8). There are no database records of the species occurrence from the wider area surrounding the Project. Suitable habitat within or near the Project is likely to be restricted to this area due to the extensive clearing carried out elsewhere (Plate 14-6).

Ecology and habitat: Greater Gliders are typically found in mature eucalypt forests and woodlands with a variety of eucalypt species and a high density of large tree hollows (van der Ree et al. 2004). Its diet is largely composed of eucalypt leaves and sometimes flowers. Large hollows in old trees are favoured as shelter sites during the daytime (Goldingay 2012). Sites with a high abundance of suitable hollows appear to support higher populations. The species uses relatively small home ranges of 1 ha – 4 ha in more productive forests (Gibbons and Lindenmayer 2002), but up to 16 ha in more open and dry habitats (Smith et al. 2007).

Distribution and breeding: The species occurs across eastern Australia in a broad swathe of territory associated with the Great Dividing Range. It is known to occur from north Queensland (Atherton Tablelands) to central Victoria.

Females breed in their second year giving birth to a single young each year (March to June). Their low birth rate may cause isolated populations in small forest fragments to be vulnerable to extinction (van der Ree et al. 2004).

Threats: Greater Glider is thought to be particularly sensitive to forest clearing / logging and forest fragmentation. They appear to have a poor dispersal ability being relatively restricted to intact forests / woodlands. They are thought to be susceptible to major disturbances such as frequent or intense fires (TSSC, 2016). Climate modelling suggests the species may be threatened by potentially increased temperatures associated with climate change, particularly populations in north Queensland (Kearney *et al.*, 2010).

Koala (*Phascolarctos cinereus*)



Plate 14-7: Koala recorded on remote camera in south of ML (November 2017)

Status: Vulnerable – NC Act and EPBC Act.

Occurrence in the study area: The species was observed in Narrow-leaved Ironbark remnant woodland within ML 80187 during spotlighting for the February and September 2017 site surveys and in Poplar Gum woodland in November 2017. Two individuals recorded on remote camera in the south of the ML (Plate 14-7), but outside of the proposed disturbance areas.

The central eastern and western portion of the ML is dominated by tracts of Narrow-leaved Ironbark (RE 11.5.1) which is considered a secondary forage tree. Forest Red Gums are considered primary feed trees (Australian Koala Foundation 2015) and occur in narrow bands along creek lines including the drainage line that crosses the ML north of the Bruce Highway. The Forest Red Gum habitat in the local area (RE 11.3.4 and 11.3.25) is likely to be the most favoured habitat for this species.

Ecology and habitat: Koalas have a distinct association with eucalypt woodland and forest habitat types containing suitable food trees (Hume and Esson, 1993; Moore and Foley, 2000; and Martin et al. 2008). Koala's are not necessarily restricted to bushland or remnant areas and are known to exist and breed within farmland and the urban environment (Dique et al. 2004). Similarly, movement is not confined to vegetated corridors, as they also move across cleared rural land and through suburbs (Martin et al. 2008). They use a variety of trees, including many non-eucalypts, for feeding, shelter and breeding purposes (Dique et al. 2004; and Martin et al. 2008).

They are known to have localised preferences throughout their range, selecting some tree species over others (Pahl and Hume 1990). They are also known to favour individual trees and this has been suggested to be a response to a variety of factors including high leaf moisture content, high leaf nitrogen content (which is often related to low fibre content making leaves more palatable) and low levels of chemical compounds which are expressed by eucalypts to resist herbivory (Pahl and Hume 1990; Hume and Esson 1993; and Moore and Foley 2000).

Distribution and breeding: Koalas occur throughout northeast, central and southeast Queensland, extending south through Victoria into South Australia and Kangaroo Island. Breeding occurs in spring / summer when males become territorial, attacking and fighting rivals and using loud bellows to advertise their presence (Martin et al. 2008). Young permanently leave the females pouch after seven months but continue to ride on the mothers back until 12 months and the beginning of a new breeding season. After this time adolescent females may remain in the natal habitat, but males generally disperse to new territories between one to three years of age (Dique et al. 2003; and Martin et al. 2008).

Threats: Current threats to Koalas include habitat destruction and fragmentation, bushfire and disease. Populations around urban / populated areas are also at increased risk of mortality due to dog attack and road strike (Maxwell et al. 1996).

Ornamental Snake (*Denisonia maculata*)



Plate 14-8: Ornamental Snake recorded during Project surveys (March 2011)

Status: Vulnerable – NC Act and EPBC Act.

Occurrence in the study area: There are suitable cracking clay soils within the Project area north of the Bruce Highway (Figure 14-8, Plate 14-8) where regrowth Brigalow occurs including extensive gilgai formations. No individuals were observed during the Project surveys despite targeted surveys (trapping, habitat searches and spotlighting) within the Project area in February 2012 and February, July and November 2017.

Two individuals were recorded in remnant Brigalow habitat (RE 11.4.9) 3.5 km west of the northern boundary of ML 80187 in September 2011. One individual was recorded in Brigalow habitat (RE 11.4.9) along a minor drainage line approximately 5.8 km north-west of the northern boundary of ML 80187 in March 2011.

Ecology and habitat: Ornamental snake occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands in Brigalow, Gidgee (*Acacia cambagei*), Blackwood (*A. argyrodendron*) or Coolabah dominated vegetation communities associated with moist areas, particularly gilgaied landscapes. It also occurs in modified grassland associated with gilgais, and lake margins and wetlands (Melzer 2012). The species has been recorded in the following REs, none of which occur in the Project area: 11.4.6, 11.4.8, 11.4.9, 11.3.3 and 11.5.16 (DotEE 2015).

Ornamental snake requires microhabitat shelter sites such as soil cracks, rocks, human debris (e.g. corrugated iron sheeting) and under fallen timber. It is a nocturnal species and feeds almost entirely on frogs, though lizards may very occasionally be eaten (Ehmann 1992; Wilson 2015). They are known to congregate around waterholes and temporary pools where frogs are abundant. They are most likely to be encountered following heavy summer rains (Melzer 2012). Gilgais are a known important habitat for the species and the presence of remnant vegetation is not required for the species to occur (DSEWPac 2011).

Distribution and breeding: The species occurs in the eastern half of the central and northern Brigalow Belt, mainly in the Fitzroy and Burdekin Basins. High population densities are known from the Isaac River (Dysart, Moranbah and Nebo) and Dawson River catchments (Melzer 2012).

Threats: Threats to ornamental snake include: habitat clearing and fragmentation; altered water quality and hydrology affecting gilgai and wetland habitat; habitat degradation by cattle and exotic weed species; predation by feral species; and consuming cane toads. The species is generally not found in areas with high numbers of cane toads (Melzer 2012).

14.6.4.6 Conservation Significant Fauna Species Profiles – Other Species

Glossy Ibis (*Plegadis falcinellus*)

Status: Special Least Concern – NC Act; Migratory – EPBC Act.

Recorded in the wider area to the north of the Project on a brackish swamp associated with the Styx River marine plains during the September 2011 survey. The Project area is likely to provide suitable habitat, particularly following heavy rainfall.

The Glossy Ibis is a widespread species, occurring throughout the northern hemisphere and over much of Australia. This species breeds in dense colonies, often with other species of ibis and waterbirds (Marchant and Higgins 1990). Outside of the breeding season, the species is nomadic, seeking suitable foraging areas. It feeds on aquatic invertebrates and occurs in terrestrial wetlands, preferring inland freshwater wetlands with abundant aquatic flora (Pringle 1985; and Marchant and Higgins 1990). Core breeding habitat for the species is within the Murray-Darling Basin (New South Wales and Victoria), the Macquarie Marshes in NSW and in southern Queensland.

Latham's Snipe (*Gallinago hardwickii*)

Status: Special Least Concern – NC Act; Migratory – EPBC Act.

This species was recorded at a single farm dam on Mamelon Station in February 2017. Several visits to the site were made to ascertain the number of individuals present. Up to 15 individuals were recorded. Individuals were recorded on farm dams in the wider area in November 2017 and January 2018.

Latham's Snipe is a secretive species that occurs in swamp and marsh margins and in wet pasture, feeding mainly on earthworms and insect larvae (Pringle 1987). Latham's Snipe breeds mainly in Japan, arriving in northeast Queensland during the northern winter and then moving south through the coastal / sub-coastal areas of southeast Queensland into much of eastern Australia during spring / summer (Pringle 1987; and Pizzey and Knight 2012). The species does not breed in Australia. It has been recorded in Australia from the Cape York Peninsula through South Australia. The species may occur around shallow wetlands and farm dams in the Project area.

Fifteen individuals is an unusually high number for this species on a relatively small site (approximately 0.6 ha in extent). The species was not recorded elsewhere within the Project area during the February 2017 survey and no other migratory shorebird / wader species was recorded within the ML. The Commonwealth's *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (DotEE 2015) treats Latham's Snipe differently to the other migratory shorebirds listed under the EPBC Act due to the different habitats and behaviour of the species. The Guideline states that important habitat for the species may be identified where:

- Areas that have previously been identified as internationally important for the species; and
- Areas that support at least 18 individuals of the species (DotEE 2015).

Six important sites have been identified in Australia located in Victoria (five sites) and Tasmania (one site) (DotEE, 2018). The Project is not considered as 'important habitat' for Latham's Snipe.

Oriental Cuckoo (*Cuculus optatus*)

Status: Special Least Concern – NC Act; Migratory – EPBC Act.

A single record of this species 1.3 km east of the ML during the March 2011 survey.

Oriental Cuckoo breeds in China, Japan and Mongolia in the northern summer. It migrates south to the Australasian region. It is widespread but sparsely recorded across eastern Queensland in the summer months (September to May). The species may occur in a wide range of habitats including relatively cleared areas such as leafy trees in paddocks (Pizzey and Knight 2012).

White-throated Needletail (*Hirundapus caudacutus*) and Fork-tailed Swift (*Apus pacificus*)

Status: Special Least Concern – NC Act; Migratory – EPBC Act.

White-throated Needletail was recorded in the south of the ML in November 2017. Fork-tailed Swift was recorded during 2011 and 2012 surveys of the wider area.

The White-throated Needletails and Fork-tailed Swift are widespread over eastern and south eastern Australia during the warmer months. Both species breed in eastern Asia and spend the non-breeding season mainly in Australia, and occasionally in New Guinea and New Zealand (Blakers et al. 1984; and Higgins 1999). White-throated Needletail arrives in eastern Australia in late October moving south along both sides of the Great Dividing Range as far south as Tasmania. Fork-tailed Swift also arrives in October but may occur throughout Australia (Higgins 1999). Both are aerial foraging species and can occur over most habitats including heavily disturbed areas. They are commonly associated with storm fronts. White-throated Needletail is likely to be more common in the Project area; however, both species may occur.

Rufous Fantail (*Rhipidura rufifrons*)

Status: Special Least Concern – NC Act; Migratory – EPBC Act.

A single record of this species during March 2011 survey. Most suitable habitat for this occurs along Deep Creek and Tooloombah Creek.

Rufous Fantails occur in moist habitats, including closed forests, coastal scrubs, mangroves and along watercourses and gullies, and urban / rural areas during mid-year migration (Pizzey and Knight 2012; Higgins et al. 2006). They predominantly feed on small insects within the understorey (Higgins et al. 2006). The species occurs across Northern Australia from the Kimberley to Cape York and down the entire eastern coast (Pizzey and Knight 2012). The eastern races migrate to the north in early Autumn and return in early Spring to breed (Pizzey and Knight 2012; Higgins et al. 2006).

Short-beaked Echidna (*Tachyglossus aculeatus*)

Status: Special Least Concern (culturally significant) – NC Act.

Scats and diggings attributable to this species were encountered on all surveys of the area. Several individuals recorded on long-term remote cameras in the south of the ML from September to December 2017. The species is likely to occur within eucalypt and acacia woodlands throughout the wider area.

The Short-beaked Echidna is, with the Platypus and the Long-beaked Echidna (*Zaglossus bruijnii*) of New Guinea, the only three extant species of monotreme, a group of mammals believed to have

diverged early in the evolution of mammals, possibly about 200 million years ago (Augee 2008). The Short-beaked Echidna is specialised for feeding on ants, termites and beetle larvae. It occurs in almost all terrestrial habitats except for intensively managed farms. The species is active both by day and night and shelters in logs, crevices, burrows and leaf litter (Menkhorst and Knight 2004; and Augee 2008). This species occurs throughout Australia and can be expected in all well forested areas. Mating takes place in July and August with juveniles seen from September (Augee 2008). Short-beaked Echidnas are killed by dingoes / dogs and motor vehicles.

14.6.4.7 Exotic Fauna Species Observed

Six introduced terrestrial vertebrate species were recorded within the Project area and surrounds during 2017 surveys: Cane Toad (*Rhinella marina*); Common Myna (*Acridotheres tristis*), Cat (*Felis catus*); European Rabbit (*Oryctolagus cuniculus*); Dingo (*Canis lupus dingo*) and Pig (*Sus scrofa*). House Mouse (*Mus musculus*) was recorded in traps in 2011 / 2012. Four of these species (Rabbit, Feral Cat, Dingo and Pig) are declared Class 2 pest species under the *Land Protection (Pest and Stock Route Management) Act 2002*.

14.6.5 Habitat Values for Terrestrial Fauna

Habitat type is a significant factor in the composition of the fauna species assemblage of a given area. Two habitat components are especially important: physical structure and resource availability.

Structure refers to the abundance and complexity of the vegetation, debris and substrate. Habitats with thick ground cover, abundant shrubs and many large trees are complex in vertical structure and provide abundant sheltering sites in dense leaf litter, dense foliage, under loose bark and in tree hollows. Horizontal habitat complexity refers to characteristics such as the presence of ground plant species, open areas, fallen timber and rock crevices that provide sheltering opportunity for terrestrial species. Habitats with higher vertical and horizontal complexity (generally with a diverse plant species assemblage) tend to be more structurally complex due to the different growth forms of different species. In addition, the availability and variety of resources (food, water and mates) affect the number and type of vertebrate species inhabiting an area. Habitats with abundant and variable resources tend to support more species, while the presence of preferred dietary items will facilitate the presence of particular taxa. However, habitat usage will be variable with certain species utilising habitats dependent upon seasonal conditions or in response to a specific event such as recent rainfall or mass flowering events.

Four principal fauna habitat types were present within the Project area and surrounds:

- Eucalypt open woodland to open forest;
- Brigalow open forest (remnant / regrowth);
- Farm dams / wetlands; and
- Non-remnant grassland with scattered trees and shrubs on previously cleared areas.

14.6.5.1 Eucalypt Open Forest to Woodland

Eucalypt woodlands dominate the remnant vegetation remaining within the Project area and surrounds. Eucalypts provide seasonal food resources for nectar-feeding birds and flying-fox and abundant nest / roost sites in the form of tree hollows for birds (such as parrots), microbats, possums, gliders and other small mammals. In general, the bird fauna recorded during the site surveys were restricted to widespread and commonly occurring species. Woodland habitat provides suitable values for Squatter Pigeon, particularly where sandy soils and permanent water occurs nearby (such as farm dams).

Narrow-leaved Ironbark woodland (RE 11.4.2) dominates the middle of the mine lease both north and south of the highway (Plate 14-9). Although Narrow-leaved Ironbark dominates, a number of other species also occur including Poplar Box and Ghost Gum. Where larger trees occur, this habitat will provide abundant tree hollows although mature trees appear scarce. This habitat generally appears impacted by cattle access. Generally, there is very little to no understorey in this habitat and large fallen timber is relatively sparse providing little cover for ground fauna. The grass layer is a mixture of native species and Buffel Grass. Koala and Greater Glider have been recorded in this habitat during Project surveys. In the western portion of the ML (in the vicinity of fauna trap site 4) a more varied woodland dominated by Poplar Gum occurs on sandy soils. This habitat provides a scattered shrub layer dominated by Lantana and Red Ash and abundant large woody debris providing potential shelter for a variety of ground fauna including reptiles and native rodents.

Narrow-leaved Ironbark also dominates the relatively continuous tracts of woodland in the southern portion of ML 80187, although the steeper, rocky section in the far southern corner of the ML becomes dominated by Lancewood (Plate 14-10). Other tree species commonly present include Ghost Gum and Clarkson's Bloodwood (*C. clarksonia*). Greater Glider was recorded in this area, well to the south of the nearest disturbance area, indicating mature trees with large hollows occur. The shrub layer is generally sparse, although Lantana becomes more common (sometimes dense) in the vicinity of drainage lines and in more disturbed areas adjacent to clearing. Large fallen timber is sparse throughout providing limited potential shelter opportunities. The ground layer is made up of largely native grass species providing a relatively continuous cover suitable for species such as Eastern Chestnut Mouse (*Pseudomys gracilicaudatus*).



Plate 14-9: Poplar Box woodland where Koala was recorded (February 2017)



Plate 14-10: Rocky ridgeline with Lancewood in southeast corner of ML

Riparian open forest featuring Forest Red Gum (RE 11.3.25) occurs along Deep Creek and Tooloombah Creek (largely outside of the mine ML). It also occurs within ML 80187 along a tributary of Deep Creek north of the highway, although this is a very narrow and degraded strip of vegetation. Adjacent floodplain woodland (RE 11.3.4) occurs in the east of the ML and is continuous with riparian vegetation associated with Deep Creek (Plate 14-11). These forests provide the most varied habitat values in the area. The canopy is multi-storeyed and relatively diverse including Moreton Bay Ash, Swamp Mahogany, large *Melaleuca* species and River She-oak (along the creeks). There is a patchily dense shrub layer which tends to be dominated by the introduced Lantana and Rubber Vine. Similarly, the ground layer is also dense in areas where the shrub layer is less developed. Large woody debris is generally abundant in these habitats.

The multilayered nature of these forests provides abundant foraging and sheltering values for a wider range of bird species than is found elsewhere on the site. The banks of Tooloombah Creek (Plate 14-12) and patchy sections along Deep Creek are often dominated by a patchy understorey of dry rainforest tree / shrub species providing additional seasonal fruiting resources. A range of

smaller bird species (such as fantails and scrubwrens) will utilise the dense shrub layer despite the dominant weed species often present. The dense shrub and grass layer may provide shelter for a range of ground fauna including frogs and reptiles, small and medium-sized mammals such as Planigale (*Planigale maculata*), and Northern Brown Bandicoot (*Isodon macrourus*) and Fawn-footed Melomys (*Melomys cervinipes*), both of which were only recorded in this habitat on Tooloombah Creek. Macropods including Agile Wallaby and Swamp Wallaby (*Wallabia bicolor*) were commonly disturbed in this habitat adjacent to Deep Creek in the eastern portion of ML 80187. Particularly along the creek lines this habitat features abundant large tree hollows for glider species and possums where mature trees remain and is favoured foraging habitat for Koala.



Plate 14-11: Red Gum open forest adjacent to Deep Creek



Plate 14-12: Western bank of Tooloombah Creek with dry rainforest understorey

14.6.5.2 Brigalow Open-forest (remnant / regrowth)

Only a single small patch of remnant Brigalow open-forest habitat (RE 11.4.9) occurs in the western portion of ML 80187. This is a small patch at 0.61 ha and is unlikely to provide substantial habitat value for fauna. A second larger patch (3.37 ha) is located in the southern portion of ML 700022 to the east of Deep Creek. However, much of the ML located north of the Bruce Highway occurs on cracking clay soils with extensive but patchy areas of regrowth generally 3 m to 5 m in height (Plate 14-13). Brigalow is the dominant species in the very patchy canopy with a scattered lower shrub layer of vine thicket species. Much of the regrowth areas occurs on cracking clay soils with gilgai formations of varying depth. Following heavy rains these areas may provide habitat for a variety of wetland birds, frog species as well as Ornamental Snake.

This habitat may provide suitable foraging values for a variety of smaller forest bird species that prefer a closed canopy and dense low vegetation such as fantails and fairywrens. There is abundant shelter for ground fauna (particularly reptiles) in the form of low shrubs, although large fallen timber is very sparse.

14.6.5.3 Farm Dams / Wetlands

There are a number of wetlands of varying size across the ML. The majority of these have been artificially created ('turkey nest' dams and dammed creek lines). A large seasonal wetland occurs in the western portion of the site (Plate 14-14). Analysis of aerial imagery indicates large portions of the ML are likely to retain water for substantial periods following heavy rains. Conditions were very dry at the time of the February 2017 survey, but water was still present throughout ML 80187. Many of these waterbodies appear relatively shallow, providing suitable habitat for a range of wetland bird species and amphibians. During the survey periods, these wetlands supported a diversity of waterbirds, including Plumed Whistling-duck (*Dendrocygna eytoni*), Wandering Whistling Duck (*D. arcuata*), a range of other duck and heron species, Little Black Cormorant (*Phalacrocorax*

melanoleucos), Brolga (*Grus rubicunda*), Purple Swamphen (*Porphyrio porphyrio*) and Eurasian Coot as well as less common species such as Cotton Pygmy-goose (*Nettapus coromandelianus*). The February 2017 survey recorded several Latham's Snipe (Migratory – EPBC Act) congregated around a vegetated farm dam. Waterbodies with abundant vegetative cover may provide habitat for shy species such as rails and Australian Painted Snipe. These areas will also provide resources for birds reliant on the presence of permanent water such as pigeon and parrot species.



Plate 14-13: Regrowth Brigalow north of highway



Plate 14-14: Large ephemeral wetland in eastern ML (May 2017)

14.6.5.4 Non-Remnant Vegetation

Non-remnant grassland areas dominate large portions of the proposed mine impact area, much of the haul road and the TLF. Within the ML these areas are generally dominated by introduced pasture grasses, including Buffel Grass. South of the highway there are few and scattered taller shade trees within this habitat, which remains largely clear of trees (Plate 14-15). Habitat to the north of the highway remains patchily vegetated with regrowth composed largely of Brigalow and Poplar Box. The haul road and TLF are located mainly to the east of Deep Creek. This area remains mostly cleared but is vegetated in patches with sparse stands of taller Narrow-leaved Ironbark (Plate 14-16) or Forest Red Gum which have been subject to tree-thinning (and are thereby non-remnant).

With limited structural and floristic diversity, non-remnant grassland habitats supported limited fauna diversity in comparison to remnant habitats but provided habitat for certain grassland dependent fauna species such as Eastern Grey Kangaroo (*Macropus giganteus*), Australian Bustard (*Ardeotis australis*), Horsfield's Bushlark (*Mirafra javanica*) and Australasian Pipit (*Anthus novaeseelandiae*). Sparsely treed habitat to the east of Deep Creek will provide additional habitat, largely to a range of widespread bird species that occur in open woodland habitats.



Plate 14-15: Typical cleared habitat south of highway



Plate 14-16: Sparsely treed habitat within haul road

14.7 Potential Impacts on Environmental Values

The Project has the potential to impact terrestrial EVs and MSES, including threatened flora and fauna, vegetation communities and other ecological values within the Study area. These include:

- Remnant vegetation (including Of Concern and Endangered communities);
- Populations of threatened flora and fauna;
- Habitat for threatened flora and fauna; and
- Ecological functioning (e.g. habitat connectivity).

Throughout the construction, operation and decommissioning phases, the Project has the potential to impact on these ecological values through the following activities:

- Removal of remnant vegetation for the MIA, spoil dump areas, dams, open cut pits, TLF and haul road;
- Topsoil stripping;
- Construction of above ground buildings and facilities;
- Day and night time operation of coal mining activities;
- Stockpiling and transportation of the coal resource; and
- General transportation movements.

14.7.1 Vegetation Clearing

The Project will require the clearing of remnant vegetation for the following Project components: Open Cut Pit 2; waste rock stockpile areas (1b and 2); Dam 1; environmental dams (Dam 1b and Dam 2d); haul and access roads; the coal conveyor; and power supply corridor (see Figure 14-9). Remnant vegetation may provide habitat for fauna and flora listed as threatened under the NC Act and / or EPBC Act (also listed as an MSES). Vegetation communities listed as Of Concern, Endangered, wetlands or considered as watercourse vegetation (under the VM Act) are listed as MSES.

The layout of the proposed mine and associated infrastructure has been revised since the publication of the EIS. The Project layout has decreased by approximately 110 ha in extent (total of 1,124.8 ha) and overall clearing of remnant vegetation (as ground-truthed) has decreased. The changes have resulted in the avoidance of Endangered REs (SEVT and Brigalow communities) and decreased impact to Greater Glider habitat (defined as continuous habitat in which the species has been located on-site). The revised Project layout and ground-truthed remnant vegetation on the site is depicted in Figure 14-9). The projected extent of vegetation clearing for the Project including potential impacts to habitat for threatened fauna and flora species is presented in Table 14-13. Only those species considered 'likely' or 'known' to occur are considered (refer to Table 14-12).

Based on ground-truthed vegetation mapping, clearing activities within the revised mine layout are predicted to impact 108.22 ha of remnant vegetation (24.87 ha of Least Concern and 83.35 ha of Of Concern vegetation). Of this, vegetation clearing for the haul road and Environmental Dam 2d is predicted to impact 0.33 ha of Least Concern and 3 ha of Of Concern vegetation where these components impact vegetation along Deep Creek and Barrack Creek. The TLF is located in heavily cleared lands and will not impact any remnant vegetation. The previous layout as described in the EIS predicted an overall impact to 138.41 ha of vegetation.

This does not include vegetation communities outside the western boundary of the mine ML through which the new access road for Mount Bison Road and the CHPP / MIA 1 areas will traverse (refer Figure 14-9). The vegetation in this area has not been subject to ground-truthing. The proposed access road occupies approximately 4.4 ha of lands in the following DNRME mapped REs: 11.4.2 (1.8 ha); and RE 11.5.8a / 11.7.2 (2.6 ha).

Table 14-13 Proposed vegetation clearing of ground-truthed remnant and non-remnant vegetation

RE	VM Act Status	Threatened species habitat	Original impact (EIS) (ha)	Impact area revised (SEIS) (ha)	Total within a 10 km radius of Project (ha)*	Total within Marlborough Plains subregion (ha)*
11.3.4	Of Concern	Koala – core foraging habitat Greater Glider – may provide hollow-bearing habitat where it occurs next to continuous woodlands in the south of the mine ML	7.92	0.6	925.5	10,042.1
11.3.11	Endangered	None	0.4	0	5.22	112.9
11.3.25	Least Concern	Koala – core foraging habitat Greater Glider – may provide hollow-bearing habitat where it occurs next to continuous woodlands in the south of the mine ML Ornamental Snake – may provide habitat where it occurs within the ML adjacent to cleared / regrowth Brigalow habitat	28.1	21.27	1,332.4	2,955.8
11.3.27	Least Concern	Koala – core foraging habitat available in surrounding trees (Forest Red Gum)	-	2.2		575.8
RE	VM Act Status	Threatened species habitat	Original impact (EIS) (ha)	Impact area revised (SEIS) (ha)	Total within a 10 km radius of Project (ha)*	Total within Marlborough Plains subregion (ha)*
11.3.35	Least Concern	Koala – secondary foraging habitat Squatter Pigeon – species may forage in this habitat.	N/A	1.4		98.8
11.4.2	Of Concern	Koala – secondary foraging habitat Squatter Pigeon – species may forage in this habitat.	94.84	82.75	2,058.6	6,121.3
11.4.9	Endangered	Ornamental Snake - species may forage in this habitat.	0.2	0	182.7	517.2
11.10.7	Least Concern	Koala – supplementary feeding habitat Greater Glider - species known to occur nearby Squatter Pigeon – species may forage in this habitat.	6.84	0	362.6	1,840
11.11.15a	Least Concern	Koala – supplementary feeding habitat Greater Glider - species known to occur nearby Squatter Pigeon – species may forage in this habitat.	0.11	0	513.5	88.4
Non-remnant vegetation			1,093.4	1,016.58	37,232.3	543,487.3

*Data source: DNRME, 2017

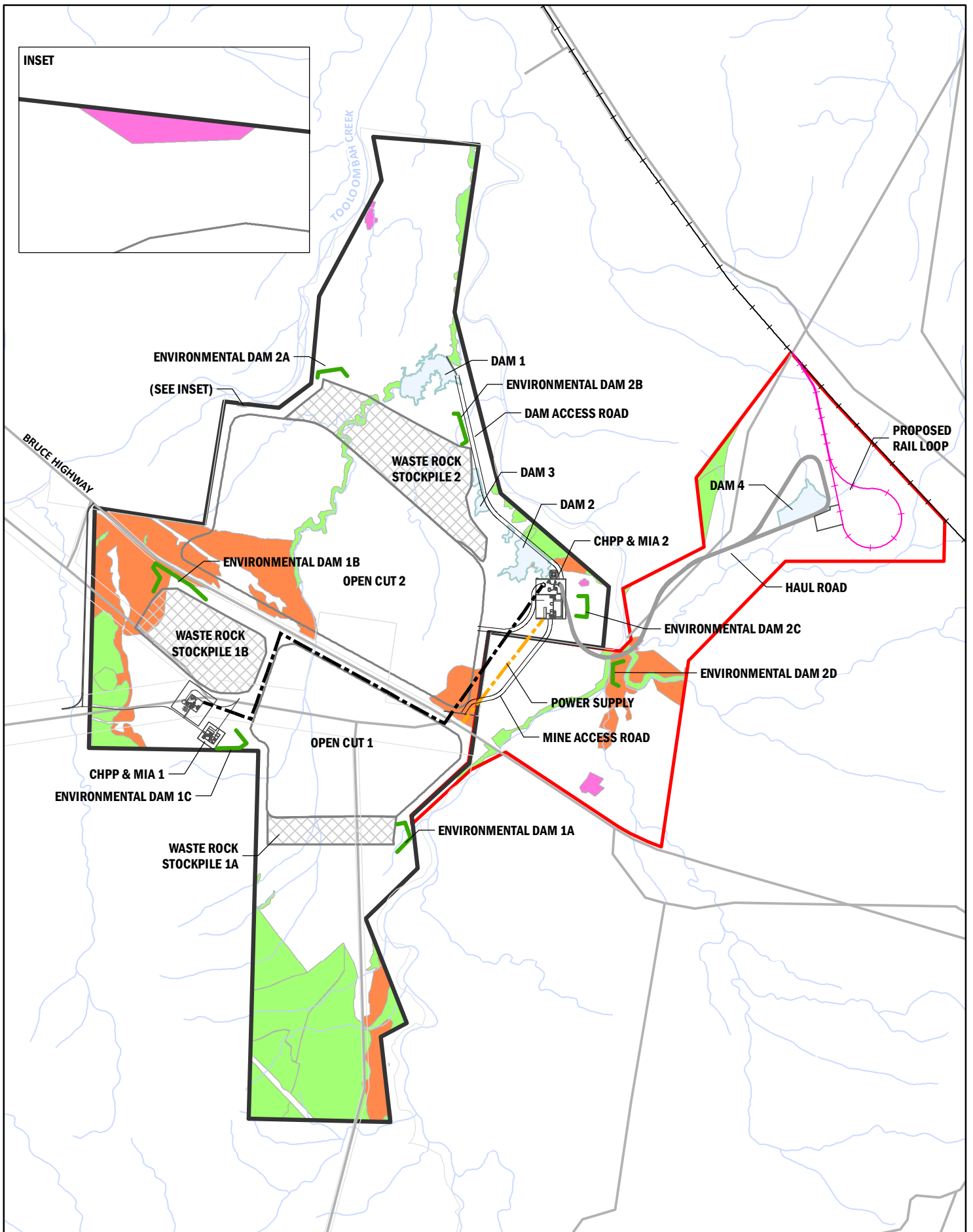


Figure 14-9

Mine infrastructure layout and existing remnant vegetation



0 0.5 1 km

Scale @ A4 1:50,000
 Date: 21/11/18
 Drawn: Gayle B.

Legend

- Haul Road
- Mine infrastructure
- Overland Conveyor
- Power
- Rail Balloon Loop
- Mine Access Road
- ML 80187
- ML 70022
- Open-cut Mine Pit
- Waste Rock Area
- Environmental Dams
- Main Road
- North Coast Rail Line
- Watercourse
- Dam

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018



14.7.2 Habitat Connectivity

Terrestrial habitat connectivity may be disturbed as a result of the Project by obstructing movement of fauna across the open cut pits, spoil areas and dams. The mine area largely occupies already cleared lands and does not sever any existing connections between tracts of continuous remnant vegetation. Lands to the immediate east of the ML are largely cleared. A relatively continuous tract of vegetation extending in a north-south orientation located to the immediate west of the ML is not impacted by the Project. The mine area presently consists of a mosaic of cleared grazing land and some woodland and is unlikely to be used as a corridor by fauna, except for some large, highly mobile species that utilise open grassland such as kangaroos.

The haul road has the potential to reduce north-south remnant habitat connectivity along Deep Creek connecting patchy eucalypt woodlands in the northeast of the ML to large habitat patches to the south and east. However, it is noted that riparian habitat along both Deep Creek (and a tributary that enters the main creek upstream of the proposed crossing point) is already intersected by the Bruce Highway to the south of the haul road maintaining an existing vegetation gap of approximately 25 m. The remainder of the haul road, TLF and rail loop is located in cleared or sparsely treed non-remnant lands which is unlikely to be used as a corridor for the majority of fauna. Impacts to landscape connectivity because of the Project activities are considered minor at worst.

The layout of the Project and its potential impact on landscape habitat connectivity was assessed using DES' 'Landscape Fragmentation and Connectivity' tool. The results of the assessment indicate no significant impact is expected (for output refer Appendix A9g – Results for Landscape Fragmentation and Connectivity).

14.7.3 Direct Fauna Mortality

Direct mortality of native fauna may occur because of the Project during habitat clearing and through vehicle collisions. Mortality during habitat clearing will be managed through the presence of a qualified fauna spotter. It is anticipated that vehicle collisions caused by an increase in local traffic may pose a longer-term risk to native fauna.

14.7.4 Dust

Increased dust resulting from excavations, topsoil stripping, vehicle movement, open cut mining activities, construction of infrastructure and from coal stockpiles has the potential to impact flora and fauna values within the Project area throughout construction and operation. Increased dust can result in respiratory issues in fauna, adverse impacts on plant photosynthesis and productivity (Chaston and Doley 2006), changes in soil properties ultimately impacting plant species assemblages' (Farmer 1993), and mortality and / or decrease in aquatic health on aquatic communities from the toxicity of poor water quality. Evidence of potential impacts on entire vegetation communities is scarce. Many studies focus on specific impacts to single species. Recent research on threatened flora in a semi-arid environment in Western Australia found no significant impact on plant health as a result of a range of dust accumulation loads caused by vehicle movements (Matsuki et al. 2016).

The deposition of (unpaved) road dust on nearby freshwater wetlands caused by heavy traffic increases due to energy development projects found minimal impact on water quality or soils (Creuzer et al. 2016). However, the actual impacts on wetlands or wetland vegetation from coal dust deposition, as (opposed to increased atmospheric dust) appear little studied.

As shown on the revised layout for the mine (see Figure 14-9) the coal conveyor is no longer located along Deep Creek. Vegetation along Deep Creek in the vicinity of the Project area has potential to be

impacted during construction works for infrastructure (such as access roads), the CHPP / MIA 2 area, and the raw water dam which is located within 500 m of Deep Creek. Operational Project components located close to extant vegetation includes Open Cut 1 and Waste Rock Stockpile 1a (200 m to 300 m from Deep Creek), Open Cut 2 (north-west corner adjacent to Tooloombah Creek and south-west corner adjacent to eucalypt woodland), and Waste Rock Stockpile 2 (adjacent to both Tooloombah and Deep Creeks). It is important to note that mining activities in the Open Cut Pits and Stockpile areas will be sequential and will include rehabilitation of mined areas as the Project progresses.

Vegetation in the vicinity of Project activities has potential to be impacted during construction works for infrastructure such as access roads, Environmental Dam 2d and the raw water dam (Dam 1). This includes Tooloombah Creek and Deep Creek and the adjacent Tooloombah Creek Conservation Park (considered a Category A ESA under the EP Act). The haul road also crosses Deep Creek, although there are no large, permanent pools on Deep Creek at, or near, the proposed haul road crossing point. Dust emitted during coal transport may have a minor potential to impact riparian vegetation associated with Deep Creek where it occurs adjacent to the haul road. Refer to Chapter 12 – Air Quality for further information.

The predominant wind directions from the region are as follows: from the north and northeast during spring; north, northeast and southeast during summer; in autumn, the winds are primarily from the southeast; and southerly and southeast winds are more frequent during the winter season. Modelling of potential dust particle deposition resulting from both Project construction and operation activities showed the areas most likely to be impacted were receptor points located to the direct west of the Project (Tooloombah Creek service station) and in the Ogmoo area to the north of the Project (refer Chapter 4 – Climate for more information).

The Tooloombah Creek service station lies adjacent to Tooloombah Creek Conservation Park. Terrestrial ecological values to the north of the Project have been severely degraded by vegetation clearing with extant remnant vegetation restricted to narrow riparian lines along Tooloombah and Deep Creeks and Styx River. Nevertheless, the modelled dust impacts to these areas were minimal in comparison to the natural background dust concentration and all concentrations were below air quality criteria set by the State under the Environmental Protection (Air) Policy 2008 (refer Chapter 4 – Climate of the EIS for more information).

The Styx River and coastal wetland areas associated with Broad Sound are located to the north of the township of Styx which is approximately 10 km north of the Project. The closest modelled sensitive receptor to this location is Ogmoo township, which is approximately 5 km closer to the Project. The maximum predicted daily dust deposition generated by the Project activities at this sensitive receptor is 0.02 mg/m²/day which is much lower than the threshold criteria of 120 mg/m²/day. Therefore, dust deposition impacts from the Project on the wetlands and waters of Broad Sound are considered negligible at worst.

Significant fauna habitat and threatened remnant vegetation is largely well removed from potential sources of dust. However, vegetation associated with Tooloombah Creek and Deep Creek is located relatively close to several components of Project infrastructure. Deep Creek is intersected by the haul road. These areas may provide habitat for Koala.

Dust impacts to terrestrial ecological values (including MSES) may occur, through the deposition of coal dust during Project operational activities, although the impact is expected to be minor at worst.

14.7.5 Noise

Understanding of the impacts of noise on fauna is limited. There are no current government policies or guidelines that recommend thresholds or limits in relation to fauna. Noise may adversely affect wildlife by interfering with communication, masking the sound of predators and prey, causing stress or avoidance reactions, and in some cases, may lead to changes in reproductive or nesting behaviour. Excessive noise may lead some species to avoid noisy areas, potentially resulting in the fragmentation of species habitat. Radle (2007) states the consensus that terrestrial fauna will avoid any industrial plant or construction area where noise or vibration presents an annoyance to them. Additionally, many animals react to new noise initially as a potential threat, but quickly 'learn' that the noise is not associated with a threat (Radle 2007).

Noise will be generated by the Project through the use of machinery, plant, vehicles, and blasting. The generation of construction and operational noise will largely be in cleared areas adjacent to intact riparian communities (RE 11.3.25) along Deep Creek and adjacent floodplain vegetation (RE 11.3.4) which may provide habitat for Koala. Potential operational noise sources include the northern waste rock stockpile and infrastructure including the CHPP / MIA, site access road and the haul road which are adjacent to this habitat.

Squatter Pigeon may also occur in woodland habitat in the south and west of the Project which lie adjacent to the open cut operations and the Waste Rock Stockpile 1b. Individuals that occur on the site are expected to leave the area of impact. During operation, the species may become habituated to adjacent habitat following completion of construction disturbance.

14.7.6 Lighting

Artificial lighting from infrastructure and machinery may impact fauna within the Project area during construction and operation. Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups. Rodents may avoid brightly lit areas at night. Frogs and nocturnal reptiles may congregate at artificial lights to feed on insects attracted to light (Perry et al. 2008). Similarly, many microbat species may congregate at artificial lighting (Rich and Longcore, 2006), although other species may avoid well-lit areas (Threlfall et al., 2013). Species such as Sugar Glider (*Petaurus breviceps*) have been experimentally shown to reduce foraging time under artificial lighting (Barber-Meyer, 2007), although whether this effect occurs in natural situations is unknown. Known impacts on birds include disruption of migratory patterns and choice of nest sites (Longcore and Rich, 2004).

There are few if any studies to suggest the fauna inhabiting the woodland around the Project area will be impacted to more than a minor extent. As suggested by the evidence above there will be differing responses between species or taxa groups with some responses considered quite benign (e.g. microbats and other taxa attracted to night lighting). Habitat around the Project area is largely cleared or woodland with a limited suite of species present. Significant fauna habitat nearest to the CHPP / MIA 2 area is likely to be Forest Red Gum habitat which may support Koala. This species was also observed onsite in Poplar Box woodland which will remain adjacent to the open cut operations. Non-remnant areas containing regrowth Brigalow and gilgaid habitat surrounding the CHPP / MIA 2, Open Cut 2 and Waste Rock Stockpile 2 may provide habitat for Ornamental Snake. Squatter Pigeon occurs in woodland as well as cleared grassy habitat in the area but it is uncertain what impact lighting will have on this species. Koala may occur, although given the species occurs in suburban habitats Project lighting is not expected to impact this species. With informed lighting design, this habitat will be at a distance where light levels would have attenuated to levels where they are unlikely to be causing a significant impact to fauna.

14.7.7 Fire

Due to the combustibility of coal, mining operations are at risk of fire. The Project is located within a mosaic of cleared grasslands and remnant woodlands which have the potential to be impacted by fire. Threatened communities such as Brigalow and Semi-evergreen Vine Thicket are sensitive to fire impact. However, the open and grazed nature of much of the habitat is considered likely to reduce the potential for catastrophic fires resulting in large scale tree mortality. Nevertheless, the site is located within the vicinity of continuous vegetation to the west (including Tooloombah Creek Conservation Park) and site-specific fire management measures will be developed and implemented to manage these risks.

14.7.8 Pests and Weeds

Pests and particularly weeds may pose a significant threat to flora and fauna within the Project area. Much of the habitat already contains a high proportion of introduced grass species and woody weeds (Lantana and Rubber Vine) because of the long farming history within the Project area. Olive Hymenachne was observed at several wetland sites. Other problem weed species such as Parthenium, also toxic to cattle, is presently limited in extent, having been recorded on Tooloombah Creek and Deep Creek. Any potential unmitigated weed introductions or spread of existing weeds and pests as a result of Project activities may therefore pose a significant risk to the productive capacity of the adjacent land-use, to less developed vegetated areas of the site, and surrounding areas which include Tooloombah Creek Conservation Park. The transportation and operation of construction vehicles and equipment has the potential to introduce pests and weeds into the Project area.

Waste has the potential to impact flora and fauna because of attracting pests and vermin through the supply of artificial food sources. This may impact on natural behaviour and natural species assemblages. Waste will be managed to the highest standards, and a range of waste minimisation strategies will be in place to reduce waste streams generated. As such, it is not anticipated that waste generated as part of the Project will have a significant impact on flora and fauna communities within the Project area.

14.7.9 Accidental Release of Pollutants

The release of pollutants into the surrounding environment and waterways has the potential to degrade stream habitat quality near the site, degrade stream water quality and thereby impact vegetation communities and terrestrial fauna utilising these areas. Without mitigation, potential exists for contaminants to enter waterways including: contaminated mine dewatering runoff; contaminated runoff from waste rock stockpiles; aqueous waste streams including oily waste water (from heavy equipment cleaning); contaminated runoff from chemical storage areas; potentially contaminated drainage from fuel oil storage areas; and general washdown water.

During operations, the creeks are not anticipated to be directly impacted by surface water runoff from Project facilities (such as the CHPP / MIA areas) as runoff will be captured in a number of environmental dams for re-use or treatment.

The majority of the Project lies within the catchment of Deep Creek which is located approximately 200 m to 300 m from the eastern edge of the Open Cut 1, and 500 m from the south east corner of Open Cut 2. Other potential sources of pollutants include the CHPP / MIA 2 area which is located approximately 500 m from Deep Creek. Waste Rock Stockpile 1a is located approximately 250 m west of Deep Creek. Waste Rock Stockpile 2 lies within 300 m of both Tooloombah Creek and Deep Creek. These areas have potential to release contaminated run-off in the creek (refer Figure 14-9).

14.7.10 Groundwater Drawdown

The Project area is dominated by shallow alluvial aquifers which are intersected by deeply incised ephemeral creeks. Recharge to this system is from direct rainfall, leakage from the creeks during surface flow events and from the underlying units. A review of groundwater bore information and GDEs in the Project area indicates the water table reaches the rooting depth of riparian vegetation along Tooloombah Creek and Deep Creek (RE 11.3.25) and the alluvial community adjacent to Dams 2 and 3, Environmental Dam 2d and Deep Creek (RE 11.3.4). These communities are described as potential 'terrestrial' Type 3 GDEs and are only referred to in this chapter (for information on other 'aquatic' GDEs occurring on the site refer to Chapter 15 – Aquatic Ecology). Elsewhere (i.e. away from watercourse), the water table is deeper, generally >10 mbgl and it is unlikely that groundwater forms a large proportion of terrestrial GDEs water requirements, if at all.

Modelling of the potential drawdown effect of the open cut mine operations has been updated based on the collection of further groundwater data since the EIS and SEIS including the establishment and sampling of 16 Project monitoring bores installed from September 2017 to March 2018. A further 30 Project monitoring bores have been installed in September and October 2018. These have been specifically located to provide greater coverage around the Project (for groundwater heads and quality), especially near to watercourses to assess potential for groundwater and surface water interactions and vertical hydraulic gradients between shallow and deeper hydrostratigraphy. There is now greater confidence in the modelling results as summarised in the following sections and described in detail in Chapter 10 – Groundwater.

Impacts to GDEs may result if they are exposed to a direct effect of mining, primarily altered groundwater quantity (drawdown, head and baseflow) and altered interactions between groundwater and surface water (and connected systems). The scale of the direct effect, both spatially (i.e. the extent of a GDE that is exposed to an adverse impact) and temporally (the length of time the GDE is exposed to that impact), combined with the GDE's capacity to adapt to altered conditions (i.e. its resistance and resilience), determines the level of threat. For example, an ecosystem reliant on surface expression of groundwater that is exposed to a significant reduction in baseflow, even if only for a short period of time may result in a high level of threat, as it may not be resilient to that change. Conversely, a terrestrial vegetation ecosystem that is exposed to a significant drawdown in water table, even for a long period of time (e.g. several years) may result in a low level threat, as they are able to utilise other sources of water e.g. soil reservoir.

The magnitude of drawdown caused by mine dewatering ranges up to >100 mbgl although this is restricted to the area around the pits and within ML 80187. This occurs within the first five years of mine operation, and may persist for up to 20 years post-mining. Further decline in the groundwater levels propagates outwards from the mine pits and particularly to the north-west the north-west creating an oval shaped region of impact that is effectively confined to the Quaternary sediments.

The 0.1 m potentiometric surface drawdown contour extends to a maximum of approximately 5.5 km north-west of the mine (but does not intercept the Styx River). The maximum drawdown extent occurs at 10 years post mining (Figure 14-10) and after 25 years post-mining, the groundwater system begins to recover back to pre-mining conditions, with regional groundwater flow occurring to the north, and local groundwater flow occurring to the watercourses. Fifty years following closure the predicted extent of the 0.1 m and 1 m drawdown contours have begun to shrink back towards the decommissioned and back filled pits, and by year 100 into closure the groundwater system is predicted to have fully recovered to the pre-mining status.

Targeted sampling for GDEs within or adjacent to the Project area indicate there is some potential for groundwater to support Forest Red Gum woodland fringing drainage lines (RE 11.3.25), and Forest Red Gum woodland on alluvial plains (RE 11.3.4) (where water tables are less than 10 mbgl) during dry periods, although the results of the study are inconclusive (refer Section 15.6.4 of Chapter 15 – Aquatic Ecology).

Type 3 GDEs (RE 11.3.25 and RE 11.3.4) occur along or adjacent to the riparian zones of Tooloombah and Deep Creek. The water requirements of these vegetation communities may include multiple sources of water including soil water stores, seasonal soil water from surface water flow and groundwater. The proportion of water use from each source making up the water requirements will influence the vegetation community's resistance to changes in groundwater. For example, if the predominant source of water use is soil water, then changes to groundwater may be less likely to adversely impact the vegetation community.

The water requirements of GDEs relevant to the Project area is uncertain. It is; however, assumed that vegetation communities along riparian areas, where the depth to groundwater varies from around 10 mbgl along creek banks to 0 mbgl (i.e. at ground surface) within creek beds, are likely to utilise groundwater during dry periods when the soil water reservoir becomes depleted (i.e. seasonally). In terrestrial areas (i.e. away from riparian zones), the depth to groundwater is typically between 10 and 20 mbgl or deeper. Although these observations do not preclude deep-rooted plant species from potentially using underlying groundwater, it is likely that groundwater is only a small component of water use during extended periods of limited soil water availability (i.e. droughts). A decline in groundwater levels may result in a reduction in the volume of water available to Type 3 GDEs for transpiration and consequently, an adverse impact on riparian and terrestrial ecosystem function.

A decline in groundwater levels may result in a reduction in the volume of water available to Type 3 GDEs for transpiration and consequently, an adverse impact on riparian and terrestrial ecosystem function. Between 0.1m and 5 m drawdown is predicted beneath riparian GDEs (RE 11.3.25) along Tooloombah Creek. Between 0.1 and 7.5 m drawdown is predicted beneath riparian GDEs (RE 11.3.25) along the majority of Deep Creek. A small section of Deep Creek to the south of the Bruce Highway is predicted to be impacted beyond the 5 m drawdown contour (refer inset Figure 14-10). Between 0.1 m and slightly more than 2 m drawdown is predicted beneath terrestrial Forest Red Gum woodlands on alluvial plains (RE 11.3.4) associated with Deep Creek (Figure 14-10). No drawdown is predicted along the lower reaches of Tooloombah and Deep Creeks (immediately upstream of their confluence), or the Styx River and Broad Sound estuary.

Drawdown of between 0.1 m and 1 m in riparian areas is considered to cause a low threat of adverse impacts to Type 3 GDEs while more than 1 m of drawdown is considered a moderate to high threat. Based on this classification and ground-truthed vegetation mapping, mining effects are predicted to pose a low level threat to an area of 40.3 ha of vegetation communities along Tooloombah Creek and 62.4 ha along Deep Creek. A moderate to high threat is predicted in vegetation communities encompassing 8.3 ha along Tooloombah Creek and 34.2 ha along Deep Creek.

In terrestrial areas (i.e RE 11.3.4 located where the water table is less than 10 mbgl), a low to moderate threat is considered to occur if drawdown is between 0.1 m and 5 m while a high level of threat is considered if drawdown exceeds 5 m. Ground-truthed vegetation mapping indicates there 14.25 ha of this community within the 0.1 m to 5 m groundwater drawdown contour. There are no occurrences of this community where the drawdown exceeds 5 m. These potential impacts are summarised in Table 14-14.

Table 14-14 Extent of potential threat on identified Type 3 GDEs from predicted groundwater drawdown

Threat level	Riparian vegetation (RE11.3.25)	Terrestrial vegetation (RE 11.3.4) where water table < 10 mbgl	Terrestrial vegetation (RE 11.3.4) where water table > 10 mbgl
Low to moderate	Drawdown < 1 m – Tooloombah Creek – 40.3 ha Deep Creek – 62.4 ha	Drawdown < 5 m – 14.25 ha	Drawdown 5 m to 10 m – 0 ha
Moderate to high	Drawdown > 1m - Tooloombah Creek – 8.3 ha Deep Creek – 34.2 ha	Drawdown > 5 m - 0 ha	Drawdown > 10 m - 0 ha

The rate at which draw down occurs is expected to influence the extent of adverse impacts. It is expected that a slow rate of draw down will result in a lesser impact as it is expected that root systems will, in part and over time, adjust to the lower water table. Conversely, a sharp and severe reduction in groundwater levels would be expected to result in a greater adverse impact.

14.7.10.1 Potential Impact on Threatened Vegetation Communities

Brigalow (*Acacia harpophylla*)

Vegetation communities comprising Brigalow on the site (RE11.4.9 – Endangered under the VM Act) occupy shrink-swell dark clays (vertosols) with well-developed gilgai microtopography in the upper soil profile (0.6 m to the surface) where the bulk of nutrient recycling occurs. The subsoil components are however typically strongly cohesive clays with high levels of salinity, sodicity, acidity and phytotoxic concentrations of chloride which may reduce the effective rooting depth in these soils (Dang et al. 2008; Grant 2012).

Johnson et al. (2016) describe brigalow as ‘a clonal species with stems arising from horizontal roots which draw resources from a substantial area around the plant’. The concentration of the Brigalow root mass in the upper soil profile enables the species to sucker profusely from horizontal roots after physical disturbance, and also limits the capacity for other woody species to compete for moisture and nutrients. Brigalow’s shallow rooting habitat is evident with the tendency of mature trees to topple as a result of churning in the upper soil profile with fallen trees universally exposing a well-developed lateral root system with little evidence for development of deeper tap roots.

With consideration given to the physical and chemical limitations of soils associated with Brigalow and the shallow rooted nature of the Brigalow tree itself, it is very unlikely that Brigalow vegetation communities can be considered as a GDE.

Semi-evergreen Vine Thicket

There are several patches of SEVT in or adjacent to the Project area associated with Tooloombah Creek. These patches (mapped as RE11.3.11 – Endangered under the VM Act) occur on an alluvial bench formed from fine silty sand that is elevated well above the flood channel of Tooloombah Creek.

Pre-dawn leaf water potential (LWP) measurements were undertaken on four species of canopy tree from within SEVT located within the mine ML during very dry conditions in August 2018 (refer Section 14.5.2.1). The measurements indicated all trees are under significant water stress with all measurements at or below the standard wilting point for crops (217 psi) with the largest of the trees measured, an emergent Narrow-leaved Bottle Tree (*Brachychiton rupestris*) demonstrating a measured LWP (-812 psi) approximately four times below standard wilting point. Despite the

obvious water stress, all plants were observed to be physically healthy with dense, green canopy foliage demonstrating an ability to withstand drought conditions.

The significant water stress that was evident in this habitat is a clear indication that constituent SEVT trees are not utilising groundwater even in the driest seasonal periods, and that a dependence on groundwater is not necessary for habitat survival and persistence. This accords with the findings of Yates et al (1988), Unwin and Kreidemann (1990) and Bowman (2000) that rainforest trees have capacity to withstand considerable drought stress. As such, it is considered unlikely that the SEVT community associated with the Project area and surrounds can be considered as a GDE.

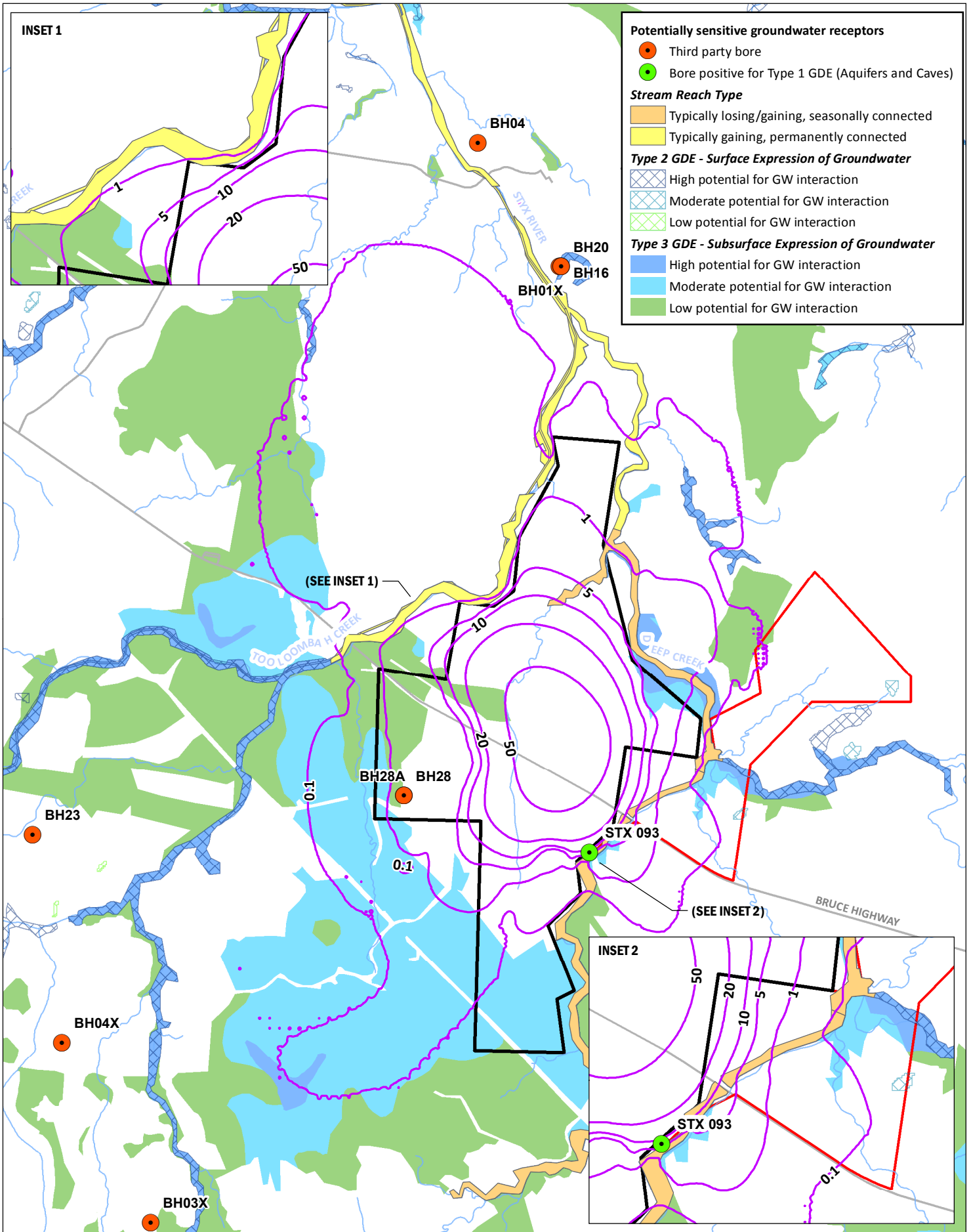
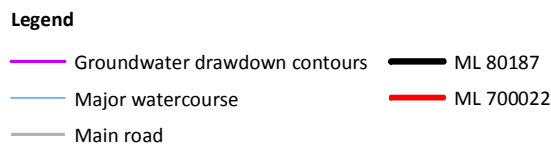
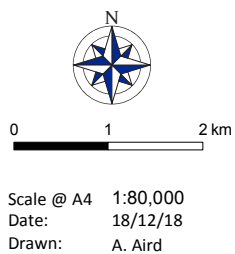


Figure 14-10
 Maximum predicted groundwater drawdown (year 2037) impacts on ground-truthed GDEs



DATA SOURCE
 QLD Open Source Data, 2018;
 GDE Atlas, BoM, 2018



14.8 Mitigation and Management Measures

Mitigation measures have been developed to minimise impacts associated with construction and operation of the Project. Mitigation strategies have been developed based on the following criteria:

- Avoid potential impacts where possible;
- Minimise the severity and / or duration of the impact; and
- Offset unavoidable impacts.

The potential impacts to terrestrial EVs, including impacts to MSES, and threatened fauna and flora because of the activities, and suggested mitigation measures associated with the Project are outlined in the following sections.

14.8.1 Vegetation Clearing

Vegetation clearing will be subject to the Project Offsets Management Plan (OMP) (refer Appendix A18). Under current ground-truthed vegetation mapping the majority of impacted remnant vegetation is listed as Of Concern (RE 11.4.2). In addition, all of the vegetation communities impacted by the Project provide habitat for threatened fauna.

To ensure the Project does not result in additional unforeseen direct impacts to remnant vegetation, the following mitigation measures will be implemented:

- Prior to construction, Project design may be further altered to avoid unnecessary clearing of remnant vegetation communities and potential habitat for threatened fauna species where possible;
- Vegetation located adjacent to the Project construction works will be appropriately marked to avoid unnecessary clearing / vegetation damage;
- Riparian vegetation and creek banks adjacent to culverts that are damaged during construction will be rehabilitated / stabilised;
- The open cut pit areas will be backfilled and rehabilitated as the mine progresses; and
- Monitoring of vegetation health in remnant vegetation potentially impacted mining activities (such as riparian vegetation along Deep Creek) to identify whether indirect impacts are occurring as a result of dust and mine run-off contamination.

14.8.1.1 Mamelon Property – Vegetation Regeneration and Environmental Offsets

Central Queensland Coal owns the Mamelon property, of which the majority of the Project's disturbance footprint occurs. Central Queensland Coal will utilise areas outside of the ML and within Mamelon for land management and environmental offsetting purposes for predicted residual impacts of the Project. Vegetation regeneration and de-stocking of cattle across the majority of the property. Mamelon encompasses a total area of 6,478 ha of which the Project ML covers 2,275 ha. This leaves a total of 4,203 ha remaining outside of the Project boundary with significant portions remaining as remnant vegetation largely subject to cattle grazing impacts.

There are extensive areas of non-remnant lands previously subject to vegetation clearing / management, within and outside the Project ML (1,725 ha and 587 ha respectively). These areas will be managed so as to allow regeneration of the original vegetation communities, thereby

extending the availability of MNES vegetation communities and fauna habitat in the area and improving habitat linkages between remnant vegetation patches to the south and north-east of the property.

The northern portion of the Project ML is dominated by cleared habitat or scattered Brigalow regrowth on cracking clay soils. Cleared habitat to the north and east of Waste Rock Stockpile 2 will be managed and allowed to regenerate tree cover over approximately 180 ha. Similar smaller patches between Deep Creek and Project infrastructure (such as the cleared habitat around CHPP / MIA 2) will also be allowed to regenerate cover. This will have several positive conservation outcomes in the long-term including:

- Substantial increase in the cover of Brigalow vegetation (Endangered REs) on the property and in the wider area;
- Substantial increase and improvement of habitat for Ornamental Snake on the property; and
- Improved vegetation connection of Tooloombah Creek to Deep Creek, thereby improving landscape connection to several large habitat patches to the north-east of the property (refer Section 14.12.5 for further detail).

Elsewhere, on the property the regeneration of eucalypt vegetation communities will allow for the increase in extent and habitat connectivity of suitable habitat for other MSES fauna known to occur in the area including Squatter Pigeon, Greater Glider and Koala. This will also provide additional ecological benefits by improving the water quality entering the adjacent creek lines (and potentially Styx River and Broad Sound) during heavy rainfall events through reducing nutrient inputs from cattle dung, reducing soil erosion and mobilisation of sediments and increasing vegetation cover on the site.

14.8.2 Habitat Connectivity

The Project clearing impacts have been assessed as 'not significant' using DES' Landscape Fragmentation and Connectivity tool (refer Appendix A9g – Results for Landscape Fragmentation and Connectivity for output). At worst, only minor impacts to habitat connectivity are expected as a result of the Project. Impacts along the haul road crossing of Deep Creek / Barrow Creek will be mitigated through the construction and installation of fauna fencing and bridge construction design that allows for the passage of terrestrial fauna (such as box culvert design).

Potential impacts to stream connectivity and fish passage are considered in Section 15-7 of Chapter 15 – Aquatic Ecology.

14.8.3 Direct Fauna Mortality

The Project requires the clearing of vegetation and therefore fauna habitat. As such direct fauna mortality during construction has the potential to occur. In addition, vehicle collisions during construction and operation pose a threat to a number of species, including listed species such as the Koala and Short-beaked Echidna. General fauna management measures will be implemented as part of the Project Land Use Management Plan (LUMP) and will establish protocols for pre-clearing surveys, data collection regarding fauna incidents.

Measures to mitigate impacts include:

- Prior to any vegetation disturbance a trained ecologist or other qualified environmental specialist will be onsite to remove fauna (if required). Hollow-bearing trees will be marked and hollows inspected for the presence of arboreal fauna prior to tree-felling. All fauna recorded during pre-clearing surveys will be recorded on a dedicated fauna register. Construction areas that pose a risk to fauna will be fenced off where practical;
- Where clearing hollow-bearing trees is required and arboreal fauna (such as gliders or microbats) are detected, appropriate nest boxes will be installed adjacent to those areas in order to minimise impacts to species utilising tree hollows. Nest box use will be regularly monitored to ensure effectiveness of nest box design and placement;
- The LUMP will include measures for monitoring and recording wildlife road collision incidents throughout construction and operation to help remediate 'high risk' collision areas and set conditions for attending to injured native wildlife;
- Appropriate speed limits will also be in place throughout the site and all contractors will be educated on the risks to local fauna to minimise impacts when driving; and
- To reduce the risk of mortality to native wildlife, no domestic animals will be allowed onsite.

A draft Significant Species Management Plan (SSMP) has been developed (refer Appendix A20) for those threatened species known or likely to occur on the site (under the NC Act and EPBC Act). The plan identifies potential impacts on these species (including identified habitat) as a result of Project activities throughout the life of the Project (construction, operation and decommissioning). The Plan details specific management measures to be implemented to mitigate impacts and incorporates adaptive management principles to allow for the adoption of new measures where necessary as the Project progresses. The draft SSMP will be developed further prior to the commencement of operations.

14.8.4 Dust

Dust is not anticipated to significantly impact terrestrial habitat in the area surrounding the Project. However, a vegetation monitoring program will be implemented as part of the Project LUMP and will include measures to monitor the health of adjacent riparian vegetation communities within close proximity to mine activities, including the haul road. Vegetation monitoring will also focus on vegetation / wetland health in areas identified as in the path of prevailing winds in the area to the immediate west of the Project including riparian vegetation along Tooloombah Creek. These areas may be potentially subject to dust accumulation impacts. Results of the vegetation monitoring will be used to inform adaptive management of mitigation measures where impacts are found to be occurring.

The following measures have been developed to ensure dust levels resulting from the Project are kept to a minimum:

- The coal conveyor will be covered (although not fully enclosed) and will incorporate 'spill protectors' along the sides for the entire length of operation in order to minimise fugitive coal dust emission;
- All areas which have the potential to give rise to airborne dust such as unsealed roads, tracks, spoil areas and coal stockpiles will be wetted down regularly using water from environmental dams;

- Speed limits will be implemented throughout the site to minimise dust generated;
- Areas stripped of topsoil for Project construction will be rehabilitated as soon as practicable where not required during operations;
- Regular cleaning of machinery and vehicle tyres to prevent wheel entrained dust emissions;
- Design haul roads to have a less erodible surface, particularly where adjacent threatened fauna habitat occurs, such as using materials with a lower silt content and / or applying chemical dust suppressants or paving used for haul roads; and
- Further dust suppression mitigation measures are discussed in Chapter 12 - Air Quality.

14.8.5 Noise

Noise is not expected to have a significant effect on local fauna population. However, the following measures will be implemented to reduce any impacts which may result from construction and operational noise:

- Noise will be mitigated by properly maintaining all equipment used onsite in accordance with manufacturers specifications;
- Enforcing speed limits to ensure that all mining operations are operating at the lowest possible noise level to minimise the impacts of noise and vibration upon wildlife;
- Ensuring mine vehicles and traffic are strictly controlled and do not operate in areas (such as threatened species habitat) outside of the needs of the mine operations; and
- Further details of mitigation measures for noise control within the Project area are provided in Chapter 13 - Noise and Vibration.

14.8.6 Lighting

Project lighting is not considered to be a significant issue for fauna. Lighting required during the construction period is expected to be minor as construction is expected to be carried out largely in daylight hours.

Night lighting will mainly be limited to lights required for safety and security. During operations Project lighting will be minimised (i.e. low luminance) as far as possible and directed towards the CHPP / MIA areas and open cut areas and thereby away from fauna habitat to reduce any minor localised impacts even further. Further investigations will be carried out during the detailed design phase of the Project into low-light spill lighting options.

Construction and Operation Environmental Management Plans (CEMP and OEMP) will be produced prior to construction commencing. These will detail and illustrate the potential impacts from lighting during both the construction and operation phases of the Project and inform the Project lighting design to minimise these impacts. Further investigations will be carried out during the development of the CEMP / OEMP into low-light intensity spill lighting options.

14.8.7 Fire

Fire management is an essential component to all coal mining operations and as such, the following measures have been developed to reduce the potential impacts of a site fire:

- Fire management measures for the Project will be developed and implemented within the LUMP;
- Specific onsite smoking areas should be designated;
- Onsite burning of any material should not be undertaken;
- Ensure onsite fire-fighting equipment is regularly maintained and adequate staff training is implemented;
- Vegetation surrounding the site will be managed for fuel load with appropriate fire management regimes in place to maintain present ecological values; and
- Weed management to prevent habitat degradation and potential increased fire risk.

In the unlikely event that a fire should escape from the area of Project activities, fire-fighting equipment and appropriately trained personnel will be on stand-by to fight potential wildfires, as will be detailed in the LUMP.

14.8.8 Pests and Weeds

Weed and pest management will be an important and integral part of proposed site management activities and will be detailed in the Project LUMP. This Plan will include measures and monitoring to be developed and managed in accordance with the requirements of the Biosecurity Act, and will include the following measures:

- Implementation of sediment control mechanisms to minimise the risk of weed seed washing into waterways;
- Implement control strategies outlined in the Department of Agriculture and Fisheries (DAF) weed and pest animal fact sheets and other relevant government biosecurity management strategies;
- Pre-construction weed mapping should be undertaken to accurately determine the extent of weeds and pests;
- Vehicle wash down procedures;
- Minimise the use of off-road vehicle movements;
- Onsite waste disposal strategies (particularly for food wastes) to be employed that will not encourage the presence of pest fauna;
- Strategies for the storage of construction and operation materials / equipment to be employed that will not encourage the presence of resident pest fauna;
- Regular onsite inspections of site infrastructure / equipment for resident pest fauna and establishment of register for pest sightings; and
- Monitoring and weed and pest inspections particularly in response to reported outbreaks or from complaints or adjacent property owners.

Waste storages are not likely to have significant impacts on native flora and fauna within the Study area, as all waste produced as a result of the Project will be stored and disposed of appropriately, as per the relevant legislation.

14.8.9 Accidental Release of Pollutants

The Project design has incorporated the following components as part of the wider Project Water Management Plan. With these design elements, it is considered the potential impacts from the Project to water quality and hence local aquatic EVs in the vicinity of the site and downstream, are appropriately minimised to the greatest possible extent.

Several environmental dams are proposed to capture rainfall runoff from the CHPP / MIA areas, TLF facility and Waste Rock Stockpile areas. The primary function of the environmental dams is to capture sediment laden runoff for sediment removal.

Deep Creek, is located approximately 200 m from the eastern edge of the Open Cut 1 / Waste Rock Stockpile 1a areas, 500 m from the south eastern corner of Open Cut 2, and 300 m from the eastern edge of Waste Rock Stockpile 2 and thereby have potential to release contaminated run-off in the creek. Other potential sources of pollutants include the MIA / CHPP 2 area which is located approximately 500 m from Deep Creek. Surface water run-off from the TLF facility will be diverted into a large environmental dam (Dam 4) for remediation before discharge into Barrack Creek. Environmental dam 2d will capture potential overflow from Dam 4 as well as run-off from the haul road to the TLF. Dams capturing surface water run-off from the Waste Rock Stockpiles and Dam 4 will be built to a 1:100 AEP standard flood level capacity.

The mine water release strategy is presented in detail in Section 9.9 (Chapter 9 – Surface Water) and sets the basic criteria for minimising the effect of mine affected water releases on the receiving environment. Water quality release limits are set for mine affected water across several parameters as conditioned under the Project EA conditions. Release contaminant trigger investigation levels also apply. Ongoing water monitoring will be undertaken at the environmental dams, mine-affected water dams, discharge locations and locations both upstream and downstream of the Project area. Discharge of mine-affected water will be restricted to flow trigger events in the relevant creek catchments and will also be limited by the quality of water to be released.

Surface waters will be managed and monitored according to the Project-specific Receiving Environment Monitoring Plan (REMP) and Water Management Plan (WMP). Surface water contaminants from Project-associated industrial pollutants have the potential to impact the localised catchment and vegetation communities in the spill area.

Surface water contaminants from industrial pollutants have the potential to impact the local catchment and vegetation communities throughout the Project area. These impacts will be mitigated through:

- All refuelling facilities and the storage and handling of oil and chemicals will comply with relevant Australian Standards (management and mitigation measures for wastewater is discussed in Chapter 7 - Waste Management);
- Bunding of chemical storage facilities and appropriate storage of chemicals according to AS 1940 'The storage and handling of flammable and combustible liquids;
- Appropriate spill control materials including booms and absorbent materials will be onsite at refuelling facilities at all times. These will be used for mitigating and managing events where a substance is spilled into the surrounding waters;

- Locate and design roads and other built infrastructure so that minimal run-off to waterways occurs;
- Retention Basins to allow a pre-treatment of water and wastewater prior to any discharge into the aquatic environment. The discharge of wastewater and stormwater will be similar to water quality of receiving waters and in accordance with EPP water quality objectives for the Styx Basin; and

Wash-down areas for plant and equipment will be clearly marked to prevent contaminated water from leaching into soils or flowing into nearby watercourses.

The Project LUMP will include monitoring of remnant vegetation considered at risk from contaminated run-off / wastewater releases from Project construction and operation to identify whether impacts are occurring.

Further details relating to surface water management and water infrastructure design are discussed in Chapter 3 – Description of the Project and Chapter 9 – Surface Water. With the proposed design features in place, significant impacts to terrestrial EVs from the release of pollutants are not considered likely to occur.

14.8.10 Rehabilitation Plan

Rehabilitation will be carried out progressively throughout the life of the Project as described on Chapter 11 – Rehabilitation and Decommissioning. As outlined in the previous sections, impacts resulting from the Project development are likely to eventuate largely because of vegetation clearing for Project activities. As such, measures to rehabilitate impacted areas will occur progressively. Clearing for open cut mining will occur progressively over the life of the mine and will be predictable with respect to both the extent and location.

A Rehabilitation Framework will be developed and evolve over time to reflect changing regulatory requirements, community values, and lessons learned onsite or at other mines. This will include the following:

- The appropriate stockpiling and placement of removed topsoil in designated rehabilitation areas. Topsoil stockpiles will be seeded to minimise the risk of soil erosion;
- Open cut mining will occur in a staged manner during the Project. Pit areas will be backfilled and, in consultation with the adjacent landowners, be revegetated as mining progresses. Revegetation will comprise those communities / flora species existing on the site prior to mining disturbance; and
- In the event that vegetation is impacted by other mining activities (such as groundwater drawdown or dust settlement), a revegetation program will be initiated using species representative of the RE impacted. Revegetated land will be surveyed periodically to quantify success of rehabilitation works.

The proposed approach to rehabilitation onsite is discussed in detail in Chapter 11 – Rehabilitation and Decommissioning.

14.8.11 Changes to Groundwater Table and GDE Impacts

The proposed open cut mining method will physically disrupt and drain saturated strata within the subsurface, resulting in groundwater depressurisation and decline of water table elevation surrounding the open-cut pits during mining. Apart from alteration of the volume of coal resource to be extracted, the magnitude and extent of groundwater depressurisation will be controlled by the hydrogeological properties of the surrounding material, with no practical measures available to mitigate these effects.

14.8.11.1 Groundwater Monitoring - REMP

A detailed REMP will be established for the Project (refer Section 10.8 in Chapter 10 – Groundwater for more detail). This will include continued monitoring of established shallow groundwater monitoring bores within the likely zone of mine influence. Based on the information collected during the first few years of mining, a need for expansion or rationalisation of the monitoring network may be identified. In the long term monitoring of these bores will allow for a better understanding of local groundwater conditions and observations regarding actual drawdown caused by mining activity. Data collected from the REMP in the first years of mining will be used to verify the groundwater drawdown model predictions and, if necessary, provide a basis for recalibration of the groundwater model. The REMP will document the proposed groundwater monitoring and evaluation plan, and will include:

- GDE condition monitoring, including vegetation and aquatic surveys;
- Groundwater monitoring, including level gauging, water sampling and laboratory testing program;
- Monitoring of mine water dewatering rates/volumes and produced water laboratory testing program;
- Data evaluation criteria;
- Monitoring frequency and reporting; and
- Requirements for revision of the REMP.

Trigger Action Response Plans (TARPS) (see Chapter 9 – Surface Water) will form part of the REMP and will outline the actions and responses required in the event that operations have or are likely to result in management objectives and approvals conditions not being achieved. TARPs will identify:

- Further investigations to identify EVs and sensitive receptors that may be impacted and to assess level of impact / threat posed to the sensitive receptors, if pre-determined trigger thresholds are reached;
- Of those mitigation measures identified in the REMP, which are appropriate to manage or remove the specific cause or pathway of the impact / threat and what other mitigation measures may be available to improve outcomes (e.g. new technology);
- Implementation of the mitigation plan(s) deemed most appropriate, including providing notification (where necessary) to relevant authorities and stakeholders;

- Reporting (internal and external) to summarise monitoring results, investigation findings and mitigation approaches, with follow up information provided to relevant authorities and stakeholders; and
- Review and update of the REMP to ensure adequate monitoring of detected impacts and mitigation efforts is incorporated, and to re-assess appropriateness of mitigation measures outlined in the plan (i.e. to ensure the mitigation measures will appropriately address the level of impact identified into the future).

Mine water inflow monitoring will consist of daily measurements of rates and/or volumes of all water pumped from the mine pit using a suitable method. Mine produced waters will be subject to quarterly:

- Measurements of field water quality parameters (e.g. TDS, EC, pH); and
- Laboratory analyses of major ions, TDS, EC, dissolved metals (including aluminium, arsenic, selenium and vanadium) and hydrocarbons (TPH, TRH and BTEXN).

Groundwater monitoring (water quantity and quality) will occur on the MLs and off-lease during the construction, operational and post-operational phase of the Project to:

- Determine if an impact has or will likely be realised, which would trigger (based on pre-determined trigger thresholds) implementation of appropriate mitigation measures, including initial review and evaluation; and
- Assess the environmental performance of any adopted management and mitigation measures once implemented, which may require expansion of the monitoring network and analytical program.

The location and configuration of monitoring bores is designed to provide sufficient coverage of identified aquifers and potential GDEs to detect and monitor groundwater effects resulting from the Project and provide a baseline from which management objectives are set. Groundwater monitoring bore locations are described in Chapter 10 – Groundwater.

Monitoring of groundwater drawdown and depressurisation will involve:

- Gauging of hydraulic head in selected groundwater monitoring bores and landholder bores located within the predicted zone of mine influence, as a minimum;
- Automated pressure transducers will be installed at selected monitoring bores to provide daily observations that can be used to distinguish short-term changes, such as seasonal recharge, from potential long-term effects of the Project (dewatering and backfilling); and
- Gauging hydraulic heads at selected locations outside of the predicted area of impact to confirm the extent of impact and to assess baseline conditions away from potential mining effects.

Groundwater quality monitoring will include the following:

- Mine water inflow monitoring will consist of daily measurements of all water pumped from the mine pit;
- Quarterly field measurements of EC and pH of groundwater sampled from monitoring bores located on the mine lease and monthly field measurements of the same parameters for water pumped from the mine;

- Quarterly field measurements of EC and pH of groundwater sampled from compliance monitoring bores located off the mine lease;
- Six monthly sampling (quarterly or more frequently for the first two years of mining, or if trigger is reached) of groundwater sampled from compliance monitoring bores for laboratory analyses of major ions, TDS, EC, dissolved metals (including aluminium, arsenic, selenium and vanadium) and hydrocarbons (TPH, TRH and BTEXN); and
- Six monthly sampling (quarterly or more frequently if trigger is reached) of groundwater from reference monitoring bores (located outside the predicted zone of drawdown influence) for laboratory analyses of major ions, TDS, EC and dissolved metals.

Groundwater chemistry data will be analysed graphically for trends (e.g. using Piper plots and Stiff patterns) and any correlation with observed groundwater levels, mine inflow and rainfall. Data collected from the recently installed monitoring bores will be assessed and evaluated to allow adjustment of the nominated trigger values for groundwater quality (following 24 months of data collection).

If a monitoring trigger is breached, after review and where required the appropriate mitigation measure will be implemented and the monitoring program appropriately adjusted, e.g. if a water quality trigger is realised, sampling frequency for analysis of water quality may be increased from six monthly to quarterly or more frequently, and additional monitoring locations may be incorporated (i.e. between bores where the trigger is reached and the threatened receptor).

Groundwater compliance reports will be prepared to facilitate the transfer of monitoring data to relevant regulatory authorities. The frequency of reporting will be decided in the relevant Project environmental authority. Issues relating to groundwater samples that are reported by the landholder or mine staff will be recorded and documented in the monitoring report, including corrective actions.

Future improvements to the numerical model will be undertaken as and when new data become available, particularly where there is a divergence of observed groundwater system response from the predicted. New data may require a revision and update of the conceptual (eco-)hydrogeological model prior to updating and recalibrating the numerical model and re-running of predictive scenarios. Where this is deemed necessary, the REMP and WMP may also need to be updated depending on model predictions.

As mining progresses, a need for further model updates will be assessed every two years based on quarterly reviews of groundwater monitoring data and findings of impact verification. It is expected the confidence level of model predictions will increase over time as the model is updated to reflect the observed effects on groundwater from the monitoring program.

Where additional management strategies are required in response to environmental performance, the existing numerical model, or new models depending on the type of impact observed (e.g. density coupled models to simulate seawater intrusion), will be used to test the effectiveness of mitigation measures prior to implementation to improve the outcomes of the proposed measures.

14.8.11.2 GDE Monitoring (Terrestrial Vegetation)

Targeted investigations of the hydrological requirements of potential Type 3 GDEs have been carried out as part of works to inform the updated SEIS (refer Section 15.5.2.3 of Chapter 15 – Aquatic Ecology). Ongoing GDE monitoring will incorporate some of these methods and inform how GDE water requirements can be maintained during and following mining.

Monitoring of Type 3 GDES will include the following:

- Establish permanent vegetation monitoring transects to measure structural characteristics and baseline condition of GDE habitats subject to impact (also including the consideration of the need for control sites);
- Monitoring transects will provide dedicated sites for structured and repeatable temporal measurements of Foliage Index / Leaf Area Index using canopy photography / hemispherical lenses;
- Temporal measurement of Leaf Water Potential at reference trees when GDE vegetation monitoring sites are established and at subsequent monitoring events, this will provide a direct measure of water stress;
- Capture of high resolution Normalised Differential Vegetation Index (NDVI) imagery over possible impact areas and any control sites, timed to coincide with monitoring events and undertaken biannually for the initial three years to establish a seasonal baseline for ongoing comparison (the data sets provide a measure of all vegetation, rather than selected sites within the transects); and
- Comparison of results against observed changes in GDE water budgets to link the cause, if possible, of observed stress to changes in the water budget attributable to the Project, and differentiating other potential factors such as climate change, fire, or introduced plant species. These factors could be as significant as the threats posed to groundwater resource condition by the Project.

14.8.11.3 Preliminary Management and Mitigation Measures

Mitigation measures will be defined to address unacceptable impacts arising on sensitive receptors from reduced groundwater quantity or diminished groundwater quality. The TARPS will form the basis for determining when management and mitigation measures will need to be confirmed and implemented.

It is recognised that GDEs within this landscape will have evolved some resilience, whereby they are able to cope with some degree of change to baseline water regimes (quantity, quality and timing). For example, Type 3 terrestrial GDEs may be able to extend the depth of rooting to access deeper soil water or the capillary fringe. Resilience levels need to be further assessed by ongoing monitoring, but for the purpose of identifying suitable mitigation measures it is conservatively assumed at this stage that sensitive ecosystems have no resilience to changed water regimes (i.e. the temporal nature of environmental water requirements is static / unchanging). In the first instance, mitigation measures are defined on this 'static' basis, but once environmental water requirements are better understood an adaptive mitigation plan will be able to be implemented.

The following sets out examples of groundwater management and impact mitigation measures for the Project. These and other mitigation measures will be further detailed in the REMP, building on from the baseline understanding of receptor water requirements with understandings developed from ongoing studies (see Section 10.8.2.2 of Chapter 10 - Groundwater). It is anticipated that, where an adverse impact is indicated as part of the approved monitoring, evaluation and reporting program, a wide range of management and mitigation approaches will be considered, not only those that may be detailed in the REMP as additional approaches may evolve with time and technology, and new knowledge gained may lead to the development of new approaches that are not identified here. Any new mitigation measures identified as part of this process will require an update of the REMP.

Water Quantity

An approach that will be considered to manage impacts where Type 3 GDEs access to groundwater might be compromised due to drawdown arising from mine dewatering involves supplementing environmental flows to waterways and soil water stores so that baseline flow/water availability regimes can be maintained or supported. Table 15-12 summarises the management and mitigation measure with details expanded upon below.

The practice of supplementing surface water flow to maintain the aquatic system and riparian vegetation health is widely used as a management tool in providing environmental flow requirements to waterways and wetlands across Australia. Examples of where the provision of environmental flows made directly into pools in response to groundwater dewatering include the Collie Basin in south-west Western Australia (DoW 2009) and Fortescue Metals Solomon Iron Ore Project Bore Field in Western Australia (FMG 2016).

Table 14-15 Available management and mitigation measures

Direct effect	Instream habitat	Riparian/terrestrial habitat	Third party bores
Change in groundwater quantity/surface water – groundwater interactions	Supplementary environmental flows provided directly to pools from mine produced water or other groundwater (e.g. pumping bores)	Supplementary environmental flows provided via irrigation from mine produced water or other groundwater (e.g. pumping bores) Land contouring, which will retard surface water run-off and encourage additional recharge to the underlying soils	Lowering of pump/ deepening bore Provision of surplus water from mine dewatering if suitable Provision of an alternative water supply
Change in groundwater quality	Onsite water and hazardous materials management Containment or capture of contaminant/pollutant e.g. cut off walls, pumping bores. Treatment of contaminated/polluted water		

For Type 3 GDEs, supplementary water can be applied to soil water reservoirs (i.e. the root zone) either directly through irrigation or indirectly through leakage from water provided to waterways/wetlands/bunded areas. Contouring of the surface could be considered to encourage ponding of any surface runoff or direct rainfall to encourage additional recharge to the underlying soils. However, the efficacy of this approach also needs to consider impact to creek flow regimes.

The source of supplementary water would ideally be mine produced water, as there would be no associated additional drawdown impacts. Mine water balance modelling, as presented in Chapter 9 – Surface Water, predicts the mine water supply exceeds the mine water demand for the duration of mining almost all of the time, with a predicted minimum available excess in the order of 40 ML in the worst case dry year. This suggests that mine produced water is a likely to be a viable source of water to offset any reduction in groundwater baseflow to the dependent pools, with adequate treatment if necessary.

However, a supply deficit will exist post-closure when mine produced water is no longer available. Alternatively, sourcing the supplementary flows from a groundwater resource is a strategy that may be considered – whilst the Alluvium aquifer would likely not present as a viable long term option (due to drawdown effects), the Styx Coal Measures, which has similar water quality to the Alluvium may provide a suitable source. Modelling has been prepared examining water ‘consumption’ at a pool near the western boundary of ML 80187 and assessing whether waterhole groundwater requirements can be met via abstraction from pumping wells accessing the Styx Coal Measures. The modelling has shown that the Styx Coal Measures is capable of supplying between 0.1 to 0.2 L/s in

the long-term, which could sustain around 2,400 to 4,800 m² of pools, with little additional effect to the predicted drawdown (discussed in detail in Appendix A6 – Groundwater Technical Report).

GDE Monitoring (Terrestrial Vegetation)

Targeted investigations of the hydrological requirements of potential GDEs have been carried out as part of works to inform the updated SEIS (refer Section 15.5.2.3 of Chapter 15 – Aquatic Ecology). Ongoing GDE monitoring will incorporate some of these methods and inform how GDE water requirements can be maintained during and following mining.

Monitoring of Type 3 GDES will include the following:

- Establish permanent vegetation monitoring transects to measure structural characteristics and baseline condition of GDE habitats subject to impact (also including the consideration of the need for control sites);
- Monitoring transects will provide dedicated sites for structured and repeatable temporal measurements of Foliage Index / Leaf Area Index using canopy photography / hemispherical lenses;
- Temporal measurement of Leaf Water Potential at reference trees when GDE vegetation monitoring sites are established and at subsequent monitoring events, this will provide a direct measure of water stress;
- Capture of high resolution NDVI imagery over possible impact areas and any control sites, timed to coincide with monitoring events and undertaken biannually for the initial three years to establish a seasonal baseline for ongoing comparison (the data sets provide a measure of all vegetation, rather than selected sites within the transects); and
- Comparison of results against observed changes in GDE water budgets to link the cause, if possible, of observed stress to changes in the water budget attributable to the Project, and differentiating other potential factors such as climate change, fire, or introduced plant species. These factors could be as significant as the threats posed to groundwater resource condition by the Project.

14.8.11.4 Environmental Offsets

A key mitigation measure of last resort that is available to deal with unacceptable outcomes that cannot be adequately managed involves committing to Project environmental offsets (refer Section 14.12). This would involve undertaking the studies required to understand how GDEs interact with groundwater and implementing management approaches, such as provision of supplementary water. Should all mitigation methods be unsuccessful these habitats / vegetation communities will be subject to the Project Offsets Management Plan (refer Appendix 18A).

14.9 Cumulative Impacts

The nature of the Styx River catchment is rural with approximately 78% of lands occupied by agriculture dominated by cattle grazing. A review of the latest publicly available information regarding proposed developments in Queensland found no large-scale industrial or mining developments proposed for the catchment other than the Central Queensland Coal Project and there are no such projects within a minimum of 100 km radius of the Project area.

The nearest mining operation to the Project is the Kunwarara magnesite mine located 60 km to the south-east. The mine began operation in 1991 and is currently owned by Sibelco. Magnesite resides

close to the surface layers and is mined using open cut pits generally between 15 m to 18 m deep. The mine is mainly divided into three sections - KG1, KG2 and KG3 pit areas. The KG1 pits are located in predominantly cleared lands. The KG2 and KG3 pit areas are located adjacent to patches of Endangered vegetation. There is no information available regarding any current or proposed expansion plans for the project and the Project is not considered further.

The only major development known from the surrounding area is the proposed expansion of the Shoalwater Bay Training Area by the Department of Defence. This area lies largely within the adjacent Shoalwater catchment which also drains into Broad Sound to the northeast of the Project area. The original proposal identified a 'likely expansion area' stretching west from the existing training area to the approximate east bank of the Styx River located to the north of the Project. Based on opposition from local communities it has been recently assessed that a reduced expansion area is 'achievable' (Department of Defence, 2017). As such, the extent of the proposed expansion and the potential changes to land use are unknown at this stage.

The next closest proposed development is the Capricorn Integrated Resort proposed by Iwasaki Sangyo and located 110 km due east of the Project at Corio Bay. Although a final Terms of Reference was issued for the Project in May 2014 no further documentation regarding this Project is available. The Project draft EIS is said to be still in preparation.

Given there are no other large projects currently known to have identified lands within the Styx River catchment, the Project impacts to terrestrial ecology will only add to those impacts that are a result of current land use in the catchment. These background land use impacts have already been characterised within this chapter. There are no other projects in the catchment or surrounds which the potential Project impacts to terrestrial ecology subject to this assessment could conceivably add to.

14.10 Qualitative Risk Assessment

Potential impacts resulting from the current Project on ecological values have been assessed utilising the risk assessment framework outlined in Chapter 1 – Introduction.

For the purposes of this risk assessment, risk levels are defined as follows:

- Extreme – Works must not proceed until suitable mitigation measures have been adopted to minimise the risk;
- High – Works should not proceed until suitable mitigation measures have been adopted to minimise the risk;
- Medium – Acceptable with formal review. Documented action plan to manage risk is required; and
- Low - Acceptable with review.

A qualitative risk assessment that outlines the potential impacts, the initial risk, control measures and the residual risk following the implementation of the control measures detailed in the previous sections is shown in Table 14-16 .

Table 14-16 Qualitative risk assessment

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
Vegetation clearing	<ul style="list-style-type: none"> Removal of habitat for threatened species (also MSES) 	Extreme	<ul style="list-style-type: none"> Prior to construction, Project design may be further altered to avoid clearing areas of threatened vegetation communities and habitat for threatened species where possible; Fauna habitat management measures incorporated within Project LUMP and SSMP; Avoid unnecessary clearing; Vegetation clearing on the site will be subject to the Project OMP; Vegetation adjacent to construction works will be appropriately marked to avoid unnecessary clearing / vegetation damage; and Long-term vegetation management on the property may increase available habitat for threatened species. 	High
	<ul style="list-style-type: none"> Bank instability and associated follow-on impacts such as further degradation as a result of clearing / construction in riparian habitat Potential offsite vegetation impacts of dust settlement from clearing activity 	High	<ul style="list-style-type: none"> Rehabilitate riparian habitat adjacent to creek disturbance such as for the haul road; Vegetation adjacent to construction works will be appropriately marked to avoid unnecessary clearing / vegetation damage; The open cut areas will be backfilled and rehabilitated as the mine progresses; and Modification to dust suppression systems to minimise any unforeseen impacts of dust on adjacent vegetation communities. 	Low
Habitat connectivity	<ul style="list-style-type: none"> Road crossing causing loss of connectivity along Deep Creek and Barrow Creek 	Medium	<ul style="list-style-type: none"> Appropriately designed culverts that allows passage of terrestrial fauna species under bridge; and Fauna fencing to reduce vehicle collisions. 	Medium
Direct fauna mortality	<ul style="list-style-type: none"> Mortality of terrestrial fauna during vegetation clearing activities Mortality of terrestrial fauna due to vehicle collisions 	High	<ul style="list-style-type: none"> Fauna management measures incorporated within Project LUMP and SSMP; Preclearance surveys carried out by qualified fauna spotter to remove resident fauna; Nest boxes installed in adjacent areas where construction requires the clearing of hollow-bearing trees; Site speed limits set and contractor education on risks to local fauna; Fauna register implemented to record fauna encountered during clearing activities and vehicle collisions; Fauna infrastructure installed along haul road to reduce vehicle collisions at Deep / Barrack Creek crossing; and No domestic animals allowed onsite. 	Medium

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
Dust	<ul style="list-style-type: none"> Impacts of coal dust settlement to onsite and offsite vegetation 	Medium	<ul style="list-style-type: none"> Incorporate monitoring program to encompass at risk riparian / wetland vegetation within Project LUMP; Project mine water to be recycled and used for dust suppression across site; Vehicle speed limits and regular maintenance enforced to reduce dust emissions; Coal conveyor designed to minimise fugitive dust emissions (covered and spill collectors featured in design); Areas stripped of topsoil during construction to be rehabilitated as soon as practical; and Haul road design to incorporate dust suppression techniques. 	Low
Noise	<ul style="list-style-type: none"> Potential impact of Project noise on local fauna populations 	Medium	<ul style="list-style-type: none"> Construction and operational machinery and vehicles maintained in an appropriate manner to reduce unnecessary noise; Site speed limits set to reduce operational noise levels to lowest possible levels; and Ensure mine vehicular activity is controlled and restricted to only those areas required for operations. 	Low
Lighting	<ul style="list-style-type: none"> Potential impacts of Project lighting on local fauna populations 	Medium	<ul style="list-style-type: none"> Operational night lighting limited to that required for site safety and security; Lighting directed towards required areas (e.g. MIA / CHPP areas) and away from vegetation; Investigation of low-light spill lighting options for Project; and Project CEMP to detail lighting design to further minimise impacts. 	Low
Fire	<ul style="list-style-type: none"> Potentially increased risk of fire due to Project activities and impact on vegetation and fauna habitat both on and offsite, including MSES and ESAs (such as Tooloombah Creek Conservation Park) 	High	<ul style="list-style-type: none"> Fire management measures developed and implemented within Project LUMP; Fire-fighting equipment maintained and regular staff training; Smoking onsite restricted to designated areas and no onsite burning / incineration practises; and Vegetation adjacent to site will be managed for fuel load risk through fire management regimes and weed management. 	Medium
Pests and weeds	<ul style="list-style-type: none"> Degradation of vegetation communities and fauna habitat both on and offsite, including MSES and ESAs through weed invasion and proliferation Predation on local fauna due to increase of introduced predators attracted to site 	High	<ul style="list-style-type: none"> Pest and weed management measures incorporated within LUMP; Carry out pre-construction weed mapping of Project site and implement control strategies as per DAF fact sheets; Implement weed wash-down procedures and minimise off-road vehicle movements across site; Implement appropriate strategies to reduce pest occurrence onsite; Implement regular weed and pest monitoring regime; and Establish complaints register to report outbreaks on neighbouring lands. 	Medium

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
Accidental release of pollutants	<ul style="list-style-type: none"> ▪ Degradation of vegetation communities and fauna habitat downstream of pollutant release ▪ Direct impact on fauna using polluted waterholes 	High	<ul style="list-style-type: none"> ▪ Design and implement Project REMP and WMP; ▪ Controlled release of better quality water in accordance with licensed EA conditions; ▪ Maintenance of Design Storage Allowance on the onset of the wet season to minimise the likelihood of uncontrolled discharges; ▪ Pipeline connectivity between storages to allow water transfer to where there is available capacity; ▪ Establish measures to minimise / control Project-associated chemical spills; ▪ Project design will locate infrastructure to minimise stormwater run-off; and ▪ All waters discharged into adjacent waterways will be treated in retention basins and similar in quality to receiving waters. 	Medium
Changes to groundwater table	<ul style="list-style-type: none"> ▪ Drawdown of groundwater impacting long-term habitat persistence in creeks (large waterholes) (Type 2 GDEs) ▪ Drawdown of groundwater impacting adjacent riparian vegetation communities (Type 3 GDEs) 	High	<ul style="list-style-type: none"> ▪ Design and implement Project REMP and WMP; ▪ Ongoing assessment and monitoring to address knowledge gaps and allow a greater understanding of hydrological function between groundwater and riparian vegetation; ▪ Regular monitoring of water levels and riparian vegetation health at identified areas considered at risk of drawdown impacts; ▪ REMP to include measures to replenish Type 2 and Type 3 GDEs in the event of identified impacts; and ▪ Implementation of the Project OMP. 	High

14.11 MSES Impact Assessment

The assessment has identified potential impacts to MNES fauna and other MNES values associated with the wider area downstream of the Project area, including values associated with the Great Barrier Reef World Heritage Area. Impacts to MNES are addressed in Chapter 16 – MNES.

The Matters of State Environmental Significance (MSES) that are applicable to terrestrial ecology EVs are compiled in the following Table.

Table 14-17 MSES as they apply to the Project

Category	Description	Project applicability
Protected area estates	Includes all classes of protected area (except nature refuges and coordinated conservation areas).	<p>Toooloombah Creek Conservation Park is located 750 m west of the westernmost boundary of the ML. Bukkula Conservation Park and Marlborough State Forest are located 17 km east of the ML boundaries. Mitigation measures will be implemented to prevent potential offsite impacts such as dust settlement.</p> <p>No significant residual impacts are expected.</p>
Marine Parks	<p>Includes ‘highly protected areas’ of State marine park zones. These zones include:</p> <ul style="list-style-type: none"> ▪ Preservation zones; ▪ Marine National Park zones; ▪ Scientific research zones; ▪ Buffer zones; and ▪ Conservation Park zones. 	<p>The boundary of the Great Barrier Reef Coast Marine Park is located approximately 8 km north of the Project in the middle estuary of the Styx River. The downstream section of the park closest to the Project is identified as a ‘general use zone’ and therefore not identified as a ‘highly protected area.’ The Marine National Park ‘highly protected area’ zone is located approximately 40 km downstream of the Project by which time the Styx River opens into a broad shallow estuary.</p> <p>The Project will release treated mine water only during flow events. Water quality of released water will be strictly controlled under the Project EA conditions. Other potential impacts resulting from Project activities include increased sedimentation and uncontrolled releases of pollutants. Mitigation measures to control for such events are described in Section 14.8 and Chapter 9 – Surface Water.</p> <p>No significant residual impacts expected.</p>
Fish Habitat Areas	Includes areas declared as Fish Habitat Area (FHA) A, or fish habitat area B under the <i>Fisheries Act 1994</i> .	<p>The Project area is located 8 km south of the boundary of Broad Sound which is listed as declared FHA (Management A). Works are considered to result in a significant residual impact to a declared FHA or highly protected zones of marine parks if:</p> <ul style="list-style-type: none"> ▪ The works are not for a purpose or a structure type listed below; and ▪ The works will result in a residual disturbance footprint within the declared FHA and/or highly protected marine park zone of 40m² or greater in area. <p>The Project does not require any works within the boundary of the FHA and no downstream impacts are predicted from Project activities. There will be no direct or indirect disturbance to fish habitat areas as a result of the Project. Impacts and mitigations will be the same as that described under ‘Marine Parks.’</p> <p>No significant residual impacts expected.</p>

Category	Description	Project applicability
Waterway fish passage	Includes any part of a waterway that provides for passage of fish. Applies to any structure that may create a barrier or otherwise impact fish habitat quality.	<p>The mine haul road will cross Deep Creek and Barrack Creek. Deep Creek is likely to be used for fish passage when flows occur. Barrack Creek is largely an ephemeral waterbody with highly intermittent flows. With appropriate crossing construction including culverts no impacts are anticipated at this crossing point.</p> <p>Several minor waterways (tributaries of Deep Creek) occur throughout the ML. Large sections of these waterways will be impacted by the Project layout i.e. they occur within the footprint of the mine pits and infrastructure. However, some of these waterways are highly ephemeral and modified and are not considered to provide passage for fish (refer Section 15.7.2 of Aquatic Ecology Chapter 15 - Aquatic Ecology).</p> <p>There is potential for waterholes along Tooloombah and Deep Creek (mapped as a 'major' waterway) to be impacted by groundwater drawdown. These creeks will be subject to water quality and water height monitoring under the Project WMP. Where monitoring detects adverse impacts are imminent the Project will establish a waterhole supplementary replenishment program (refer Section 14.8.11).</p> <p>Significant residual impacts expected in areas within the ML where development will occur. Discussions with DAF required to confirm outcome of application to amend the waterway mapping</p>
Regulated vegetation	Includes: REs classified as 'endangered' or 'of concern', REs classified as 'watercourse'; Habitat mapped as 'essential habitat'; and Wetlands on the VM Act map.	<p>Under ground-truthed vegetation mapping there are two REs classified as Of Concern and regulated vegetation intersecting a watercourse that may be directly impacted by the Project, thereby triggering offsets.</p> <p>Clearing within the mine area and transport corridor will require the removal of 83.35 ha of Of Concern vegetation.</p> <p>A total of 3.53 km or 7.78 ha of lands mapped as 'watercourse vegetation' will be impacted by clearing for Waste Rock Stockpile 2, Dam 1, and for the haul road (refer Section 14.12.2 for further detail).</p> <p>There is potential for groundwater drawdown to impact sensitive vegetation communities requiring access to shallow groundwater including Least Concern watercourse vegetation (RE 11.3.25), Of Concern (RE 11.3.4) and a wetland mapped under the VM Act (11.3.12). These communities will be subject to vegetation health monitoring and mitigation actions where adverse impacts are imminent (refer Section 15.8.10). The wetland will be subject to groundwater height monitoring through a site specific bore. Where mitigations are unsuccessful these areas will be subject to significant residual impacts.</p> <p>Significant residual impacts limited to cleared areas expected. Potential significant residual impacts from groundwater drawdown (refer Section 15.7.5).</p>
Protected wildlife habitat	Includes flora and fauna species listed as Special Least Concern, Vulnerable, or Endangered under the NC Act and includes habitat that supports a listed fauna	<p>There are several terrestrial fauna and flora species listed as Endangered, Vulnerable or Special Least Concern that occur or have potential to occur in the study area.</p> <p>One threatened aquatic species is likely to occur in the waters adjacent to the Project area boundary – Estuarine Crocodile. Several threatened marine species may occur in</p>

Category	Description	Project applicability
	species (e.g. foraging roosting or breeding habitat).	<p>downstream waters associated with the Styx River estuary / Broad Sound area. No significant residual impacts to habitat supporting these species are expected. Refer Chapter 15 – Aquatic Ecology.</p> <p>Several threatened marine species (marine turtles and inshore dolphin species) may occur in downstream waters associated with the Styx River estuary / Broad Sound area. However suitable habitat for marine species is not considered likely to occur close to the Project area due to the impact of the large tidal regime in the area (much of the river is very shallow and narrow at low tide). Suitable habitat for these species is not considered likely to occur upstream of Rosewood Island (approximately 30 km downstream of the Project boundary). Refer Chapter 15 – Aquatic Ecology.</p> <p>There is potential for groundwater drawdown to impact sensitive vegetation communities that provide habitat for Koala and likely require access to shallow groundwater (RE RE 11.3.25 and 11.3.4). These communities will be subject to vegetation health monitoring and mitigation actions where impacts are detected (refer Section 14.8.11). Where mitigations are unsuccessful these areas will be subject to significant residual impacts.</p> <p>Significant residual impacts limited to areas of cleared habitat for threatened terrestrial fauna only expected. Potential significant residual impacts from groundwater drawdown (refer Section 15.7.10 in Chapter 15).</p>
Connectivity	Includes all remnant vegetation.	<p>The landscape Project impacts to the extent of remnant vegetation in the area have been analysed using EHPs 'landscape fragmentation and connectivity' tool. Refer Appendix A9g – Results of Landscape Fragmentation and Connectivity of the EIS.</p> <p>No significant residual impacts expected.</p>
Designated precinct in a strategic environmental area	Includes areas designated under the <i>Regional Planning Interests Regulation 2014</i>	<p>No strategic environmental area is designated within or near the Project area.</p> <p>Not applicable.</p>
High conservation value wetlands and watercourses	<p>Includes:</p> <ul style="list-style-type: none"> ▪ Wetlands assessed as 'High Ecological Significance' on the map of referable wetlands; or ▪ High Ecological Value (HEV) freshwater and estuarine areas declared under the Environmental Protection (water) Policy 2009 [EPP (water)]. 	<p>Land based wetlands</p> <p>There is a single HEV wetland considered as a 'WPA' on the map of referable wetlands located in the western portion of the ML. Project mine infrastructure does not intersect the 500 m buffer area applied to the WPA. The indicative access road for the CHPP / MIA 1 area and Mount Bison Road is currently proposed to intersect the 500 m buffer area (refer Section 15.7.1). Central Queensland Coal will configure the final design / route for the access road in such a way as to avoid impacts to the WPA.</p> <p>No significant residual impacts expected. Refer Section 15.11.1.4 of Chapter 15.</p> <p>Marine wetlands</p> <p>The middle estuary of the Styx River is mapped as HEV under the EPP (water) approximately 8 km north and downstream of the Project area.</p> <p>No significant residual impacts expected. Refer Section 15.11.1.4 of Chapter 15.</p>

Category	Description	Project applicability
Marine Plants	Protected marine plants as regulated under the <i>Fisheries Act 1994</i> .	<p>Marine Couch was identified along the edge of the Styx River approximately 2.5 km downstream of the Project boundary and is considered a marine plant. Extensive stands of saltmarsh and mangrove species occur downstream of the Project (14 km and 21 km downstream respectively) along the margins of the Styx River and Broad Sound. There are no marine plants within the Project area.</p> <p>There will be no direct impact on marine plants from the Project. The project will not result in indirect damage to marine plants, changes to the marine plant community composition, or cause fragmentation of an ecological community.</p> <p>No significant residual impacts expected. Refer Section 15.11.1.5.</p>
Legally secured offset areas	Includes offset areas legally secured under a registered covenant, easement, conservation agreement or development approval condition.	<p>There are no secured offset areas on or near the Project area.</p> <p>Not applicable.</p>

Project impacts to MSES requiring offsetting under the *Environmental Offsets Act 2014* are based on current DNRME vegetation mapping. A 'Regional Ecosystem assessment request' including vegetation data, GIS data (ESRI shapefiles), and site photographs has been lodged with DES regarding amendments to the vegetation mapping associated with the Property the Project is located on – Mamelon (refer Appendix A19 for request letter and site data). The impacts to regulated vegetation and habitat for MSES fauna species discussed below are based on updated vegetation mapping associated with the assessment request.

14.11.1 High Conservation Value Wetlands and Watercourses

A HEV wetland mapped as a Wetland Protection Area has a low potential to be impacted by groundwater drawdown in the long-term. The wetland has been mapped as RE 11.3.12 under updated vegetation mapping. This community occurs within the predicted zone of groundwater drawdown impact (from 0.1 m - 0.5 m predicted drawdown at maximum extent). Groundwater drawdown may impact woody vegetation in the wetland. However, the reliance of these trees on groundwater remains uncertain and may only occur during very dry conditions. It is likely these trees draw moisture most of the time from the soil water reservoir (refer Section 15.6.4.1 of Chapter 15 – Aquatic Ecology).

This area will be subject to vegetation health monitoring as part of the Project LUMP and WMP. In the event that impacts have been found to occur and mitigation actions are unsuccessful this area will be subject to the Project's environmental OMP.

The waters of Broad Sound are prescribed as HEV marine waters starting 8 km downstream of the Project boundary. Given the distance this area is from the Project site and with the application of mitigation measures described in Section 14.8 and Section 15.8 of Chapter 15 – Aquatic Ecology no significant residual impacts are predicted.

Refer to Section 15.11.1.4 for an assessment using the significant impact criteria regarding wetlands and watercourses described in DES's *Significant Impact Residual Guideline* (EHP 2014). No significant impacts are predicted on either wetland.

14.11.2 Waterways for Fish Passage

Approximately 13.4 km of waterways mapped under the Waterway Barrier Works for Fish Passage mapping layer occurs within the Project area, much of which will be heavily impacted by components of the Project. Central Queensland Coal considers some of these waterways to be incorrectly mapped as discussed in Section 15.7.2 of Chapter 15 – Aquatic Ecology. Should DAF require further assessment and / or consider these areas to be used for fish passage then the extent of area required to be considered for Environmental Offsets (upon discussions with DAF / DES) will be included in the Project OMP refer Section 14.12 and Appendix A18.

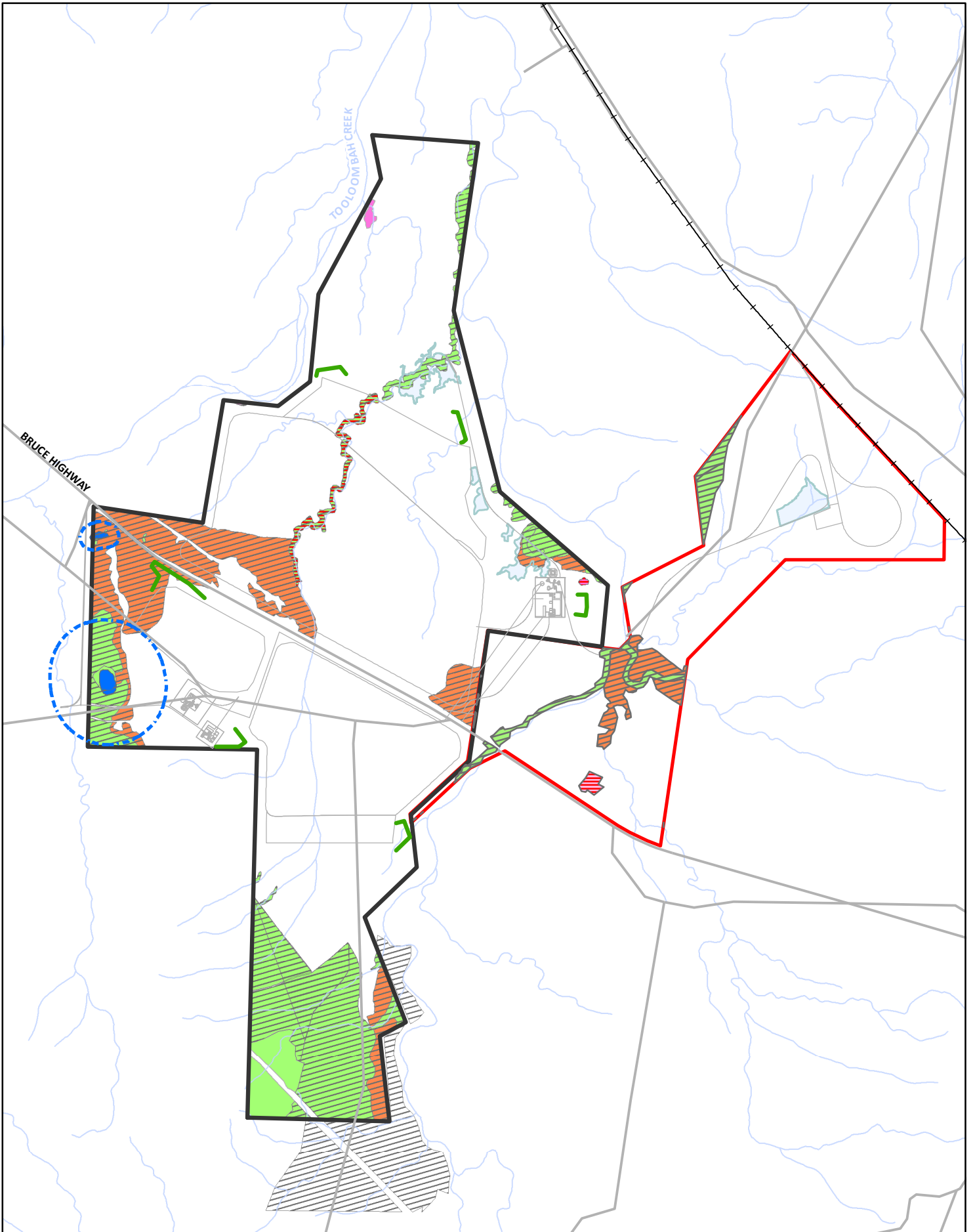
Tooloombah Creek and Deep Creek are waterways mapped as ‘major’ under the Waterway Barrier Works for Fish Passage mapping layer. Sections of these waterways lie within the predicted area of groundwater drawdown as discussed in Section 15.7.2. This includes a low to moderate threat of adverse impact to 4 km of Tooloombah Creek and almost 6 km of Deep Creek, while a high threat is expected at 1.2 km of Tooloombah Creek and 3.7 km of Deep Creek. Waterholes in these waterways will be monitored and subject to supplementary replenishment where drawdown impacts are expected.

14.11.3 Regulated Vegetation

The Project will require the clearing of remnant vegetation considered to be MSES under Criteria 8a i.e. listed as Of Concern or Endangered under the VM Act. Clearing within the mine area and haul road will require the removal of 83.35 ha of Of Concern vegetation (RE 11.4.2 and 11.3.4) (refer Figure 14-9).

The Project will impact watercourse vegetation (Criteria 8e) i.e. vegetation along a watercourse mapped as Least Concern. A total of 3.74 km of lands mapped as ‘watercourse vegetation’ will be impacted by clearing for Waste Rock Stockpile 2 (2.64 km or 5.38 ha of 2nd order watercourse), dam 1 (800 m or 1.6 ha of 2nd order watercourse) and for the haul road (70 m or 0.55 ha across 3rd / 4th order watercourses – Barrack Creek, and 25 m or 0.25 ha across 5th order watercourse – Deep Creek).

There is potential in the long-term for remnant vegetation classified as Least Concern watercourse vegetation to be adversely impacted by groundwater drawdown in the vicinity of open cut mining operations. Where this community occurs within the predicted zone of groundwater drawdown impact these areas will be subject to vegetation health monitoring as part of the Project LUMP and REMP. As described in Section 14.7.10 areas mapped as RE 11.3.25 have a low to moderate threat of being impacted where groundwater drawdown is less than 1 m. Above this level there is a moderate to high threat (Figure 14-10). Areas mapped as RE 11.3.4 are located within the predicted 5 m drawdown contour where a low to moderate threat has potential to occur. In the event that impacts have been found to occur and mitigation actions are unsuccessful these areas will also be subject to the Project’s environmental OMP (refer Section 14.12).



0 0.5 1 km

Scale @ A4 1:50,000
 Date: 21/11/18
 Drawn: Gayle B.

Legend

- Wetland (VM Act)
- Endangered
- Least Concern
- Of Concern
- Ornamental Snake Habitat
- Koala Habitat

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Main Road
- North Coast Rail Line

- Watercourse
- Dam

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018

Figure 14-11
 Mine infrastructure layout
 and MSES values
 (DNRME vegetation mapping)



14.11.4 Habitat for Threatened Fauna

Sections 14.6.2 and 14.6.4 describe the likelihood of occurrence of threatened flora and fauna (listed under the NC Act and / or EPBC Act). Species that are considered unlikely or with potential to occur are not considered further and will not be subject to significant residual impacts from Project activities. There are four terrestrial fauna species listed as Vulnerable under the NC Act (and EPBC Act) which are considered as likely or known to occur in the Project area or immediate surrounds:

- Squatter Pigeon (known to occur);
- Koala (known to occur);
- Greater Glider (known to occur); and
- Ornamental Snake (likely to occur).

Short-beaked Echidna and several migratory bird species are listed as Special Least Concern and considered as likely or known to occur in the Project area. Habitat for migratory species is not considered as a MSES and are not discussed further. These species are considered in more detail in Chapter 16 – MNES.

The most significant impacts for each species and applicable mitigation measures as already detailed in Section 14.8 and Table 14-16 are outlined below. All of these species are included in the Project SSMP (refer to Appendix A19) in which species specific mitigation measures are identified (where necessary) and to be implemented throughout the life of the Project.

Squatter Pigeon

Identified onsite within the proposed mine area, occurring in individuals, pairs or small groups within vegetated and nearby disturbed areas. Substantial amounts of habitat in which this species has been recorded is already cleared of native vegetation. The Project will require clearing of 84.15 ha of potential woodland habitat (RE 11.3.35 and 11.4.2) in which the species may forage. Substantial similar habitat occurs across the wider area and region surrounding the Project. Individuals are expected to naturally move away from clearing and construction activities. Vehicle collisions may represent a long-term threat if individuals remain in the area.

The species remains widespread across northern and central Queensland. No significant impacts to this species are expected from the Project. All of the remnant vegetation impacted by Project activities will be included under the Project OMP (under corresponding vegetation impacts for Koala). Mitigation measures outlined under 'Direct Fauna Mortality' (refer Section 14.9.3) will alleviate the potential impact of vehicle traffic on this species.

Koala

Recorded in several areas throughout activities in 2017 and 2018 carried out within the ML. Primary foraging habitat (where Forest Red Gum occurs) will be intersected by the haul road, Waste Rock Stockpile 2 and Dam 1. The Project will require clearing of 24.07 ha of habitat containing primary feed trees (RE 11.3.4, 11.3.25 and 11.3.27) and 84.15 ha of habitat containing secondary feed trees (RE 11.3.35 and 11.4.2).

Vehicle collisions along the haul road may represent an ongoing threat to the Koala although the Bruce Highway bisecting the Project is likely to represent a greater ongoing threat.

There is potential in the long-term for remnant vegetation that provides suitable habitat for Koala (RE 11.3.25) to be adversely impacted by groundwater drawdown in the vicinity of open cut mining operations. Where this community occurs within the predicted zone of groundwater drawdown impact these areas will be subject to vegetation health monitoring as part of the Project LUMP and REMP. Drawdown of more than 1 m of drawdown is considered a moderate to high threat for riparian areas mapped as RE 11.3.25 (Figure 14-12). In the event that impacts have been found to occur and mitigation actions are unsuccessful these areas will also be subject to the Project's environmental OMP.

Mitigation measures outlined under 'Direct Fauna Mortality' above will alleviate the potential impact of Project-associated vehicle traffic on this species.

Greater Glider

Previous impacts to Greater Glider habitat, as reported in the EIS, have now been avoided through refinement of the Project design.

There is potential in the long-term for remnant vegetation that provides suitable habitat for Greater Glider (RE 11.3.25) along Deep Creek (south of the Bruce Highway) to be adversely impacted by groundwater drawdown in the vicinity of open cut mining operations. Where this community occurs within the predicted zone of groundwater drawdown impact these areas will be subject to vegetation health monitoring as part of the Project LUMP and REMP. Drawdown of more than 1 m of drawdown is considered a moderate to high threat for riparian areas mapped as RE 11.3.25. In the event that impacts have been found to occur and mitigation actions are unsuccessful these areas will also be subject to the Project's environmental OMP under impacts to Koala.

Ornamental Snake

Suitable habitat for this species (regrowth Brigalow on gilgais and cleared gilgai habitat) occurs to the north of the Bruce Highway. The Project will require clearing of 20.9 ha of a narrow strip of remnant riparian vegetation within this habitat which may also provide shelter and foraging habitat (RE 11.3.25). This area will be subject to the Project OMP. The proposed construction of Open Cut 2, Waste Rock Stockpile 2 and CHPP / MIA 2 will clear a substantial portion of the Brigalow regrowth habitat, although it is not known if the species occurs and similar cleared habitat is abundant across the wider area surrounding the Project. Indirect impacts to this species (if it occurs) are restricted to changes to water quality resulting from uncontrolled contaminated runoff entering the minor creek line draining this area and adjacent gilgais / wetlands. The Project EA will require a site Water Management Plan to control contaminated rainfall runoff from the Stockpile and infrastructure areas and environmental dams associated with mine pit water extraction (refer Chapter 9 - Surface Water).

Short-beaked Echidna

The Project will require clearing of remnant habitat suitable for this species. However, Echidna occurs widely across the landscape including cleared areas. A fauna spotter will be present and required to remove individuals during clearing activities. Vehicle collisions also represent an ongoing threat to the Short-beaked Echidna during construction and operation. Mitigation measures outlined under 'Direct Fauna Mortality' above will alleviate the potential impacts of mortality during vegetation clearing and vehicle traffic on this species.

MSES and MNES Significant Impact Assessment

Under the Queensland Environmental Offsets Policy: Significant Residual Impact Guideline (SoQ, 2014) the residual impact criteria for assessing the potential impact of a project's activities are essentially the same as that for Vulnerable MNES fauna under the EPBC Act Significant Impact Guidelines 1.1 (DotEE, 2013) (refer Chapter 16 – MNES). The significant impact criteria assessment for each of the threatened species listed above is presented in Table 14-18 and Table 14-19.

Table 14-18 Assessment against MSES and MNES significant impact criteria

Assessment criterion	Squatter Pigeon (known to occur)	Koala (known to occur)	Greater Glider (known to occur)	Ornamental Snake (likely to occur)
	Assessment against significance criteria			
Lead to a long-term decrease in the size of a local population of the species	Recorded in mine area in woodland and cleared habitat. Extensive habitat surrounds the site. Species is widely dispersed across central Queensland and considered a single population. Expected to leave disturbed area during construction. Unlikely to lead to a decrease of a local population.	Species observed once onsite in woodland habitat. Density of population in area likely to be sparse and therefore widely dispersed. Haul road will bisect suitable habitat and may lead to localised road mortality. Fauna infrastructure will be included in corridor construction to reduce mortality events. Unlikely to lead to a long-term decrease of a local population.	Recorded in woodland south of the highway and outside of disturbance area. Project does not disturb habitat for the species. Remaining habitat within the disturbance footprint appears less favourable. Species is widely dispersed across eastern Queensland and considered a single population. Unlikely to lead to a decrease of a local population.	Not recorded in the Project area. Known from west of Project area. Suitable gilgai habitat (already cleared of vegetation) occurs patchily north of Bruce Highway and will be impacted by clearing activities. Potential indirect impacts restricted to surface water quality downstream of mine activities. With mitigations applied to surface water flows, erosion and sediment controls and water quality monitoring unlikely to lead to a decrease of a local population.
Reduce the area of occurrence of the species	Project will reduce the localised area of occurrence of this species during clearing for construction but given the widespread occurrence of the species this is considered a very marginal impact.	Project will reduce the localised area of occurrence of this species during clearing for construction. Potential for further reduction in suitable habitat due to impact of groundwater drawdown on favoured habitat.	Species only recorded outside of disturbance footprint. Project unlikely to reduce the area of occurrence of this species.	Some suitable habitat to be cleared within the Project area although uncertain if species occurs. Habitat has already been cleared of remnant vegetation. Project unlikely to reduce the area of occurrence of this species during clearing for construction.
Fragment an existing population	Species is widely dispersed across central Queensland and considered a single population. Unlikely to fragment an existing population.	Species is widely dispersed across central and southern Queensland. Haul road crossing bisects suitable habitat connection along Deep Creek, however this habitat is already crossed by the Bruce Highway to the south. Fauna infrastructure will be included in corridor construction. Unlikely to fragment an existing population.	Species is widely dispersed across eastern Queensland. Extensive similar habitat occurs to the south and east of the Project. Unlikely to fragment an existing population.	Suitable habitat to be cleared for the Project is patchy and occurs in the surrounding region. Unlikely to fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Project design and location within surrounding landscape is unlikely to result in habitat isolation of any species.			

Assessment criterion	Squatter Pigeon (known to occur)	Koala (known to occur)	Greater Glider (known to occur)	Ornamental Snake (likely to occur)
	Assessment against significance criteria			
Result in invasive species that are harmful to a vulnerable species becoming established in the species habitat	The Project Environmental Management Plan (EMP) will incorporate a LUMP to control the introduction and spread of weed and pest species across the Project area. The LUMP will be in place for the life of the Project, and will minimise the potential for weed invasion and may in the long-term improve habitat condition within vegetation communities located adjacent to Project infrastructure. The Project is considered very unlikely to result in invasive species becoming established in the Project area to the detriment of any threatened species' habitat.			
Introduce disease that may cause the population to decline	The Project EMP will incorporate the management of invasive species which will assist in the prevention of pest plant introduction and associated diseases resulting from Project activities. Project equipment sourced from overseas will be quarantined as required under State and Commonwealth legislation. The Project is considered unlikely to introduce disease that may cause a population of threatened species to decline.			
Interfere with the recovery of the species	The extent of the Project area is relatively small and no substantial populations of any of the threatened species have been found on the Project site. With mitigation of potential Project impacts through ecological monitoring, surface water management, an offset program and measures incorporated within the Project EMP, any potential impact on a threatened species, should it occur in the Project area, will be minor and is considered unlikely to interfere with the recovery of the species.			
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Project may cause disruption to existing feeding sites where habitat clearing occurs, however the species is often seen feeding in cleared areas.	Project may disrupt suitable feeding locations during clearing for construction. Species known to occur in urban areas. Unlikely to cause disruption to ecologically significant locations during operation.	Species only recorded outside of Project footprint. Project does not disturb habitat for the species. Unlikely to cause disruption to ecologically significant locations during operation.	Project may cause disruption to existing feeding and resting sites where habitat clearing occurs should the species occur onsite.
Assessment of potential for significant residual impacts	No significant residual impacts expected.	Significant residual impacts considered likely to occur through habitat loss.	No significant residual impacts expected.	Project may cause disruption to existing feeding and resting sites where habitat clearing occurs should the species occur onsite.

Table 14-19 Assessment against MSES significant impact criteria: Echidna (special least concern)

Assessment criterion	Assessment against significance criteria
Lead to a long-term decrease in the size of a local population of the species	Sign of species presence (scats) observed onsite. Species is dispersed across the entire continent. No subpopulations noted on mainland Australia. Unlikely to lead to a long-term decrease of a local population.
Reduce the area of occurrence of the species	Species is dispersed across the entire continent. Project is not likely to reduce the area of occurrence of the species in more than a very minor extent.
Fragment an existing population	Species is dispersed across the entire continent. Project will not fragment an existing population.
Result in genetically distinct populations forming as a result of habitat isolation	Species is dispersed across the entire continent. Project will not cause habitat isolation for this species.
Cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species	Species has potential to be encountered at feeding and resting sites during construction clearing. Mitigation measures during construction include presence of qualified fauna spotter / ecologist. Project unlikely disrupt ecologically significant location.
Assessment of potential for significant residual impacts	No significant residual impacts are considered likely to occur for this species.

From the significant impact assessment guidelines for habitat for MSES fauna and flora the following species are considered to have significant residual impacts as a result of Project activities and as a result will be subject to a biodiversity offsets plan:

- Ornamental Snake; and
- Koala.

14.12 Offsets

14.12.1 Introduction

The Queensland Environmental Offsets Policy 2014 identifies an environmental offset as an action taken to counterbalance unavoidable, negative environmental impacts that result from an activity or a development. The policy provides a decision-support tool to enable government agencies assess proposals and ensure the requirements of the EO Act are met.

The EPBC Act Environmental Offsets Policy (2012) defines offsets as measures that compensate for the residual adverse impacts of an action on the environment. In both cases, an offset may be located within or outside the geographic site of the impact and may be applicable once the impacts from an action have been avoided or minimised, as an additional management tool.

Avoidance and mitigation measures are the primary strategies for managing the potential significant impacts of a project. Offsets are not intended to reduce the likely impacts of a proposed project, but to compensate for any residual significant impact.

It is essential for projects to address and incorporate offsets issues and policies early in the project planning lifecycle to avoid impacts, reduce any likely impacts through mitigation, and accept that any residual impacts associated with the project must be offset. Environmental offsets:

- Are necessary to protect or repair impacts to a protected matter;
- Relate specifically to the matter being impacted; and
- Seek to ensure that the health, diversity and productivity of the environment are maintained or enhanced.

14.12.2 Legislation

Offsets are a legislative requirement, with each specific project (or action) having potential offsetting requirements dependent on the relevant project impacts. The Commonwealth and State Governments have a number of requirements under various acts, regulations and policies which need to be addressed for most projects.

The proponent will ensure that the Project meets all offset obligations under Queensland and Commonwealth legislation. Generally, projects will be conditioned as part of the approvals process to provide specific offset outcomes. The Queensland Environmental Offsets Policy promotes coordination of any Australian Government and Queensland Government offset requirements.

14.12.2.1 Commonwealth Legislation

The Commonwealth Government released the EPBC Act Environmental Offsets Policy in October 2012. The policy outlines the DotEE approach to environmental offsets under the EPBC Act. It applies to new referrals and variations to approval conditions from 2 October 2012 and applies to any projects currently under assessment for which a proposed decision has not yet been made.

The key aims of the Policy are to:

- Ensure the efficient, effective, timely, transparent, proportionate, scientifically robust and reasonable use of offsets under the EPBC Act;
- Provide proponents, the community and other stakeholders with greater certainty and guidance on how offsets are determined and when they may be considered under the EPBC Act;
- Deliver improved environmental outcomes by consistently applying the policy;
- Outline the appropriate nature and scale of offsets and how they are determined; and
- Provide guidance on acceptable delivery mechanisms for offsets.

Ten overarching principles are defined in the EPBC Act Environmental Offsets Policy to be applied in determining the suitability of offsets.

The first eight principles require that suitable offsets must:

- Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action;
- Be built around direct offsets but may include other compensatory measures;
- Be in proportion to the level of statutory protection that applies to the protected matter;
- Be of a size and scale proportionate to the residual impacts on the protected matter;
- Effectively account for and manage the risks of the offset failing;
- Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action);
- Be efficient, effective, timely, transparent, scientifically robust and reasonable; and
- Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

The last two principles require that in assessing the suitability of an offset, government decision-making will be:

- Informed by scientifically robust information and incorporate the precautionary principle in the absence of scientific certainty; and
- Conducted in a consistent and transparent manner.

For this Project, offsets required under Commonwealth legislation will be addressed under a separate approvals process.

14.12.2.2 State Legislation

The Queensland DES, Queensland Environmental Offsets Policy provides a single, streamlined framework for environmental offsets which replaces a number of former policies. The framework was introduced in July 2014 and includes:

- *Environmental Offsets Act 2014* – this is the primary legislation that establishes a head of power for the State to impose offset conditions and rules around how offsets will be required and delivered. It outlines offsets will be required to counterbalance a significant residual impact of a prescribed activity on a prescribed environmental matter. Key definitions are established, and it also provides for the making of an Environmental Offsets Policy;
- *Environmental Offsets Regulation 2014* – the regulation defines those prescribed environmental matters that may require an offset and are referred to as “Matters of State Environmental Significance” that may be required to provide an offset. It also sets out the requirements of an Offset Delivery Plan and provisions for advance offsets; and
- *Environmental Offsets Policy 2014* – the policy is where the operational detail and guidance can be found as to how offsets will be assessed and need to be delivered. The policy includes information on the relationship between Commonwealth and State offsets, criteria that offsets must meet, offset delivery options and staging of offsets.

14.12.2.3 Queensland Environmental Offsets Policy

The aim of the Queensland Environmental Offsets Policy is to increase the long-term viability and protection of Queensland’s biodiversity where residual, post-mitigation impacts on Commonwealth MNES, MSES and MLES cannot be avoided. MNES specific to the Project area include impacts to water resources from mining activities, threatened vegetation communities, fauna and flora. Potential impacts to MNES because of the Project are covered in detail in Chapter 16 – MNES.

MSES include designated conservation areas, endangered and of concern REs, high value regrowth and watercourse vegetation, essential habitat for threatened fauna, wetlands and watercourses of high ecological value, and threatened wildlife under the NC Act.

MLES are designated areas or features (not already considered under MSES) by local government under regional planning instruments. Livingstone Shire Regional Council is currently reviewing public comments on the draft *Livingstone Planning Scheme* recently and as such no MLES have been identified. The Project area remains covered under the *2005 Planning – Reprint 6*.

‘Locally significant vegetation’ is identified in small patches of Endangered vegetation (under the VM Act) to the north of the Bruce Highway within the Project area. Much of the continuous habitat that intersects the southern portion of the ML is also considered as ‘locally significant vegetation.’ The scheme identifies Tooloombah Creek Conservation Park as a ‘protected area.’ The eastern

boundary of this area lies less than 1 km west of the Project. These matters are already covered under MSES.

Biodiversity offsets are required where residual impacts to ecological matters of interest remain after all reasonable and practical efforts have been taken to avoid and minimise impacts. Thus, biodiversity offsets are not required where impacts can be effectively mitigated such that no residual impacts remain.

14.12.2.4 Offset Delivery Options

Central Queensland Coal proposes to offset or apply mitigation measures to impacted lands in accordance with the Queensland Environmental Offsets Policy and / or EPBC Environmental Offset Policy including:

- The use of ecological equivalence assessment methodologies to quantify potential offset requirements;
- The identification of potential offset areas that occur on lands adjacent to the Project such as neighbouring properties;
- Consultation with State and Commonwealth agencies to secure offsets;
- Identification of the potential for alternative biodiversity offset strategies such as financial settlement offsets or Direct Benefit Management Plan Offsets as described under Section 2.3.1.2 within the Queensland Environmental Offsets Policy; and
- Where land-based offsets are acquired prepare an OMP that will include:
 - Rehabilitation and planting requirements;
 - Ongoing monitoring and maintenance;
 - Weed and pest management;
 - Fire management; and
 - Flood management.

Further information on the offset delivery options is presented below.

Land-based Offsets

This is referred to as a type of proponent-driven offset. The offset is to deliver a conservation outcome that achieves an equivalent environmental outcome. It must be of a size and scale proportionate to the significant residual impact on MSES. The size of a land based offset can be determined through use of the Land-based Offsets Multiplier Calculator or using a rapid assessment which caps the offset at a ratio of 1:4.

Land-based offsets are to provide EVs as similar as possible to those being lost and may consist of remnant or non-remnant vegetation. Where remnant vegetation is used, management actions are required to demonstrate additional outcomes and enhance the EVs. For example, Endangered and Of Concern RE offsets must be of the same broad vegetation group as the impacted RE, of the same or higher status and within the same bioregion. For flora and fauna species the offset must contain, or be capable of containing, a self-sustaining population of that same impacted species.

The offset site is preferably located in a strategic offset investment corridor closest to the impacted site, and risks of a conservation outcome not being achieved are identified and mitigated. The offset must be legally secured for at least the duration of the impact. The policy provides a number of options for legal security, specifically:

- Voluntary declaration under the VM Act;
- Nature refuge or other form of protected area under the NC Act; and
- Statutory covenant for environmental purposes under the *Land Act 1994* or *Land Title Act 1994*.

Financial Settlement

A financial settlement payment can be used to meet an offset requirement for MSES impacted by a development. It must be calculated using the Financial Settlement Offset Calculation Methodology set out in the Queensland Environmental Offsets Policy. A financial settlement must be paid to the offset account administered by DES prior to project commencement. Financial payments are made up of costs associated with on-ground land management, administration and landholder incentive payment. The impact site needs to be divided into distinct matter areas. Each distinct matter area is then multiplied by four to determine the offset area for payment.

Direct Benefit Management Plan

Proponent-driven offsets can also be delivered through priority actions identified in a Direct Benefit Management Plan (DBMP). DBMPs are pre-approved packaged investments that outline priority actions to address threats to, and provide substantial benefits for, MSES. Examples of DBMP actions are:

- Enhancing, restoring and establishing key habitat across multiple tenures or properties;
- Threat mitigation activities such as weed or feral animal control on a landscape or multiple property scale;
- Research programs that are consistent with published recovery plans, conservation advice statements or government and community established programs; and
- Landscape scale fire management activities.

In electing to provide an offset (or part of) through a DBMP, the proponent will need to include the approved DBMP that relates to the MSES, in an Offset Delivery Plan outlining how the actions will be implemented and demonstration of how proposed actions are additional to existing activities, are cost effective, and will provide a conservation outcome.

14.12.3 Method for Developing Offsets Management Plan

Central Queensland Coal have developed an OMP in accordance with the relevant State and Commonwealth policies, as per the draft OMP in Appendix A18. The Plan will offset the residual impacts detailed in the next section. The aim of the Plan is to provide an overall net environmental gain. Central Queensland Coal considers the most effective and efficient way to achieve this is to provide an OMP which includes all aspects of the Project, rather than a piecemeal approach to offsetting. The Plan incorporates the provision for acquiring future offsets should they be required due to the impacts of future groundwater drawdown, or other unforeseen impacts resulting from Project activities.

Central Queensland Coal will continue to collaborate with the relevant agencies regarding offset options to ensure optimal environmental net benefit. The Plan identifies solutions that:

- Will protect against or repair residual impacts to matters of Commonwealth and State environmental significance;
- Relate specifically to the matter (for example, species or their habitat) being impacted; and
- Seek to ensure that the health, diversity and productivity of the environment are maintained or enhanced.

The key steps for development and implementation of an OMP are as follows:

- Step 1: Identifying and quantifying residual Project impacts;
- Step 2: Identification of applicable offset requirements to address residual Project impacts;
- Step 3: Smart consolidated approach to meeting offset requirements – preparation of Draft Plan;
- Step 4: Relevant agency input and approval of OMP;
- Step 5: Implementation of the OMP; and
- Step 6: Ongoing monitoring of OMP.

Central Queensland Coal has developed a draft OMP that it believes acceptably satisfies approval requirements, in an ecologically strategic manner. The draft OMP includes further ground-truthing verification and detailed assessment of the following aspects:

- Location and type of land / vegetation required to be offset and field assessment of the quality of this habitat (using DES habitat quality assessment guidelines);
- Identification and assessment of land / vegetation that could be utilised in offsets (using detailed analysis of mapping, aerial imagery, and field habitat assessment);
- Land use and land management techniques that will improve on methods contributing to historical degradation; and
- Ongoing monitoring and management techniques and schedules. Applicable recovery plans, EPBC Act Conservation Advice, and Threat Abatement Plans specific to impacted species are also to be used for guidance regarding offset management.

The following section provides a summary of the quality and quantity of areas required to be offset as a result of project activities. This includes habitat quality assessments (as per State guidelines – EHP, 2017) of directly impacted (i.e. vegetation clearing) and potentially impacted (i.e. through future groundwater drawdown) vegetation communities within the Project area. Section 14.12.5 summarises the quality and quantity of proposed offset sites and proposed management of these areas. The draft OMP is presented as Appendix A18. It is anticipated that DotEE and DES will issue a condition of approval, requiring a final OMP to be prepared and submitted for review prior to Project construction occurring.

14.12.4 Potential Residual Impacts

The current Project footprint and design have been planned to avoid significant environmental impacts, where possible or practicable, however, unavoidable residual environmental impacts have been identified. This section identifies the identified and potential future residual impacts that may require offsets.

Potential impacts of the proposed mining activity have been assessed during detailed ecological investigations that were designed to assess current biodiversity values. The potential for significant impacts on MNES have been assessed under the Significant Impact Guidelines for Matters of National Environmental Significance 1.1 (DotEE 2013) and are detailed in Chapter 16 – MNES. Ground-truthed and significant impacts to MNES and MSES within the overall Project area comprise:

- Two Of Concern REs;
- Linear watercourse features as described on the Vegetation Management Watercourse Map; and
- Threatened species habitat for Koala and Ornamental Snake.

There is potential for further MSES to be impacted under the Waterway Barrier Works for Fish Passage mapping layer. Central Queensland Coal considers some of these waterways to be incorrectly mapped (refer Section 15.7.2 of Chapter 15 - Aquatic Ecology) and further discussions are required with DAF as to the requirement for further assessment of these water features.

The Queensland Offsets Policy (Version 1.4, 2017) notes the State can only impose a requirement for environmental offset conditions in relation to a Project 'if the same, or substantially the same impact and the same, or substantially the same matter has not been subject to assessment' under the Commonwealth legislation such as the EPBC Act. Although Commonwealth conditions have not been applied to the Project as yet, it is expected that DotEE will issue conditions requiring environmental offsets for direct impacts to habitat for Koala and Ornamental Snake.

Impacts to vegetation communities associated with Koala include clearing of RE 11.3.4, 11.3.27, 11.3.35 and RE 11.4.2. Two of these communities are also listed as Of Concern under the VM Act and therefore MSES (RE 11.4.2 and 11.3.4). Therefore, environmental offsets imposed by the Commonwealth on impacts to Koala habitat will be for the same impacts for both Koala habitat and Of Concern REs as considered by the State. As such, additional environmental offsets (for MSES) to those imposed by DotEE under MNES should not be required for the Project.

The predicted areas of vegetation clearing impacts based on ground-truthed vegetation mapping (see Section 14.6.2.1) are presented at Table 14-20. These matters entirely overlap, and the overall extent of impact encompasses an area of 104.7 ha. As such, biodiversity offsets will be required.

Table 14-20 Identified residual and potential impacts to MNES and MSES

Matter of concern	Description	Impact area total (ha)
Identified residual impacts		
Habitat for threatened fauna	Ornamental Snake: RE 11.3.25	20.9
	Koala (based on all eucalypt habitat present) – 11.3.4, 11.3.25, 11.3.27, 11.3.35, and 11.4.2.	108.22
Regulated vegetation (Of Concern)	RE 11.4.2	82.75
	RE11.3.4	0.6
Regulated vegetation (watercourse)	Mapped watercourses intersecting remnant vegetation (Least Concern only). Project will impact 1.06 km of 1 st or 2 nd order streams – distance from defining bank 10 m (i.e. 20 m corridor width). Haul road will also intersect 0.19 km of 3 rd and 4 th order stream – distance from defining bank 25 m (i.e. 50 m corridor width) Overlaps with habitat for Koala.	
	Mine area RE11.3.25	2.12
	Haul road RE11.3.25	0.38
	Total Watercourse vegetation	2.5
Overall impact area		108.22 ha

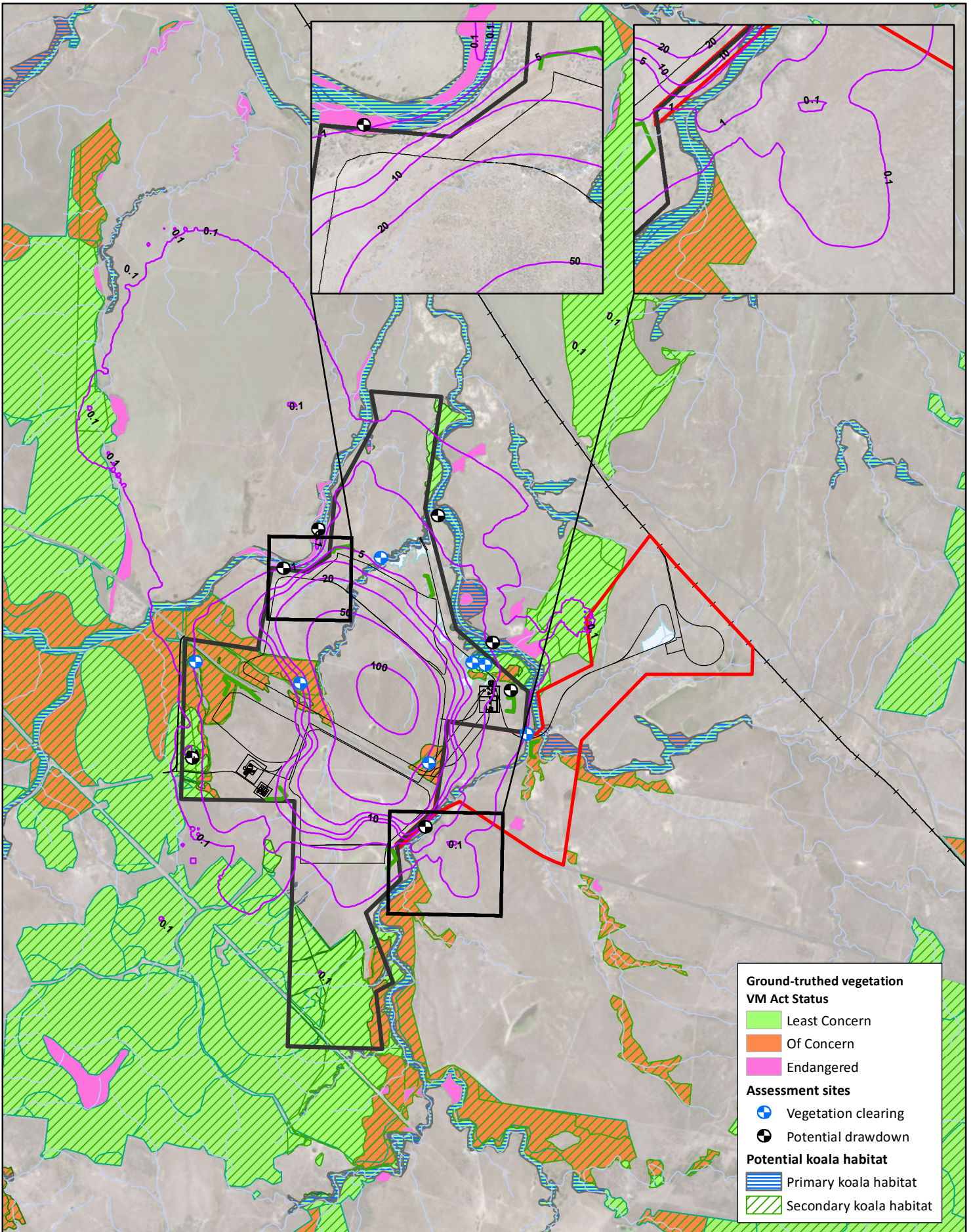
There is further potential in the long-term for impacts to MSES because of possible groundwater drawdown impacts in the vicinity of open cut mining operations which may impact sections of Deep Creek and Tooloombah Creek. This comprises potential impacts to the following:

- A single HEV wetland mapped as a Wetland Protection Area (RE 11.3.12);
- Waterholes in Tooloombah Creek and the lower reach of Deep Creek mapped as ‘major’ waterways under the Waterway Barrier Works for Fish Passage mapping layer; and
- Forest Red Gum communities comprising riparian vegetation (RE 11.3.25 and 11.3.4) which provides foraging habitat for Koala.

The area of impact on these communities is depicted in Table 14-12 and detailed in Table 14-19. It is uncertain at this stage what level of groundwater drawdown may be required to cause impacts to the vegetation communities. Areas mapped as RE 11.3.25 have a low to moderate threat of being impacted where groundwater drawdown is less than 1 m. Above this level there is a moderate to high threat. Areas mapped as RE 11.3.4 are located within the predicted 5 m drawdown contour where a low to moderate threat has potential to occur. These areas will be subject to vegetation monitoring under the Project LUMP and wetland health monitoring and management under the REMP. Where vegetation communities or waterhole habitat are found to be unavoidably impacted by groundwater drawdown these areas will be subject to the Project OMP.

Table 14-21 Potential impacts to MSES vegetation communities (ground-truthed) from predicted groundwater drawdown (maximum extent – 10 years following mine closure)

Extent of predicted maximum drawdown	Potential impact area (ha)		
	Tooloombah Creek	Deep Creek	
	11.3.25	11.3.25	11.3.4
< 1 m	40.3	62.4	-
> 1 m	8.3	34.2	-
< 5 m (RE 11.3.4 only)	-	-	14.25
Total	48.6	96.6	14.25



Ground-truthed vegetation
VM Act Status

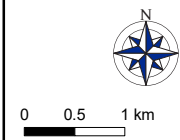
- Least Concern
- Of Concern
- Endangered

Assessment sites

- Vegetation clearing
- Potential drawdown

Potential koala habitat

- Primary koala habitat
- Secondary koala habitat



- Legend**
- ML 80187
 - ML 700022
 - Groundwater drawdown contours
 - Mine infrastructure
 - Environmental Dams
 - Main Road
 - North Coast Rail Line
 - Watercourse
 - Dam

Figure 14-12
 Predicted extent of maximum drawdown impact on MSES vegetation communities

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018
 QLD Department of Environment
 and Heritage Protection, 2016



14.12.4.1 Habitat Quality of Project area

Land-based offsets under the State and Commonwealth Offsets Policies require the quality of vegetation to be at least similar to that impacted. The quality of the vegetation associated with the draft Project OMP (Appendix A18) (both impacted sites and proposed offset sites) has been assessed using the 'Guide to determining terrestrial habitat quality V1.2' (EHP, April 2017) (herein referred to as the Guide). The assessment methods are based on the BioCondition Assessment Manual (developed by the Queensland Herbarium) and align with the habitat quality measures required for input into the EPBC Act 'Offsets Assessment Guide' thereby determining land-based offset ratios. This allows for a consistent framework for environmental offsets between the State and Commonwealth approval process.

The assessment of habitat quality ensures a proposed offset site is of a suitable quality and extent to achieve a gain that is sufficient to compensate for the loss of ecological values (for MSES / MNES) at the Project impact site. The habitat quality of the Project area is summarised below relating to the relevant matter of concern and whether impacts are direct (vegetation clearing) or potentially indirect (future groundwater drawdown).

Direct Impacts – vegetation clearing and Project construction

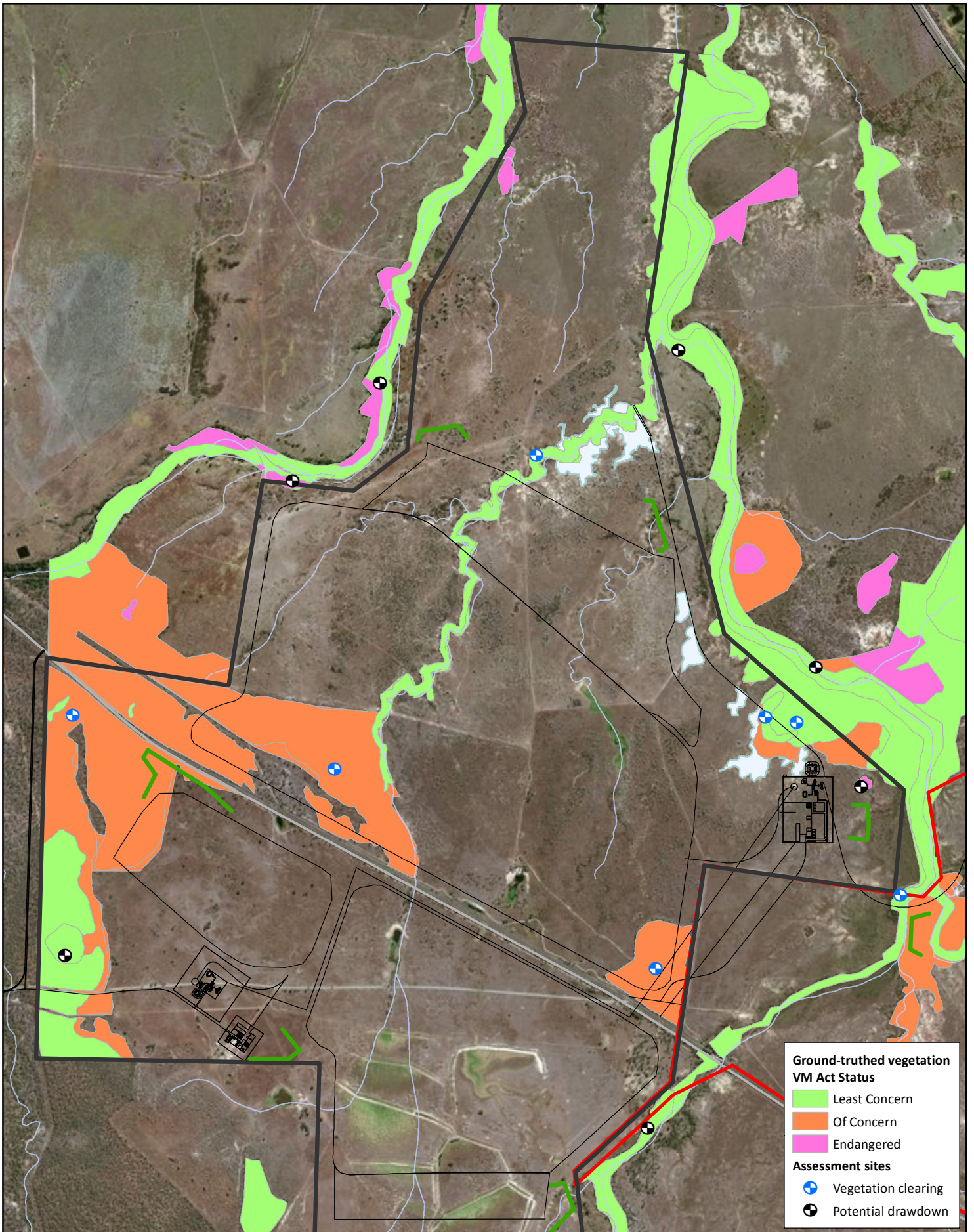
Areas of vegetation on site requiring environmental offsetting due to vegetation clearance comprise:

- Regulated vegetation - two Of Concern REs (RE 11.3.4 and 11.4.2) are mapped as occurring in the Project footprint;
- Regulated vegetation - watercourse vegetation (Least Concern only) as featured on the vegetation management map (RE 11.3.25); and
- The above matters are also mapped as habitat for MNES threatened species - Koala and/or Ornamental Snake (comprising RE 11.3.4, 11.3.25, 11.3.27, 11.3.35, and 11.4.2).

Areas of regulated vegetation and watercourse vegetation impacted by the Project will be offset through proposed offset activities for MNES threatened species habitat. No further offset is required for these MSES. Habitat quality assessments for these areas are discussed below under 'habitat for threatened fauna'.

The Project will also remove several waterways mapped under the 'fish passage' mapping layer. These waterways do not have to be vegetated and are not subject to 'habitat quality assessment'. These areas will be offset using a proposed financial settlement.

The habitat quality assessment of impact sites was carried out in July 2018 and comprised 14 assessment sites as shown in Figure 14-13. Assessment sites comprised seven sites in vegetation communities associated with Project clearing and seven sites associated with potential future groundwater drawdown impacts. This information is also summarised in the draft OMP provided as Appendix A18. The various blocks of vegetation subject to impact are treated in the following sections as two 'assessment units' as referred to in the Guide i.e. for Koala and Ornamental Snake.



Ground-truthed vegetation VM Act Status

- Least Concern
- Of Concern
- Endangered

Assessment sites

- Vegetation clearing
- Potential drawdown

Figure 14-13
Habitat quality assessment sites
– Project impact areas

0 0.5 1 km

Scale @ A4 1:30,000
Date: 01/11/18
Drawn: J Parnwell

Legend

- ML 80187
- ML 700022
- Mine infrastructure
- Environmental Dams
- Cadastral boundary
- Main Road
- North Coast Rail Line
- Watercourse
- Dam

DATA SOURCE
Waratah Coal, 2018
QLD Open Source Data, 2018
QLD Department of Environment
and Heritage Protection, 2016



Under the EPBC Offset Assessment Guide there are three components to be considered when calculating habitat quality: site condition, site context, and species stocking rate. These differ slightly from the DES' Guide which describes site condition, site context and fauna species habitat (i.e. the ability of an area to support the threatened species in focus). The following habitat quality values (for both impact and offset sites) are provisional and based on precedents set under recent projects. As such, the habitat attributes as measured onsite have been apportioned differently to the method in the DES Guide so as to inform the three habitat components described in the EPBC Offset Assessment Guide.

Site condition and site context are described using 15 and seven attributes respectively (refer Appendix A18 for more detail). Species stocking rate is considered as a measure of the species presence on the site. For this assessment species stocking rate has been assessed on a scale of 0 – 4 as described in Appendix A18. The overall scores (out of 10) for site condition and site context have then been weighted at a 30% contribution each to the overall habitat quality score used in the EPBC Offset Assessment Guide (based on level of importance). The species stocking rate number contributes the remaining 40% of the final habitat quality score (refer Appendix A18 for more detail).

Habitat for threatened fauna

Habitat for Koala relates to REs 11.3.4, 11.3.25, 11.3.27, 11.3.35 and 11.4.2 discussed above under 'Regulated Vegetation'. State based offset requirements for offsetting 'Of Concern' regional ecosystems will be discharged by offsetting for species habitat under the EPBC Act.

Habitat for Ornamental Snake relates to RE 11.3.25 as discussed above under 'Regulated Vegetation'.

Habitat quality was assessed following the attributes detailed in the Guide which informs inputs for the EPBC Act Offsets Assessment Guide as directed under the EPBC Act Environmental Offsets Policy. The habitat quality of the Project area for Koala is summarised in Table 14-22 and for Ornamental Snake in Table 14-23. Individual habitat value measures associated with individual assessment sites are provided as appendices to the draft OMP (Appendix A18).

Table 14-22 Habitat quality in the Project area for Koala

Attribute	Discussion	
Area	Koala has been recorded within or adjacent to the proposed impact areas during surveys for the Project. The overall impact area covers a total of 108.22 ha across six areas. These areas consist of grassy ironbark dominated woodlands subject to cattle grazing, and riparian Forest Red Gum habitat.	
Quality		
Site condition	<p>Grassy woodlands encompass 84.15 ha of the overall impact area. These areas are currently subject to cattle grazing. These grassy woodlands comprise a number of eucalypt species suitable for Koala foraging including the dominant Narrow-leaved Ironbark, Poplar Box and Pink Bloodwood.</p> <p>Forest Red Gum open forest (including fringing wetlands) comprises 24.07 ha of the remaining impact area. For the most part these areas exist as a thin degraded strip along a minor waterway and are subject to cattle disturbance. The canopy is dominated by Forest Red Gum and is a favoured forage tree species for Koala. The understorey often comprises shrubby weed species including Lantana and Rubber Vine. Weed cover in riparian REs was well above benchmark conditions.</p> <p>Site assessments indicated tree height and canopy cover in the woodland sites and riparian forest sites are comparable to benchmark sites for the same vegetation communities as set out under the BioCondition benchmarks for the Brigalow Belt (Queensland Herbarium 2016).</p>	
Site context	<p>Koala occurs as far north as the Atherton Tablelands in north Queensland, into southern Australia, and extends west into central Queensland. The impact sites occupy a very small area within the species overall distribution and is very unlikely to be of importance to the overall population. Given the relatively small area the impact sites occupy across the Koala's wider distribution it is likely the local population plays a very minor role in relation to the overall population.</p> <p>The impact areas are located in a fragmented landscape and are located outside of any ecological corridors (as mapped by DES). Nevertheless, tracts of similar eucalypt woodland habitat occur adjacent to the west and further to the south of the proposed impact areas. Riparian open forest occurs along the eastern boundary and to the north and north-west of the impact area providing habitat connectivity to woodlands to the east and west. Much of the Project impacts already cleared lands and the Project will not further fragment surrounding habitat.</p> <p>The woodland impact sites comprise the majority of the impacted area and lie adjacent to the Bruce Highway, thereby providing an elevated risk of road collisions in these sites. Dingo / wild dog (a known risk to Koala) has been sighted in the Project area on several occasions during Project surveys.</p>	
Species stocking rate	<p>The species has been identified on six occasions during spotlighting surveys in or near the impact sites (four individuals over four separate spotlighting events) and camera trapping further to the south of the Project area (two records).</p> <p>There is no local data as to the species population density in the area. Further west in the Springsure area the species uses an average home range of 38 ha (females) to 80 ha (male) (Melzer 1995). Individuals further north (Blair Athol) occupy larger home ranges of 101 ha (females) to 135 ha (male) (Ellis et al. 2002).</p> <p>Given only individuals have been observed during surveys the species appears occur at low densities across the local area. As such a 'stocking rate' number of 1 has been attributed to the impact sites.</p>	
Assessed habitat quality value	5	As per desktop and habitat attributes measured using the DES Guide and species stocking rate as per the EPBC Act Offsets Assessment Guide (refer Appendix A18 for site attribute details and calculations).
Total quantum of impact (adjusted ha)	54.1	As per the results of the EPBC Act Offsets Assessment Guide (refer Appendix A18 for output results).

Table 14-23 Habitat quality in the Project area for Ornamental Snake

Attribute	Discussion	
Area	Ornamental Snake has been recorded 3 km to the west of the proposed impact areas during surveys for the Project in 2011/2012. The species has not been detected within the Project area. The overall impact area covers a total of 20.9 ha across two areas of riparian Forest Red Gum habitat, located within a matrix of cleared Brigalow habitat with gilgais on cracking clay soils.	
Quality		
Site condition	<p>The impact site exists as a thin degraded strip along a minor waterway located within a matrix of cleared Brigalow habitat with gilgais on cracking clay soils. This habitat is subject to cattle disturbance. The understorey comprises a range of SEVT species and shrubby weed species including Lantana and Rubber Vine.</p> <p>Site assessments indicated that suitable habitat factors (presence of coarse woody debris) were well below the benchmark data for the same vegetation community as set out under the BioCondition benchmarks for the Brigalow Belt (Queensland Herbarium 2016). Weed cover was also well above benchmark conditions.</p>	
Site context	<p>Ornamental Snake occurs as far north as Charters Towers in north Queensland, west to Emerald and the Belyando River and south into the Dawson River floodplain. The species has not been identified on or near the impact sites which occupy a very small area within the species overall distribution. Given the relatively small area the impact sites occupy across the Ornamental Snake's wider distribution it is likely any local population, should one occur in the area, plays a very minor role in relation to the overall population.</p> <p>The impact areas are located in a heavily fragmented and cleared landscape. Extensive similar habitat occurs to the west of Tooloombah Creek where the species was identified in remnant Brigalow habitat in 2011 / 2012. Similar cleared habitat also occurs to the immediate north to the confluence of Deep Creek and Tooloombah Creek, and cleared habitat to the west of Deep Creek.</p> <p>Dingo/wild dog and feral cat have been sighted in the Project area on several occasions during Project surveys and Cane Toad has been sighted on most surveys. The site is subject to invasive weeds which may also impact the values of habitat for the species.</p>	
Species stocking rate	<p>The species has not been identified on the site despite extensive survey effort. The species has been identified 3 km to the west in remnant Brigalow habitat in 2011/2012.</p> <p>There is no data available as to the species population density. Observations elsewhere in central Queensland (the Belyando River floodplain) indicate the species may be common where suitable habitat occurs (pers. Comm. B. Taylor).</p> <p>Given the species has not been identified on the site a 'stocking rate' number of 0 has been attributed to the impact sites.</p>	
Assessed quality value	3	As per desktop and habitat attributes measured using the DES Guide and species stocking rate as per the EPBC Act Offsets Assessment Guide (refer Appendix A18 for site attribute details and calculations).
Total quantum of impact (adjusted ha)	6.27	As per the results of the EPBC Act Offsets Assessment Guide (refer Appendix A18 for output results).

Indirect Impacts – groundwater drawdown

Groundwater drawdown has potential in the future to impact vegetation requiring access to groundwater. The groundwater assessment for the Project has identified the potential for impacts to GDEs including MSES-associated vegetation communities dominated by Forest Red Gum (RE 11.3.25). The maximum predicted extent of impacts from groundwater drawdown (i.e. 10 years following the cessation of mining activities) may impact 42.5 ha of RE 11.3.25 where the drawdown is predicted to exceed more than 1 m (Moderate to high chance of impact), and 102.7 ha where drawdown is less than 1 m (low to moderate chance of impact). Drawdown has a low to moderate chance of impacting 14.25 ha of RE 11.3.4 where drawdown is less than 5 m and the water table sits above 10 mbgl. These and adjacent areas will be subject to vegetation health monitoring throughout the life of the Project. Should impacts be identified these will require further offsets located outside the boundary of potential groundwater drawdown impacts.

Areas of vegetation on site that may require environmental offsetting due to the predicted effects of future groundwater drawdown comprise:

- Watercourse vegetation (Least Concern only) as featured on the vegetation management map (RE 11.3.25);
- RE 11.3.25 and RE 11.3.4 are mapped as habitat for a MNES threatened species - Koala;
- A HEV wetland mapped as a Wetland Protection Area (RE 11.3.12); and
- Waterways mapped under the 'Waterway barrier works for fish passage' mapping layer.

Habitat for Threatened Fauna

Habitat for Koala relates to RE 11.3.25 and 11.3.4. The habitat quality of the Project area to the Koala is summarised in Table 14-24 and is based on four assessment sites (Figure 14-13). Individual habitat value measures associated with individual assessment sites are provided as attachments to the draft OMP located in Appendix A18.

Table 14-24 Habitat quality for Koala – predicted groundwater drawdown zone

Attribute	Discussion	
Area	Koala has been recorded in the local area during surveys for the Project and is therefore likely to use the Forest Red Gum community (RE 11.3.25) along the adjacent creek lines. The overall potential maximum groundwater drawdown impact area (refer Figure 14-12) covers a total of 159.45 ha across the two creeks (Table 14-21).	
Quality		
Site condition	<p>These areas exist as a relatively thin degraded strip along Tooloombah Creek. This habitat is more variable along Deep Creek with some areas buffered by adjacent floodplain vegetation. Deep Creek appears less subject to cattle disturbance. The canopy is dominated by Forest Red Gum and is a favoured forage trees species for Koala. The understorey often comprises shrubby weed species including Lantana and Rubber Vine.</p> <p>Site assessments indicated tree height and canopy cover in the woodland sites and riparian forest sites are comparable to benchmark sites for the same vegetation communities as set out under the BioCondition benchmarks for the Brigalow Belt (Queensland Herbarium 2016).</p>	
Site context	<p>Koala occurs as far north as the Atherton Tablelands in north Queensland, into southern Australia, and extends west into central Queensland. The site occupies a very small area within the species overall distribution and is very unlikely to be of importance to the overall population.</p> <p>The potentially impacted areas are located in a fragmented landscape. Riparian open forest extends to the north and south.</p> <p>The southern extent of the drawdown area potentially impacting Deep Creek lies adjacent to the Bruce Highway providing an elevated risk of road collisions in these sites. Dingo/Wild Dog has been sighted in the Project area on several occasions.</p>	
Species stocking rate	<p>The species has been identified on six occasions during spotlighting in the area (four individuals over four separate spotlighting events) and camera trapping further to the south of the Project area (two records).</p> <p>There is no local data as to the species population density in the area. Given only individuals have been observed during surveys the species may occur at low densities across the local area. Further west in the Springsure area the species uses an average home range of 38 ha (females) to 80 ha (male) (Melzer 1995). Individuals further north (Blair Athol) occupy larger home ranges of 101 ha (females) to 135 ha (male) (Ellis et al. 2002).</p> <p>Given the relatively small area the impact sites occupy across the Koala's wider distribution it is likely the local population plays a very minor role in relation to the overall population.</p>	
Assessed habitat quality value	5	As per the <i>Guide to determining terrestrial habitat quality. A toolkit for assessing land based offsets under the Queensland Environmental Offsets Policy V1.2</i> (SoQ, April 2017) (refer Appendix A18 for baseline data).

Attribute	Discussion	
Total quantum of impact (adjusted ha)	79.5	As per the results of the EPBC Act Offsets Assessment Guide (refer Appendix A18 for output results).

14.12.5 Offset Activities

Under the EPBC Offsets Policy it is recognised that direct land-based offsets should comprise a minimum of 90% of the offset requirements for any given impact. At this stage, the residual significant impacts due to vegetation clearing for the Project is 108.22 ha of MSES / MNES associated vegetation. Central Queensland Coal Project will liaise with DES and DotEE to discuss the preferred approach and outcomes for offsetting these impacts.

14.12.5.1 Proposed Offset Site

Mamelon Property

Central Queensland Coal owns the Mamelon property, of which the majority of the Project's disturbance footprint occurs. Central Queensland Coal will utilise areas outside of the ML and within Mamelon for offsetting purposes for predicted residual impacts of the Project. Central Queensland Coal will seek to achieve synergistic habitat and conservation benefits through the retention and improvement of existing vegetation, and the rehabilitation of previously cleared lands on the property. Central Queensland Coal considers that, with suitable management of the available lands on the property (outside of the Project footprint), a conservation benefit can be derived that goes well beyond the immediate direct impacts of vegetation clearing for the Project.

Mamelon encompasses a total area of 6,478 ha of which the Project ML covers 2,275 ha. This leaves a total of 4,203 ha remaining outside of the Project boundary with significant portions remaining as remnant vegetation largely subject to cattle grazing impacts. A summary of the remnant vegetation remaining on the property and outside the Project footprint as mapped under State vegetation mapping is provided at Table 14-25.

Although the Project will result in a small loss of habitat for listed species, the improvement of habitat and management of potentially threatening processes (such as weed invasion and uncontrolled bushfires), on the property and adjacent to the project is anticipated to compensate and reduce the residual impact of that loss.

The property is topographically complex with two central rocky hills encircled by foothill slopes and alluvial flats bordered by Deep Creek to the south and Tooloombah Creek and a major tributary to the north and west. As such the property comprises a range of habitat types. Within the wider landscape Mamelon is well connected to a large remnant habitat patch to the north and less well connected to several large patches to the south, west, east and north-east. These patches, particularly to the south, provide linkages to extensive habitat in the Connors Range. Mapping under the Queensland Biodiversity Planning Assessment process (BPA) for state-wide ecological corridors shows the property, along with adjacent large remnant vegetation patches, can provide a link between two ecological corridors considered to be of 'State' importance (Figure 14-3). The restoration of previously impacted habitat on Mamelon property will help to improve / restore these links.

Remnant Vegetation

A total of 2,590 ha of remnant vegetation occurs on Mamelon outside of the Project ML. The major direct impact to MSES / MNES as a result of the Project is to habitat for Koala. Current vegetation

mapping indicates that up to 792 ha of remnant vegetation is available within Mamelon that provides favoured foraging habitat for Koala and is suitable for Squatter Pigeon and Greater Glider (all species that are known to occur in the area). This includes 74.4 ha of vegetation comprising primary foraging habitat for Koala (RE 11.3.4 and 11.3.25). There is a further 1,736 ha of eucalypt habitat which the species may also utilise and in which it has been recorded during Project surveys (Figure 14-14). In addition, there is currently 4.6 ha of habitat mapped as threatened REs and as EPBC Act-listed TECs: Brigalow vegetation (RE 11.4.9), and 45 ha of SEVT vegetation. Inspection of aerial imagery indicates this may be a substantial underestimation of the extent of SEVT on the property (with other patches seemingly present on west facing slopes of the rocky hills to the west of the highway).

Within the Project ML itself there are an additional 402 ha of remnant vegetation that will not be impacted under the Project footprint. Ground-truthing vegetation surveys indicate this includes 357 ha of vegetation suitable for Koala (RE 11.3.25, 11.3.27, 11.3.35, 11.4.2, 11.5.8a, 11.10.7 and 11.11.15a) and therefore also suitable for potential use as environmental offsets for the project.

All of the remnant habitat as described is currently subject to varying degrees of cattle grazing. The majority of the remnant vegetation located outside of the Project ML is Least Concern and under current legislation. Central Queensland Coal proposes to remove cattle from the majority of the property and manage the remaining remnant vegetation (through weed and fire management) thereby improving habitat values for fauna on the site.

Table 14-25 Mamelon property - remnant vegetation (DNRME) outside of Project footprint

RE	Area (ha)	Suitability for MNES
Area outside of Project ML		
11.3.4	15.5	Variety of eucalypt species present including Forest Red Gum. Suitable for Koala.
11.3.25	58.9	Canopy dominated by Forest Red Gum. Occurs along creek lines. Suitable for Koala and potentially Ornamental Snake.
11.3.29	125.2	Variety of eucalypt species present over <i>Melaleuca</i> understorey. Suitable for Koala.
11.4.2	219.2	Poplar Box dominated woodland. Suitable for Koala.
11.4.9	4.6	Brigalow (TEC). Suitable for Ornamental Snake.
11.5.8a/11.7.2	344.1	Variety of eucalypt species present in 11.5.8a (90% dominance in community polygon) including Forest Red Gum. Suitable for Koala. <i>Acacia</i> species dominate 11.7.2 which is generally unsuitable for Koala.
11.10.7	488.6	Narrow-leaved Ironbark dominated woodland. Foraging habitat for Koala.
11.10.7/11.10.1	638.1	Narrow-leaved Ironbark dominated woodland for 11.10.7 (90% dominance in community polygon). Foraging habitat for Koala. 11.10.1 Dominated by Spotted Gum (<i>Corymbia citriodora</i>) with other species. Suitable for Koala.
11.11.1	135.0	Narrow-leaved Ironbark dominated woodland. Foraging habitat for Koala.
11.11.15a	538.4	Narrow-leaved Ironbark dominated woodland. Foraging habitat for Koala.
11.11.18	45.6	Semi-evergreen vine thicket (TEC).
Total remnant	2,590	
Area ground-truthed within Project ML (outside footprint)		
11.3.11	2.2	SEVT along creek lines.
11.3.12	4.2	Broad-leaved Paperbark over an ephemeral wetland.
11.3.25	5.3	Canopy dominated by Forest Red Gum. Occurs along creek lines. Suitable for Koala.
11.3.27	1.2	Forest Red Gum over ephemeral wetland depression. Suitable for Koala.
11.3.35	27.3	Poplar Gum dominated woodland. Foraging habitat for Koala.
11.4.2	126.5	Poplar Box dominated woodland. Suitable for Koala.
11.4.9	0.54	Brigalow (TEC). Suitable for Ornamental Snake.
11.5.8a	33.4	Variety of eucalypt species present in 11.5.8a (90% dominance in community polygon) including Forest Red Gum. Suitable for Koala.
11.10.3	36.6	Lancewood dominated open forest.
11.10.7	76.4	Narrow-leaved Ironbark dominated woodland. Foraging habitat for Koala.
11.11.15a	88.3	Narrow-leaved Ironbark dominated woodland. Foraging habitat for Koala.
Total remnant	401.94	

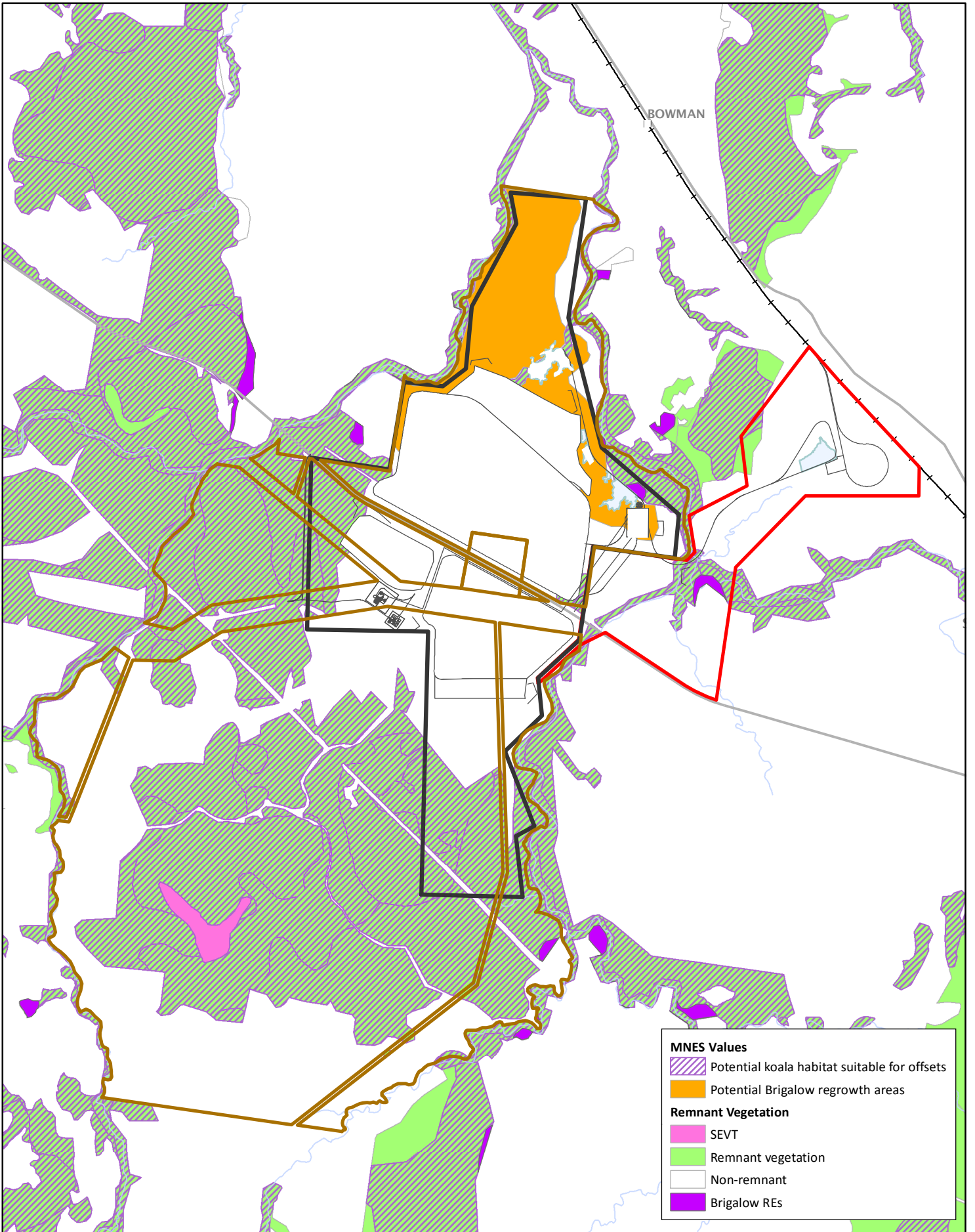


Figure 14-14
 Mamelon property – remnant vegetation suitable for MNES habitat offsets



0 0.5 1 km

Scale @ A4 1:70,000
 Date: 08/11/18
 Drawn: Gayle B.

Legend

- ML 80187
- ML 700022
- Mamelon Property
- Mine infrastructure
- Main Road
- North Coast Rail Line
- Watercourse
- Dam

DATA SOURCE
 QLD Spatial Catalogue (QSpatial), 2017



14.12.5.2 Proposed Offset Areas

Central Queensland Coal proposes three specific Offset Management Areas (OMA) within Mamelon to manage the significant residual impacts resulting from the Project works as depicted in Figure 14-15. Although it is noted the intention is to manage the entire property for conservation purposes into the future. Vegetation communities identified as potential offset locations on the property, were assessed during assessments carried out in August 2018. A total of 18 assessment sites were established as per the Guide (Figure 14-15). The OMAs were selected based on their potential to acquit the Project's offset requirements.

The RE composition of each proposed OMA is detailed in Table 14-26. This information is also provided in the draft Offset Management Plan provided as Appendix A18.

Table 14-26 Styx Project Offset management areas – ground-truthed RE composition

RE	Area (ha)	Suitability for MNES
OMA 1		
11.3.25	6.19	Canopy dominated by Forest Red Gum. Suitable for Koala.
11.3.35	29.33	Variety of eucalypt species. Suitable for Koala.
11.4.2	118.9	Narrow-leaved Ironbark / Poplar Box dominated woodland. Suitable for Koala.
11.4.9	2.35	Brigalow (TEC). Suitable for Ornamental Snake.
11.11.15a	84.7	Narrow-leaved Ironbark dominated woodland. Suitable for Koala.
Non-remnant	13.54	Cleared habitat, potentially suitable for Ornamental Snake.
Total area	255.01	
OMA 2		
11.3.4	2.12	Canopy dominated by Forest Red Gum with other eucalypt species. Suitable for Koala.
11.3.25	16.62	Canopy dominated by Forest Red Gum. Suitable for Koala.
11.4.2	28.99	Narrow-leaved Ironbark / Poplar Box dominated woodland. Suitable for Koala.
11.9.7	8.03	Narrow-leaved Ironbark dominated woodland. Marginal foraging habitat for Koala.
11.10.7	8.15	Narrow-leaved Ironbark / Poplar Box dominated woodland. Suitable for Koala.
Non-remnant	37.82	Cleared habitat with partial regrowth. Suitable for restoration of Koala habitat.
Total area	101.73	
OMA 3		
Non-remnant (total area)	128	Cleared gilgai habitat with scattered regrowth Brigalow, suitable for Ornamental Snake and restored as Brigalow TEC.

The surveys specifically identified the following REs associated with Project impacts to Koala habitat within the designated OMAs (refer Figure 14-15):

- RE 11.4.2 - 147.89 ha;
- RE 11.3.4 - 2.12 ha;
- RE 11.3.35 - 129.33 ha; and
- RE 11.3.25 - 22.95 ha.

There is an additional 100.88 ha of remnant vegetation within the OMAs also considered suitable for Koala due to the presence of forage species including Narrow-leaved Ironbark and Poplar Box (RE 11.9.7, 11.10.7 and 11.11.15a). In total OMA 1 and OMA 2 comprise 303.03 ha of remnant habitat suitable for Koala. OMA 3 comprises 128 ha of non-remnant habitat considered suitable to support Ornamental Snake.

An assessment of the Mamelon OMAs suitability to achieve positive environmental outcomes for impacted MSES / MNES matters (namely Koala and Ornamental Snake) has been carried out using

the EPBC Act Offsets Assessment Guide. Based on the assessment the proposed OMAs can acquit the Project's direct impacts resulting from vegetation clearing.

EPBC Act Offset Assessment Calculations

The habitat assessment surveys examined the habitat quality of proposed offset areas, and enabled calculations of the habitat value of the proposed area (accounting for averted loss and quality improvements) to be undertaken following the EPBC Act Offsets Assessment Guide calculator.

Considering the assessment described above (incorporating current habitat quality of the proposed offset sites, habitat improvement measures and risk of loss), the proposed offset locations will exceed the offset requirements for the Project. The areas of habitat will constitute more than a 'like-for-like' offset provided habitat management practices identified are implemented over the area.

A copy of the offset calculations are provided as an appendix to the draft OMP (Appendix A18). Table 14-27 discusses the inputs to the EPBC Act offsets assessment guide for Koala habitat. Both OMA 1 and OMA 2 have been assessed as a combined entity as habitat quality within the areas were considered the same through the results of the habitat quality assessments. Table 14-28 summarises the inputs to the EPBC Act offsets assessment guide for Ornamental Snake habitat associated with OMA 3.

Based on the output from the EPBC Act Offset Assessment Guide the OMAs will acquit the Project's environmental offset requirements for both species. The property is considered more than likely to be able to acquit additional impacts resulting from groundwater drawdown on Koala habitat in the future (as identified in Table 14-21), should they occur. Offset calculations based on the maximum total area of predicted drawdown impact (135.3 ha) and the habitat attributes detailed in Table 14-27 indicate, in the unlikely event of this occurring, 407 ha of lands will be required to acquit this loss. There are extensive areas of eucalypt woodlands remaining on the property which are suitable for Koala (refer Table 14-25) and can then be used for further offsets into the future.

Table 14-27 Summary of offset calculations and habitat values for Koala as per EPBC Act Offsets Assessment Guide – OMA 1 and OMA 2

Attribute	Rating	Discussion
Start habitat quality	5	<p>There are six records of Koala from the property from fauna surveys in 2017 and 2018 (refer Figure 14-8). Two of these are located 800 m and 300 m (respectively) to the west of OMA 1. Given the proximity of the records to the OMAs the species is expected to occur in these areas. The site assessment observed the woodland areas (RE 11.4.2) had been subject to 'heavy logging' (particularly of ironbarks) with few large trees present. The impact of heavy cattle grazing were also noted at assessment sites. The understorey of riparian open forest was noted as having a relatively dense understorey of Lantana at all survey sites. Lantana thickets may restrict Koala movement (DECC 2008) and thereby access to forage trees.</p> <p>OMA 2 and OMA 3 both comprise remnant vegetation that connects vegetation on Mamelon with tracts to the immediate south. The retention and improvement of these areas, along with regeneration of cleared lands elsewhere on the property will improve these connections as well as improving habitat for Koala in the local for the long-term.</p>

Attribute	Rating	Discussion
Risk of loss (%) without offset	10	<p>Without the establishment of the proposed OMAs there will be continued cattle grazing (through agistment practises as is currently carried out) impacting canopy tree recruitment, associated land management practises, and impacts of unmanaged weeds. Site assessments indicated that past thinning / logging of these areas has occurred in the past to increase productivity of cattle grazing.</p> <p>It is reasonable to assume these management practises would continue into the future, potentially degrading the habitat present further. However, recent changes in the Qld VM Act may decrease the potential for clearing / thinning activities to occur. Where other normal land management practices are considered to continue into the future then a 10% risk of loss is considered reasonable.</p>
Future habitat quality without offset	5	<p>Continued cattle grazing in the OMAs will lead to long-term degradation of suitable habitat for Koala including overgrazing and soil compaction. Riparian habitat is also at risk from the proliferation of existing weed species such as dense patches of Lantana which can impact Koala access to forage trees and suppress canopy tree recruitment. Woodland habitat has potential to be impacted by uncontrolled and high intensity bushfires which may cause direct Koala mortality and impact woodland habitat through mortality of mature and juvenile forage trees. Feral dogs/Dingos may impact Koala through predation through direct predation.</p> <p>Nevertheless, it is reasonable to assume that current management practises would continue into the future and therefore the current habitat quality of the subject lands will be retained into the future.</p>
Risk of loss (%) with offset	0	<p>The Mamelon property will be managed for conservation purposes (excluding the mine footprint). The OMAs will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. This protection mechanism will preclude development within the designated OMAs for the current landowners (Fairway Coal) and for any future landowners. With intended land management practises to be carried within the OMAs there will be no loss of habitat quality and it is expected there will be improvement over time.</p>
Future habitat quality with offset	7	<p>Habitat quality for Koala will be improved by the application of active habitat management across Mamelon property with a specific emphasis on the OMAs. 'Future quality' will be improved and will be represented by an improvement in the habitat quality score as measured by annual habitat and biannual fauna monitoring assessments. An OMP will be developed detailing generic management measures and Koala presence monitoring to be applied across Mamelon and specific management measures for the OMAs. Management actions will be developed and guided by the approved Commonwealth 'Conservation Advice' for the species. There are no recommended threat abatement plans of recovery plans for the species. Management actions will include (but not be restricted to):</p> <ul style="list-style-type: none"> ▪ Removal of cattle grazing to eliminate degrading processes such as soil compaction, and suppression of native tree regeneration; ▪ Increased tree cover by allowing canopy species recruitment; ▪ Fire management to eliminate the potential for high intensity bushfires which may cause direct Koala mortality, and mortality of canopy trees and and juvenile canopy trees; ▪ Managing problem weed species including Lantana (already known on-site) which can impede Koala access to forage trees and suppress native tree recruitment. Pest and weed management within Mamelon and the OMAs will be integrated with measures within the Project LUMP; and ▪ Managing pest species as part of an integrated including potential predators (e.g. feral Dogs / Dingos).

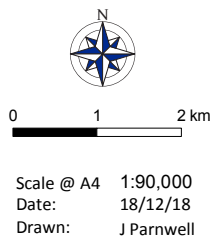
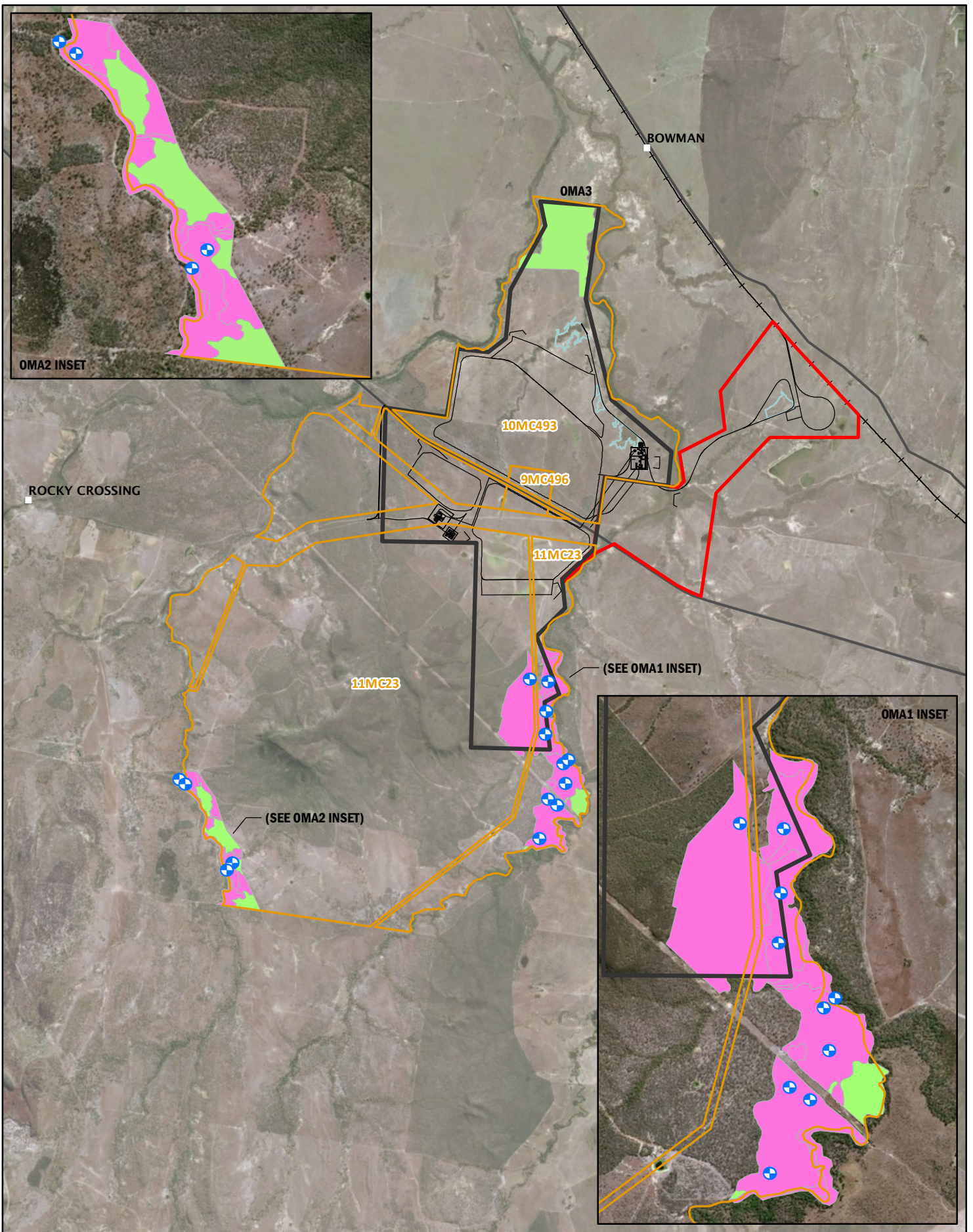
Attribute	Rating	Discussion
Confidence in result (habitat quality)	90%	There is an inherent risk in restoring ecological communities as present conditions may differ from historic conditions in which the community developed. As a result it may be difficult to predict with accuracy the direction of restoration development. Nevertheless, with the application of management measures within the OMP including detailed and measurable objectives, and habitat (and species monitoring) monitoring to measure progress, there is a high degree of confidence the future habitat quality score can be realised. This is reflected in a 'confidence' score of 90%.
Confidence in result (averted loss)	90%	<p>There is reasonable confidence that without protection and improved land management the area will be subject to continued cattle grazing and continue to decline in habitat quality. The management measures to be applied as part of the OMP are standard methods and widely used. Improvement in habitat quality measures is expected to be gradual but almost certain.</p> <p>Mamelon property including the designated offset areas (excluding the mine footprint) will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. This protection mechanism will preclude development within the designated OMAs for the current landowners (Fairway Coal) and for any future landowners.</p>
Time over which loss is averted	20	The Mamelon property will be managed for conservation purposes (excluding the mine footprint). The OMAs will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. As such the 'time over which loss is averted' is considered as the maximum available time – 20 years.
Time until ecological benefit	15	<p>OMA 1 and OMA 2 comprises 303.03 ha of habitat considered suitable for Koala and the species is likely to occur in the area. Management of the offset will include the removal of cattle, fire and weed and pest management. This will have relatively immediate ecological benefits in the OMAs through the control of introduced predator impacts on the species. Other ecological benefits will take time to provide measurable ecological gains given the dry nature of the habitat in focus. An increase in the habitat quality score within a 15 year period will be achieved through the following:</p> <ul style="list-style-type: none"> ▪ Reducing degrading processes (particularly soil compaction and canopy tree recruitment) through the removal of cattle; ▪ Managing high intensity bushfires in eucalypt habitat; ▪ Managing problem weed species including Lantana which can suppress canopytree recruitment and impede access to forage trees where present; and ▪ Managing pest species including potential predators (e.g. feral Dogs / Dingos).
Final % of impact offset	109.9	As per EPBC Act Offset Assessment Guide output (refer Appendix A18)

Table 14-28 Summary of offset calculations and habitat values for Ornamental Snake as per EPBC Act Offsets Assessment Guide – OMA 3

Attribute	Rating	Discussion
Start habitat quality – OMA 3	3	<p>There are no records of Ornamental Snake from the property. However, the species has been recorded nearby during earlier Project surveys in 2011 / 2012. OMA 3 has been cleared in the past and now comprises non-remnant habitat with patchy Brigalow and Belah regrowth and gilgai formations. The introduced Buffel Grass is prevalent in the ground layer. The offset area is located between Tooloombah Creek and vegetation abutting Deep Creek. Therefore the offset also provides opportunity to increase Brigalow TEC in the landscape and increase landscape connectivity by creating a vegetation connection between the two creek lines.</p> <p>OMA 1 is considered to present ample opportunity to improve the condition of lands suitable for Ornamental Snake due to the presence of primary habitat features for the species presence – cracking clay soils and gilgai formations.</p>
Risk of loss (%) without offset	20	<p>Without the establishment of the proposed OMA there will be continued cattle grazing (through agistment practises as is currently carried out) and associated land degradation, particularly soil compaction and weed invasion. The vegetation in this area is non-remnant or high-value regrowth and woody vegetation has been actively suppressed in the past to increase productivity and management of cattle.</p> <p>Therefore it is reasonable to assume these management practises would continue into the future, further degrading the habitat present through soil compaction, erosion and degradation of water quality, and weed spread. Based on this it is considered that 20% is a reasonable estimated risk of loss of habitat quality without offsetting and improved land management.</p>
Future habitat quality without offset	3	<p>Continued cattle grazing in OMA 3 could lead to further degradation of suitable habitat for Ornamental Snake including overgrazing and soil compaction. Gilgai habitat is also at risk from the proliferation of existing weed species such as Olive Hymenachne which can choke wetlands adversely impacting habitat for prey species (frogs). Feral species may impact Ornamental Snake through direct predation or through wetland habitat degradation by Pigs.</p> <p>Nevertheless, it is reasonable to assume that current management practises would continue into the future and therefore the current habitat quality of the subject lands will be retained into the future.</p>
Risk of loss (%) with offset	0	<p>The Mamelon property will be managed for conservation purposes (excluding the mine footprint). The OMAs will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. This protection mechanism will preclude development within the designated OMAs for the current landowners (Fairway Coal) and for any future landowners. With intended land management practises to be carried within the OMAs there will be no loss of habitat quality and it is expected there will be improvement over time.</p>

Attribute	Rating	Discussion
Future habitat quality with offset	5	<p>Habitat quality for Ornamental Snake will be improved by the application of active habitat management across Mamelon property with a specific emphasis on the OMAs. 'Future quality' will be improved and will be represented by an improvement in the habitat quality score as measured by annual habitat monitoring assessments. An OMP will be developed detailing generic management measures to be applied across Mamelon and specific management measures for the OMAs. Management actions will be developed and guided by the approved Commonwealth 'Conservation Advice' for the species. There are no recommended threat abatement plans of recovery plans for the species. Management actions will include (but not be restricted to):</p> <ul style="list-style-type: none"> ▪ Removal of cattle grazing to eliminate degrading processes such as soil compaction, trampling of habitat features that serve as shelter sites (such as fallen timber), and degradation of water quality in gilgais by mobilising sediments during rainfall events. In the long-term removal of cattle will allow OMA 1 to return to remnant vegetation status; ▪ Increased tree cover by allowing Brigalow to recover across the area will in the long-term shade out weed species and provide additional shelter sites in the form of fallen timber; ▪ Fire management to eliminate the potential for high intensity bushfires which may impact Brigalow recruitment and reduce potential shelter sites (fallen timber); ▪ Managing problem weed species including Olive Hymenachne (already known on-site) which can invade and choke wetlands including gilgai habitat. Pest and weed management within Mamelon and the OMAs will be integrated with measures within the Project LUMP; and ▪ Managing pest species as part of an integrated including potential predators (e.g. feral Cats and Red Fox) and species that degrade wetland (gilgai) habitats such as feral Pigs. Methods may include trapping and baiting.
Confidence in result (%) (future habitat quality)	90	<p>There is an inherent risk in restoring ecological communities as present conditions may differ from historic conditions in which the community developed. As a result it may be difficult to predict with accuracy the direction of restoration development. Nevertheless, given the current degraded state of the proposed offset area, with the application of management measures within the OMP including detailed and measureable objectives, and habitat (and species monitoring) monitoring to measure progress, there is a high degree of confidence the future habitat quality score can be realised. This is reflected in a 'confidence' score of 90%.</p>
Confidence in result (%) (averted loss)	90	<p>There is reasonable confidence that without protection and improved land management the area will be subject to continued cattle grazing and continue to decline in habitat quality. The management measures to be applied as part of the OMP are standard methods and widely used. Improvement in habitat quality measures is expected to be gradual but almost certain.</p> <p>Mamelon property including the designated offset areas (excluding the mine footprint) will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. This protection mechanism will preclude development within the designated OMAs for the current landowners (Fairway Coal) and for any future landowners.</p>
Time over which loss is averted (years)	20	<p>The Mamelon property will be managed for conservation purposes (excluding the mine footprint). The OMAs will be protected under State legislation (as a voluntary declaration under the VM Act) following agreement with DES and DotEE and will remain in perpetuity including after the cessation of the Project. As such the 'time over which loss is averted' is considered as the maximum available time – 20 years.</p>

Attribute	Rating	Discussion
Time until ecological benefit (years)	10	<p>OMA 3 comprises 128 ha of habitat considered suitable for Ornamental Snake and the species is likely to occur in the area. Management of the offset will include the removal of cattle, and weed and pest management. This will have relatively immediate ecological benefits in the OMA through the reduction of known threatening processes on the species and assisted recruitment of tree cover. An increase in the habitat quality score is very likely within a 5 - 10 year period and will be achieved through the following:</p> <ul style="list-style-type: none"> ▪ Reducing degrading processes (particularly soil compaction and browsing of vegetation) through the removal of cattle; ▪ Increased tree cover by allowing Brigalow to recover across the area; ▪ Managing high intensity bushfires that may eliminate Brigalow regrowth and fallen timber; ▪ Managing problem weed species including Olive Hymenachne which can invade and choke wetlands including gilgai habitat; and ▪ Managing pest species including potential predators (e.g. feral Cats and Red Fox) and species that degrade wetland habitats such as feral Pigs.
Final % of impact offset	464.69	As per EPBC Act Offset Assessment Guide output (refer Appendix A18)



- Legend**
- Habitat quality assessment site
 - Remnant
 - Non-remnant
 - Mamelon Property
 - ML 80187
 - ML 700022
 - Mine infrastructure
 - Main Road
 - North Coast Rail Line
 - Dam

Figure 14-15
 Habitat quality assessment sites – proposed offset management areas

DATA SOURCE
 Waratah Coal, 2018
 QLD Open Source Data, 2018
 QLD Department of Environment
 and Heritage Protection, 2016



14.12.5.3 Mamelon Property – General Habitat Management

Vegetation regeneration and de-stocking of cattle across the property in general, will in the long-term increase vegetation cover and landscape connectivity, and contribute to localised surface water quality improvements in the adjacent creek lines, through a reduction in surface erosion and nutrient entrainment during rainfall events.

Erosion and Sediment Load Reduction

An assessment of the existing sediment loads on Mamelon property has been carried out under differing stocking regimes (refer Section 5.6.5 of Chapter 5 – Land). The results of the assessment show that for the areas assessed within ML 80187 the estimated annual sediment generation potential ranges between 777 to 3,653 t/ha (dependent on cattle stocking regime). Soil loss estimate calculations undertaken for the site (refer Section 5-11 of Chapter 5 – Land) indicate a maximum soil loss of 217 tonnes per hectare per year, assuming no erosion and sediment controls are implemented as part of Project activities. With the removal of cattle from much of the property, this represents a significant reduction in downstream sedimentation compared with the current grazing regime.

This has follow-on impacts by contributing to improving the water quality entering Broad Sound and the Great Barrier Reef World Heritage Area. Thereby providing a positive contribution to the future of the Great Barrier Reef by reducing localised nutrient and sediment run-off in the Great Barrier Reef lagoon, a key action in improving the health and resilience of the reef (CoA 2015).

A key aspect of the destocking approach will be to allow the vegetation communities within the riparian corridors to regenerate without being subjected to ongoing grazing pressures. As vegetation coverage continues to increase within the riparian corridors and across the property more generally combined with the absence of grazing, the potential for sediments to mobilise reduces and will continue to do so.

Non-remnant Vegetation

There are extensive areas of non-remnant lands previously subject to vegetation clearing / management, within and outside the Project ML (1,725 ha and 676 ha respectively). These areas will be managed so as to allow regeneration of the original vegetation communities (including within the non-remnant areas within the OMAs), thereby extending the availability of threatened fauna habitat in the area and improving habitat linkages between remnant vegetation patches to the south and north-east of the property.

The northern portion of the Project ML is dominated by cleared habitat or scattered Brigalow regrowth on cracking clay soils. Cleared habitat to the north of Waste Rock Stockpile 2 will be managed within OMA 3 and allowed to regenerate tree cover over 128 ha. There is approximately 50 ha of lands to the east of Open Cut 2 and Waste Rock Stockpile 2 also likely to be suitable for Brigalow regeneration. Weed management, particularly for existing problem species in the area such as Rubber Vine and Lantana, will be a necessary part of managing these areas. Similar smaller patches between Deep Creek and Project infrastructure (such as the cleared habitat around CHPP / MIA 2) will also be allowed to regenerate cover. This will have several positive conservation outcomes including:

- Substantial increase in the cover of Brigalow vegetation on the property and in the wider area;
- Increase the width of riparian vegetation along Tooloombah Creek and Deep Creek potentially increasing SEVT cover and Koala habitat trees (Forest Red Gum), and / or providing a vegetated buffer to riparian habitat;
- Substantial increase and improvement of habitat for Ornamental Snake on the property (Figure 14-14); and

- Improved vegetation connection of Tooloombah Creek to Deep Creek, thereby improving landscape connection to several large habitat patches to the north-east of the property (Figure 14-14).

In the southern portion of the ML regeneration could also be applied to vegetation on and adjacent to sections of Deep Creek (which are relatively thin due to past clearing), and currently cleared habitat to the south of Open Cut 1 and Waste Rock Stockpile 1a. Allowing these areas to regenerate will increase suitable eucalypt habitat for Koala and Greater Glider.

Within the remainder of the Mamelon property (outside of the Project ML) there are extensive areas of cleared vegetation (1,725 ha as noted above) in the south and south-west. This includes 51 ha of non-remnant cleared lands within OMA 1 and OMA 2 (refer Table 14-26). Allowing these areas to regenerate has the capacity to improve localised conservation outcomes including:

- Restore several kilometres of watercourse vegetation that has been cleared in the catchments of both Tooloombah and Deep Creeks;
- Improve the connectivity of vegetation within the property to the south of Deep Creek;
- Substantially increase available habitat for Koala, Squatter Pigeon and Greater Glider in the wider area; and
- Several small patches of Brigalow can be allowed to increase in size and connect in the south-east corner of the property.

Central Queensland Coal will implement a management and monitoring approach for all vegetation to increase the overall vegetation coverage and connectivity of such communities across the Mamelon property, and improve the health of existing vegetation communities, particularly with regard to problem weed species.

14.12.5.4 Offset Management Areas – Offset Management Plan

The draft OMP has been prepared and is provided in Appendix A18. The Plan details Central Queensland Coal's proposed management methods and monitoring scheduling for the OMAs on the Mamelon property. For the purposes of the SEIS submission, an outline of what the plan will contain is provided below with further detail provided in Appendix A18.

The following sections provide a summary of habitat management measures to be applied onsite.

Vegetation Clearing

Vegetation clearing within the OMAs will be restricted to clearing necessary for the removal of non-native weeds, to establish and maintain fencing around the boundary of the OMA, or establish and maintain firebreaks. Any vegetation clearing will follow best practice management methods, and any applicable legislative requirements. Stockproof fencing will be established to assist in managing grazing around the OMAs, and no other disturbance activities such as forestry, cultivation, ploughing, contour banking, construction of irrigation, earthworks and stockpiling will be allowed.

Any vegetation clearing will be overseen by the Project Environmental Officer in accordance with clearing mitigation measures carried out for the Project. Quarterly inspections will monitor and document clearing that has occurred for an approved purpose. Any unapproved occurrences will be documented, and corrective actions developed (such as revegetation).

Weed and Pest Management

Weed and pest control measures will be incorporated into the OMP and integrated with similar measures within the Project LUMP to control the introduction and spread of weed species across the Property. The local landscape is already subject to extensive weed infestation. Lantana, Rubber Vine and Olive Hymenachne are known to be present within the OMAs. Pest species including Dingo, Cat, Pig and Chital have all been observed on the property. A feral pest and weed control program will be developed by a Suitably Qualified Person appointed by the Project Environmental Officer.

Weed mapping will be undertaken upon establishment of the OMAs to accurately determine the weed species present and their extent on the sites. Subsequent to this, weed mapping within the OMAs will occur on an annual basis.

Where infestation by a targeted weed species is recorded, the infestation will be subject to species specific control measures. Species specific weed and pest control methods/strategies will be informed by methods outlined in the Department of Agriculture and Fisheries weed and pest animal fact sheets and other relevant government biosecurity management strategies. The results of control measures applied to a weed infestation will be subject to further monitoring to inform future management of the area (where required).

Other general measures to prevent weed invasion/spread associated with Project activities and within the LUMP will also be incorporated into the OMP such as vehicle washdown procedures. A vehicle washdown facility will be established and maintained at the mine area. All machinery, vehicles and mobile plant equipment entering the OMAs will be washed down in the washdown facility.

Feral fauna species were surveyed within the OMAs using a variety of methods including baited camera traps and recording of scats and tracks as well as direct observations. Incidental observations by Project staff will also be documented with all pest sightings recorded on a register associated with the wider Project.

The presence of feral fauna and weeds within the OMAs will be regularly monitored under the offset monitoring program. This will allow for an adaptive management approach to weed / pest control including regular review and audit of the control strategies in place.

Fire Management

Fire management is an essential component to all coal mining operations and as such, control measures will be incorporated into the OMP and integrated with similar measures within the Project LUMP. Uncontrolled high-intensity bushfires have the potential to cause direct mortality of fauna, mature trees, and regrowth/seedlings impacting the conservation and habitat quality improvement aims of the OMAs and the wider property.

Fire management measures appropriate to the region will be developed by a suitably qualified person and will be overseen by the Project Environmental Officer. Fire will, where possible, be excluded from the OMA by maintaining firebreaks (collocating firebreaks with existing tracks and fence lines where possible), and not using fire as a tool for regrowth management. Quarterly inspections will document evidence of wild fire and document if controlled burns have occurred. Any unapproved occurrences will be documented, and corrective actions developed (including repairing firebreaks and reassessing fuel load management practices).

Strategic 'low intensity' burning may be required to minimise fuel loads and form fire breaks across the landscape. The burning regime will seek to maintain ecological diversity through the

development of a mosaic presenting a range of patches of varying burning history across the OMAs and wider Property. This will serve to reduce the potential for intense dry-season bushfires by reducing fuel loads. Any 'low intensity' fuel reduction burning will be subject to a risk assessment to assess the potential for impacting habitat quality within the OMAs with a focus on the presence of small vegetation (woody) regrowth and fallen woody debris (where Ornamental Snake is likely to occur).

The following measures will be incorporated within the OMP to reduce the potential impacts of high-intensity fires within the OMAs:

- Regular inspections within and surrounding the OMAs for fuel hazard assessment;
- Weather conditions and current bushfire risk will be assessed prior to any proposed burning activity;
- Road access across the property and OMAs will be maintained appropriately for fire management access including for any management-initiated burns;
- Onsite burning of any material will be managed via a Risk Assessment;
- All fuel-reduction burn carried out will be recorded and integrated with fire management across the property and Project LUMP;
- Access to water supply on the property (dams or creek line waterholes) will be maintained in a trafficable condition at all times;
- Fire-fighting equipment will be regularly maintained, and adequate staff training will be implemented. Training and equipment will address fighting wildfires, as well as for fighting fires around facilities;
- Weed management to prevent potential increased fire risk (such as Lantana);
- Quarterly inspections will document evidence of wild fire and document if controlled burns have occurred. Any unapproved occurrences will be documented, and corrective actions developed (including repairing firebreaks and reassessing fuel load management practices; and
- Weed management to prevent habitat degradation and potential increased fire risk.

Vegetation Health and Habitat Monitoring

The OMP includes monitoring of vegetation communities within the OMAs for vegetation health and habitat quality. Monitoring methods will follow the methods detailed in DES' 'Habitat quality assessment guide' as used to establish baseline habitat quality measures within the OMAs. Monitoring locations will be those established for the habitat quality baseline survey as depicted in Figure 14-15. The results of the habitat assessment will allow a revised calculation following the EPBC Act Offset Assessment Guide calculator to compare the OMA over the term of the offset and measure any improvement in condition. These are site based, and quantitative, and therefore repeatable over the life of the offset.

The habitat monitoring assessments will:

- Assess how the offset area is progressing against target criteria detailed in the OMP over time;
- Identify and manage potential risks to achieving the OMP objectives; and
- Assist in developing corrective management actions to improve progress towards achieving the OMP objectives.

Photo and visual assessment monitoring points will be established within the OMAs at the habitat monitoring sites and at other sites considered as representative of the vegetation communities present. Central Queensland Coal will engage a suitably qualified person to monitor condition at each site annually, to assess visual changes over time. The visual assessment will record parameters relating to vegetation health such as:

- Foliar discolouration;
- Partial defoliation;
- Evidence of pathogenic attack; and
- Tree death.

As impacts become apparent, mitigation measures will be developed on a case by case basis, and potential for offset requirement determined.

Targeted fauna surveys will be carried out as part of the habitat monitoring. The surveys will target Koala (OMA 1 and OMA 2) and Ornamental Snake (OMA 3).

Surveys for Ornamental Snake will include nocturnal surveys during periods of frog activity (i.e. after rainfall events between October to March) and will be carried out in suitable habitat for the species within OMA 1. Other methods such as funnel trap lines may also be used. Timing will be flexible to coincide with rain events and suitable conditions for the species and follow Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC, 2011).

Surveys for Koala will be carried out in accordance with direct and indirect methods outlined in EPBC Act referral guidelines for Koala. Surveys will be conducted between August and January when activity is at a peak. Methods will include transects, nocturnal spotlighting and remote sensor activated cameras. Indirect observation methods will include identification of tree scratches and scats but will take into account factors which affect the detectability and persistence of signs.

OMP Monitoring Activities

An offset monitoring program will be prepared as part of the OMP to guide the management and monitoring of each OMA and ensure offset habitat condition improvements and associated timeframes are achieved. Monitoring activities will include habitat quality assessments, vegetation health and photo monitoring, weed surveys, pest animal surveys, targeted fauna surveys and general inspections of fencing, access tracks and firebreaks. Site and species specific details for monitoring will be defined in the OMP. Indicative activities are summarised as follows:

- Habitat quality assessments will be carried out annually for the first five years of the offset, then every five years until defined completion criteria within the OMP are achieved;
- Vegetation photo monitoring carried out annually and visual health surveys carried out biannually;
- The occurrence and distribution of weed infestations will be mapped and monitored on an annual basis within the OMA. Quarterly observations will also be made under General Inspections (see below);
- Biannual surveys of pest animals (e.g. dogs, cats and pigs) will be undertaken;
- Surveys for targeted fauna species within the OMAs will be carried out annually; and

- General site inspections will be carried out on a quarterly basis. This will include inspections of site infrastructure (such as fencing, signage, access tracks and firebreaks), incidence of fire, grazing animal incursion (and evidence of vegetation damage), opportunistic weed surveys, and evidence of erosion events. More frequent inspections may be required in the case of an extreme event (e.g. fire). Observations, subsequent corrective actions and incidences of fire, unauthorised access, fence maintenance, pest animals, pest plants and grazing will be recorded during the inspections.

To summarise the outputs from the offset monitoring activities, Central Queensland Coal will prepare offset area monitoring reports and submit the reports to the administering authority every 5 years for the life of this plan.

14.12.5.5 Securing the Project Offset Management Areas

The proposed OMAs will be secured using a legally binding mechanism as available under State legislation on land title for ensuring the protection of an environmental offset and implementation of measures under the OMP. Available legislative measures include:

- An area declared as 'high conservation value' under Section 19F of the VM Act secured for the purposes of an environmental offset;
- An 'offset protection area' as declared under Section 30 of the *Environmental Offsets Act 2014*;
- An area declared as a 'nature refuge' under Section 46 of the NC Act secured for the purposes of an environmental offset; or
- An area declared as a 'protected area' under Section 29 of the NC Act secured for the purposes of an environmental offset'.

The legislative approach adopted for the Project will be subject to approval following agreement with DES and DotEE.

14.12.5.6 Financial Settlement

Approximately 13.4 km of waterways mapped under the Waterway Barrier Works for Fish Passage mapping layer occurs within the Project area, much of which will be impacted by components of the Project. This represents the sole impact to MSES not covered under impacts to MNES described previously. This covers an approximate impact area of 6.7 ha subject to environmental offsets under the QEOP. Central Queensland Coal considers some of these waterways to be incorrectly mapped as discussed previously.

Central Queensland Coal proposes to acquit the final agreed area of impact (following discussions with DAF) under the Waterway Barrier Works for Fish Passage mapping layer via the option of financial settlement. An estimate of the required payment (using an estimated ground-truthed area of impact of 3.5 ha) has been carried out using DES 'financial settlement offset calculator' and is provided as an attachment to Appendix A18.

14.12.5.7 Summary of Mamelon's Value to MSES Fauna and General Landscape Values

With the management of the majority of the Mamelon property for conservation purposes, including those measures detailed in Section 6 for the OMAs, Central Queensland Coal considers the site has

the capacity to improve outcomes for the threatened species of concern (Koala and Ornamental Snake) as well general localised conservation outcomes including the following:

- Improvement in the current values of remnant habitat through management of key attributes such as:
 - Vegetation health management
 - Weed and pest management, particularly with regard to problem weed species known to be present such as Lantana and Rubber Vine
 - Bushfire management
- In the long-term increase the extent of suitable habitat (through managed regrowth in cleared areas) on the property for both Koala and Ornamental Snake (and other known threatened species in the area such as Squatter Pigeon and Greater Glider) by > 1,000 ha;
- Restore several kilometres of watercourse vegetation that has been cleared in the catchments of both Tooloombah and Deep Creeks;
- Improve the landscape connectivity of vegetation within the property to the south of Deep Creek and to habitat patches to the south-west and west linking to State-wide ecological corridors to the south and west;
- A large extent of Brigalow vegetation community (Endangered under the VM Act) can be restored to the north of the mine area and several small patches of Brigalow can be allowed to increase in size and connect in the south-east corner of the property; and

Patches of semi-evergreen vine-thicket TEC along Tooloombah Creek can be allowed to increase in size and connect with adjacent vegetation through assisted regrowth and weed management.

14.12.6 Conclusion and Offsets Management Plan

Offsets will be applied to compensate residual environmental impacts from Project activities remaining after all practical and practicable management and mitigation actions have been applied. Unavoidable residual ecological impacts have been quantified for the above-ground construction and operation activities associated with the Project as described above.

Central Queensland Coal will seek to achieve synergistic benefits where possible on Central Queensland Coal lands thereby providing net environmental benefits close to the area of impacts.

Central Queensland Coal has prepared a draft OMP for State and Commonwealth comment (attached to this SEIS as Appendix A18). The draft OMP provides a detailed account of the proposed offset settlement which has been summarised here in Section 14.12.5 and includes the following:

- Identification of the proposed offset lands including a description of current land use;
- Ecological condition (through the habitat quality assessment process) of potentially impacted areas within the Project area and the proposed offset lands;
- Legislative measure selected to secure the land as an approved offset area; and
- An accompanying OMP detailing proposed management and offset monitoring program to ensure the required conservation outcome occurs.

A finalised OMP will be submitted for approval to DotEE and DES prior to any Project construction works and impacts occurring on MNES or MSES as agreed with the relevant government agencies.

14.13 Conclusion

The Project is located largely within the Marlborough Plains subregion of the Brigalow Belt South bioregion. A small portion in the south of the mine area lies within the adjacent Nebo-Connors Range subregion. The region has experienced a long history of human disturbance due to agriculture and mining activities. The Project area is representative of the wider region and landscape with over 79% of the Project area cleared and currently mapped as non-remnant. Remnant vegetation within the Project area is largely confined to the south and western portions of the mine area. The TLF and haul road lie entirely in cleared lands excepting a linear riparian strip of vegetation associated with Deep Creek that is crossed by the haul road. The ground layer in cleared areas and in remnant open woodland was often observed to be dominated by the exotic Buffel Grass, particularly that portion of the mine ML located north of the Bruce Highway.

Vegetation was composed of 12 RE types situated on five landforms: alluvial river and creek flats; Cainozoic clay plains; Cainozoic sand plains / remnant surfaces; coarse-grained sedimentary rocks; moderately to strongly deformed and metamorphosed sediments and interbedded volcanics; reflecting the underlying geology and position in the landscape. Field verification of REs within the Project area identified a number of inconsistencies in current RE mapping, relating to RE composition and polygon size. Remnant vegetation listed as Endangered under the VM Act, and as a TEC under the EPBC Act, was observed during field assessments as two small polygons of semi-evergreen vine thicket located on the west boundary of the mine area, and two polygons of Brigalow vegetation adjacent to the eastern boundary of the ML. The majority of remnant vegetation within the ML comprises communities listed as Of Concern and Least Concern under the VM Act.

No listed flora species were observed during the field assessments and no species identified as occurring in the wider area during desktop searches was identified as having a high likelihood of occurring within the Project area.

Listed fauna species observed in the Project area include Koala, Greater Glider and Squatter Pigeon (all listed as Vulnerable under the NC and EPBC Act) and several bird species listed as Migratory (EPBC Act) and Special Least Concern (NC Act). Suitable habitat for Koala occurs within the mine area and along the haul road and adjacent riparian communities associated with Deep Creek and Tooloombah Creek. Suitable gilgai habitat for Ornamental Snake (listed as Vulnerable under the NC Act and EPBC Act), identified in remnant Brigalow habitat to the west of the Project area, also occurs in cleared lands north of the Bruce Highway.

The Project will require unavoidable significant impacts to ecological matters of State and Commonwealth significance including: remnant vegetation listed as Of Concern under the VM Act; habitat for listed species (Koala and Ornamental Snake); and watercourse remnant vegetation (listed as Least Concern under the VM Act). There will also be significant impacts to drainage lines mapped under the waterway barrier works for fish passage, although the extent of these impacts is subject to further assessment. Significant impacts will be a result of clearing for mining infrastructure, open cut pits and environmental dams. The total extent of these impacts has been calculated to be 108.22 ha and is the subject of the Project OMP.

Other potential impacts of concern include the drawdown of the groundwater table because of open cut mining. This may have long-term impacts, particularly to the north of the Project and to a lesser degree, to the east and south. This may have long-term impacts on permanent waterholes and riparian vegetation (including habitat for Koala), largely in those areas closest to mining operations where the groundwater drawdown is at its greatest. Based on ground-truthed vegetation mapping, mining effects are predicted to pose a low level threat (< 1 m drawdown) to areas of riparian Forest Red Gum vegetation (RE 11.3.25) along Tooloombah Creek (40.3 ha) and Deep Creek (62.4 ha). A moderate to high threat (> 1 m drawdown) is predicted in vegetation communities encompassing 8.3 ha along Tooloombah Creek and 34.2 ha along Deep Creek. There may also be a low to moderate threat (<5 m drawdown) on 14.25 ha of a terrestrial Forest Red Gum vegetation community (RE 11.3.4).

The mitigation measures proposed as part of the Project will minimise additional indirect impacts to terrestrial fauna and flora communities within and surrounding the Project area from construction and operational activities. These measures include fauna crossing infrastructure to minimise fauna traffic collisions along the haul road and a detailed ecological monitoring program to monitor the health of vegetation communities adjacent to the Project for indirect impacts such as dust and surface water contamination. With control measures in place indirect impacts to fauna and flora are not expected to be significant.

Central Queensland Coal owns the Mamelon property, of which the majority of the Project's disturbance footprint occurs. Central Queensland Coal has proposed to utilise areas outside of the ML and within Mamelon for offsetting purposes for predicted residual impacts of the Project. Central Queensland Coal seeks to achieve synergistic habitat and conservation benefits through the retention and improvement of existing vegetation, and the rehabilitation of previously cleared lands on the property. Central Queensland Coal considers that, with suitable management of the available lands on the property (outside of the Project footprint), a conservation benefit can be derived that goes well beyond the immediate direct impacts of vegetation clearing for the Project. The draft OMP describes the approach taken by Central Queensland Coal to offset significant residual impacts to MSES.

14.14 Commitments

In relation to managing terrestrial ecology, Central Queensland Coal's commitments are provided in Table 14-29.

Table 14-29 Commitments – terrestrial ecology

Commitment
Develop and implement a Land Use Management Plan which will establish a vegetation monitoring program, identify pest and weed management controls, fire management measures and principles for managing fauna.
Develop and implement Significant Species Management Plans for managing those threatened species known or likely to occur on the site.
Develop and implement a series of dust mitigation and monitoring measures.
Prepare and implement a Water Management Plan that outlines the monitoring and management measures for surface water and groundwater.
Develop and submit to DES and DotEE an Offsets Management Plan in accordance with the relevant State and Commonwealth policies, prior to construction.
Collaborate with the relevant agencies (such as DNRME, DES and DotEE) regarding offset options to ensure optimal environmental net benefit.
Seeks to achieve synergistic habitat and conservation benefits through the retention and improvement of existing vegetation, and the rehabilitation of previously cleared lands on the Mamelon property.
Investigate other programs being conducted locally, regionally and nationally to determine if they can provide information (such as ongoing monitoring data), research assistance, in order to get a higher net benefit for the environment through indirect offsets.

14.15 ToR Cross-reference Table

Table 14-30 ToR cross-reference

Terms of Reference	Section of the EIS
8.7 Flora and Fauna	
Describe the potential direct and indirect impacts on the biodiversity and natural environmental values of affected areas arising from the construction, operation and decommissioning of the project.	Section 14.7
Consider any proposed avoidance and/or mitigation measures.	Section 14.8
The EIS should provide information based on relevant guidelines, including but not limited to DES's EIS information guidelines that cover flora and fauna, aquatic ecology, coastal issues, ground-dependent ecosystems, water, matters of national environmental significance, and biosecurity.	Noted
The assessment should include the following key elements: <ul style="list-style-type: none"> identification of all significant ecological species and communities, including MSES and MNES, listed flora and fauna species, and regional ecosystems, on the project's site and in its vicinity 	Section 14.6 and Chapters 15 – Aquatic Ecology and 16 - MNES
<ul style="list-style-type: none"> terrestrial and aquatic ecosystems (including groundwater-dependent ecosystems) and their interactions 	Section 14.6 and Chapters 10 – Groundwater, 15 – Aquatic Ecology, and 16 – MNES
<ul style="list-style-type: none"> biological diversity 	Section 14.6 and Chapter 16 - MNES
<ul style="list-style-type: none"> the integrity of ecological processes, including habitats of listed threatened, near threatened or special least-concern species 	Section 14.6.5 and Chapters 10 – Groundwater, 15 – Aquatic Ecology and 16 - MNES
<ul style="list-style-type: none"> connectivity of habitats and ecosystems 	Section 14.7.2
<ul style="list-style-type: none"> the integrity of landscapes and places, including wilderness and similar natural places 	Section 14.6.1 and 14.6.2
<ul style="list-style-type: none"> chronic, low-level exposure to contaminants or the bio-accumulation of contaminants 	Section 14.7.9 and Chapters 9 – Surface Water, 10 – Ground Water, 15 – Aquatic Ecology and 16 - MNES
<ul style="list-style-type: none"> impacts (direct or indirect) on terrestrial and aquatic species and ecosystems whether due to: vegetation clearing; hydrological changes; discharges of contaminants to water, air or land; noise; etc. 	Section 14.7 and Chapters 9 – Surface Water, 10 – Groundwater, 15 – Aquatic Ecology and 16 - MNES
<ul style="list-style-type: none"> impacts of waterway barriers on fish passage in all waterways mapped on the Queensland Waterways for Waterway Barrier Works spatial data layer. 	Chapter 15 – Aquatic Ecology

Terms of Reference	Section of the EIS
Describe any actions of the project that require an authority under the <i>Nature Conservation Act 1992</i> , and/or would be assessable development for the purposes of the <i>Vegetation Management Act 1999</i> ¹ , the <i>Regional Planning Interests Act 2014</i> , the <i>Fisheries Act 1994</i> and the <i>Planning Act 2016</i> . Features to consider include regional ecosystems, environmentally sensitive areas, wetlands, nature refuges, protected areas and strategic environmental areas.	Section 14.2
Propose practical measures to avoid, minimise, mitigate and/or offset direct or indirect impacts on ecological environmental values.	Sections 14.8, 14.10 and 14.12 and Chapters 10 – Groundwater, 15 – Aquatic Ecology and 16 - MNES
Assess how the nominated quantitative indicators and standards may be achieved for nature conservation management.	Section 14.8
Address measures to protect or preserve any listed threatened, near-threatened or special least concern species.	Section 14.8
Propose measures that would avoid the need for waterway barriers, or propose measures to mitigate the impacts of their construction and operation.	Chapter 15 – Aquatic Ecology
Assess the need for buffer zones and the retention, rehabilitation or planting of movement corridors. The assessment should take account of the role of buffer zones in maintaining and enhancing riparian vegetation to enhance water quality and habitat connectivity.	Chapter 15 – Aquatic Ecology
Propose rehabilitation success criteria, in relation to natural values, that would be used to measure the progressive rehabilitation of disturbed areas. Describe how the achievement of the objectives would be monitored and audited, and how corrective actions would be managed. Proposals for the rehabilitation of disturbed areas should incorporate, in suitable habitat, provision of nest hollows and ground litter.	Chapter 11 - Rehabilitation
Specifically address any obligations imposed by State or Commonwealth legislation or policy or international treaty obligations, such as the China–Australia Migratory Bird Agreement, Japan–Australia Migratory Bird Agreement, or Republic of Korea–Australia Migratory Bird Agreement.	Chapter 16 - MNES
8.7.1 Offsets	
For any significant residual impacts, propose offsets that are consistent with the following requirements as set out in applicable State and Commonwealth legislation or policies: <ul style="list-style-type: none"> Where a significant residual impact will occur on a prescribed environmental matter as outlined in the Environmental Offsets Regulation 2014, the offset proposal(s) must be consistent with the requirements of Queensland’s <i>Environmental Offsets Act 2014</i> and the latest version of the Queensland Environmental Offsets Policy². 	Section 14.12
<ul style="list-style-type: none"> Where the Commonwealth offset policy requires an offset for significant impacts on a MNES, the offset proposal(s) must be consistent with the requirements of the EPBC Act Environmental Offsets Policy (October 2012), the <i>Offsets Assessment Guide</i> and relevant guidelines³ (refer to also Appendix 3 of the Project TOR). 	Chapter 16 - MNES
8.8 Coastal Environment	
Conduct impact assessment in accordance with the DES’s <i>EIS Information guideline – Coastal</i> .	Noted

¹ This is notwithstanding that the Vegetation Management Act 1999 does not apply to mining projects. Refer also to <https://www.qld.gov.au/environment/land/vegetation/clearing/>

² <https://www.qld.gov.au/environment/pollution/management/offsets/>

³ <http://www.environment.gov.au/epbc/publications/epbc-act-environmental-offsets-policy>

Terms of Reference	Section of the EIS
<p>Provide illustrated details of the existing coastal zone that is potentially affected by the project, and describe and illustrate any proposed works in the coastal zone, including a schedule of ongoing maintenance requirements. The description should at least address the following matters:</p> <ul style="list-style-type: none"> • state or Commonwealth marine parks in the region of the project's site 	Section 14.11
<ul style="list-style-type: none"> • separately mention marine plants and any fish habitat areas protected under the <i>Fisheries Act 1994</i> 	Section 14.11
Assess the potential impacts of the project's activities in the coastal zone.	Section 14.7
Propose measures to avoid or minimise the potential impacts of the project's activities in the coastal zone. If acid sulphate soils would be disturbed, describe measures to avoid oxidation of the sulphides or to treat and neutralise the acid if it forms.	Chapter 5 – Land Chapter 10 - Groundwater
Detail any residual impacts that cannot be avoided and propose measures to offset the residual loss.	Sections 14.11 and 14.12
Develop and describe suitable indicators for measuring coastal resources and values and set objectives to protect them in accordance with relevant State Planning Policy July 2014, guidelines and legislation. Refer to DES's guidelines on coastal development.	As no development is proposed within the coastal zone this aspect of the ToR is not considered relevant. Aspects associated with preserving the values of the coastal area are discussed in Chapter 4 Climate, Chapter 5 Land, Chapter 9 Surface Water, Chapter 14 Terrestrial Ecology, Chapter 15 Aquatic Ecology and Chapter 16 MNES.
Detail a monitoring program that would audit the success of mitigation measures, measure whether objectives have been met, and describe corrective actions to be used if monitoring shows that objectives are not being met.	Section 14.8