Central Queensland Coal Project

Chapter 14 - Terrestrial Ecology

Central Queensland Coal

CQC SEIS, Version 3

October 2020

Contents

Figures

Tables

Terms and Abbreviations

µS/cm	Micro siemens per centimetre
ALA	Atlas of Living Australia
AS	Arsenic
AS	Australian Standards
ASSMP	General Acid Sulfate Soil Management Plan
BfMP	Bushfire Management Plan
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
BPA	Biodiversity Planning Assessment
CIA	Cumulative Impact Assessment
cm	Centimetres
CQC	Central Queensland Coal
DAWE	Department of Agriculture, Water and Environment
dB	Decibel
dB(A)	The A-weighted sound pressure level
DES	Queensland Department of Environment and Science
Disturbance Area or Disturbance Footprint	The area within, and roads adjacent to, the Mining Lease Applications that will be disturbed to enable construction and operation of the mine – covers an area of 1,372.5 ha (taken as the earthworks footprint plus a 10 m buffer to allow for vegetation clearing)
DIWA	Directory of Important Wetlands in Australia
Downstream Environment	Refers to the Styx River and its estuaries and Broad Sound.
EA	Environmental Authority
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EO	Environmental Objectives
EP Act	*Environmental Protection Act 1994*
EP Regulation	Queensland Environmental Protection Regulation 2019

EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPC	Exploration Permit for Coal
EPP	Environmental Protection Policy
ESA	Environmentally Sensitive Areas
ESCP	Erosion and Sediment Control Plan
FHA	Fish Habitat Area
Fitzroy NRM region	Fitzroy Natural Resource Management region
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRWHA	Great Barrier Reef World Heritage Area
GDE	Groundwater Dependent Ecosystems
GDEMMP	Groundwater Dependent Ecosystem Monitoring and Management Plan
GES	General Ecological Significance
GMMP	Groundwater Management and Monitoring Plan
ha	Hectares
HES	High Ecological Significance
HMMP	Hazardous Materials Management Plan (including spill management)
HVR	High-Value Regrowth
Hz	Hertz – unit of frequency
IBA	Important Bird Area
IESC	Independent Expert Scientific Committee
kHz	Kilohertz (1000 hertz per second)
kL/day	Kilolitres per day
km	Kilometres
km^2	Square Kilometres
kV	Kilovolts
L/s/km	Litres per second per kilometre
LAeq	the A-weighted, equivalent continuous sound pressure level
LUMP	Land Use Management Plan

Lux	Unit of Illuminance
LWP	Leaf Water Potential
m	Metres
mbgl	Metres below ground level
MDL	Mineral Development Licence
mg/m^2/day	Milligrams per square metre per day
MIA	Mine Infrastructure Area
ML	Mining Lease Application
mm	Millimetres
MNES	Matters of National Environmental Significance
Mo	Molybdenum
MS	Migratory Shorebird
MSES	Matters of State Environmental Significance
MWMP	Mineral Waste Management Plan
NC Act	*Nature Conservation Act 1992*
NRM	Natural Resource Management
NZS	New Zealand Standard
OAMP	Offset Area Management Plan
PDCA	Plan-Do-Check-Act
PM	Particulate Matter
PMST	Protected Matters Search Tool
PRCP	Progressive Rehabilitation and Closure Plan
Project Site	Everything within the boundaries of Mining Lease Applications 80187 and 700022 – covers an area of 2,661 ha
Near Surrounds	Land (particularly relevant habitat) adjacent to, or within, approximately 3 km of the Project Site.
Qa	Quaternary Alluvium
QEOP	Queensland Government Environmental Offsets Policy
QPa	Quaternary Pleistocene Alluvium
RE	Regional Ecosystems
Se	Selenium

SEIS	Supplementary Environmental Impact Assessment
SEVT	Semi-Evergreen Vine Thickets
SMP	Soil Moisture Potential
SO_4^{2-}	Sulphate
SSMP	Significant Species Management Plan
Study Area	Refers to the Project Site, together with additional sites surveyed or assessed in the broader area surrounding the Project Site
SWMP	Surface Water Management Plan
t/year	Tonnes per year
TEC	Threatened Ecological Community
TEM	Transient Electromagnetic
The Project	Central Queensland Coal Project
TLF	Train Loadout Facility
ToR	Terms of Reference
V	Vanadium
v2	Version 2
VM Act	*Vegetation Management Act 1999*
WMP	Mine Site Water Management Plan
WoNS	Weeds of National Significance
WPA	Wetland Protection Area
WPMP	Weed and Pest Management Plan

14 Terrestrial Ecology

14.1 Introduction

Activities undertaken during the construction and operation of the Central Queensland Coal (CQC) Project (the Project) have the potential to impact the terrestrial environment if not managed properly. This chapter addresses the relevant legislation and policies, the assessment methods, the existing terrestrial environmental values, identifies potential impacts, and proposes mitigation measures for the construction and operation of the Project.

This Chapter has been rewritten since that presented in the Supplementary Environmental Impact Assessment (SEIS) Version 2 (v2) to include recent work undertaken in 2019 and 2020. The recent work was undertaken to assess changes to the Project layout and operations that have occurred since SEIS v2, and to address comments by regulatory agencies on SEIS v2. See Chapter 3 – Project Changes and Responses to Regulator Comments for the full description of Project changes since SEIS v2, and the responses to submissions received relating to the SEIS v2. Recent work undertaken in 2019 and 2020 to support the revised terrestrial ecology assessment includes:

- supplementary vegetation assessments to confirm regional ecosystems (RE) in areas not previously surveyed
- supplementary fauna surveys and revision of habitat mapping for threatened species
- reassessment of the direct and indirect impacts on environmental values, including groundwater dependent ecosystems (GDEs)
- reassessment of the significance of impacts where required
- provision of additional avoidance, mitigation and management measures to reduce the potential impacts of the Project on environmental values and
- reconsideration of offsets for any unavoidable significant residual impacts to matters of national environmental significance (MNES) and matters of state environmental significance (MSES).

14.1.1 Environmental Objectives and Outcomes

The environmental objectives and performance outcomes relevant to terrestrial ecology are provided in Schedule 8, Part 3, Division 1 of the Environmental Protection Regulation 2019 (EP Regulation). Objectives and outcomes for flora, fauna and biosecurity that are specific to the Project are outlined in Table 1 of the Project's Terms of Reference (ToR). The overarching objective is to operate the Project in a way that protects, to the greatest extent possible, the environmental values of land including flora and fauna.

14.1.1.1 EP Regulation Environmental Objectives and Performance Outcomes

The environmental objectives and performance outcomes relating to terrestrial ecology outlined in the EP Regulation are described below.

14.1.1.1.1 Environmental Objective

Land

The activity is operated in a way that protects the environmental values of land, including soils, subsoils, landforms and associated flora and fauna.

Wetlands

The activity will be operated in a way that protects the environmental values of wetlands.

14.1.1.1.2 Performance Outcomes

Land

1. there is no actual or potential disturbance or adverse effect to the environmental values of land as part of carrying out the activity
2. all of the following apply:
   - activities that disturb land, soils, landforms and the land use, flora and fauna associated with the land will be managed in a way that prevents or minimises adverse effects on the environmental values of land
   - areas disturbed will be rehabilitated or restored to achieve sites:
     i. that are safe and stable and
     ii. where no environmental harm is being caused by anything on or in the land and
     iii. that are able to sustain an appropriate land use after rehabilitation or restoration
   - the activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants and
   - the application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils.

Wetlands

1. There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.
2. The activity will be managed in a way that prevents or minimises adverse effects on wetlands.

14.1.1.2 ToR Environmental Objectives and Outcomes relevant to the Project

The Environmental Objectives and Outcomes for flora, fauna and biosecurity given in the Project ToR are replicated below.

Flora and Fauna

- The activity will be operated in a way that protects to the greatest extent possible the environmental values of the land including flora and fauna. There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.
- The project minimises serious environmental harm on areas of high conservation value and special significance and sensitive land uses at adjacent places. The location for the activity on a site protects all environmental values relevant to adjacent sensitive use.
- The project manages the impacts on the environment by seeking to achieve ecological sustainability, including, but not limited to, protected wildlife and habitat.
- Critical habitat receives special management considerations and protection through a management plan for the project.
- The project avoids significant residual impacts to MNES and MSES, mitigates impacts where they cannot be avoided, and offsets any residual impacts.

- The project provides for the conservation of the marine environment, particularly the Great Barrier Reef Marine Park (GBRMP).
- The construction, operation and decommissioning of the project must be consistent with all statutory and regulatory requirements of the Commonwealth, state and local government and be consistent with their relevant plans, strategies, policies and guidelines that relate to the terrestrial and aquatic ecological environment.

Biosecurity

- The construction, operation and decommissioning of the project must ensure:
  - the introduction and spread of weeds, pests (including marine pests) and disease, pathogens and contaminants are avoided or minimised
  - existing weeds and pests, including marine pests, are controlled and eradicated where practicable, including biosecurity threats and their management and
  - the performance outcomes correspond to the relevant policies, legislation and guidelines, and that sufficient evidence is supplied (through studies and proposed management measures) to show these outcomes are achieved.

14.1.2 Terms of Reference Addressed in this Chapter

Table 14-1 outlines the ToR for flora, fauna and offsets and identifies where they are addressed. Specific ToR for MNES are provided in Chapter 16 – Matters of National Environmental Significance.

Table 14-1: ToR cross reference

Terms of Reference	Section of the SEIS
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 14.4 Section 14.6
Consider any proposed avoidance and/or mitigation measures.	Section 14.5 Section 14.7
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.	Section 14.1.3.6
The assessment should include the following key elements: • 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 14.3
• terrestrial and aquatic ecosystems (including groundwater-dependent ecosystems) and their interactions	
• biological diversity	
• the integrity of ecological processes, including habitats of listed threatened, near threatened or special least-concern species	
• connectivity of habitats and ecosystems	
• the integrity of landscapes and places, including wilderness and similar natural places	

Terms of Reference	Section of the SEIS
• chronic, low-level exposure to contaminants or the bio-accumulation of contaminants	Section 14.4 Section 14.6
• 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.	
• 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 and Marine Ecology
Describe any actions of the project that require an authority under the Nature Conservation Act 1992, and/or would be assessable development for the purposes of the Vegetation Management Act 1999 , the Regional Planning Interests Act 2014, the Fisheries Act 1994 and the Planning Act 2016. Features to consider include regional ecosystems, environmentally sensitive areas, wetlands, nature refuges, protected areas and strategic environmental areas.	Section 14.1.3 Chapter 2 – Legislation and Approvals
Propose practical measures to avoid, minimise, mitigate and/or offset direct or indirect impacts on ecological environmental values.	Section 14.5 Section 14.7 Section 14.8
Assess how the nominated quantitative indicators and standards may be achieved for nature conservation management.	Section 14.7
Address measures to protect or preserve any listed threatened, near threatened or special least concern species.	Section 14.7
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 and Marine 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.	Section 14.4 Section 14.6
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 and Decommissioning
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.	Section 14.3.9 Section 14.6.5
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: • 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 Environmental Offsets Act 2014 and the latest version of the Queensland Environmental Offsets Policy .	Section 14.8

Terms of Reference	Section of the SEIS
• 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 Offsets Assessment Guide and relevant guidelines (refer to also Appendix 3 of the Project TOR).	

14.1.3 Relevant Legislation and Policy Instruments

Environmental protection of the terrestrial environment is governed by several legislative Acts, policies and guidelines. The impact assessment presented in this chapter has been undertaken in accordance with the requirements of these legislative instruments as described below.

14.1.3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) establishes a process for assessment and approval of proposed actions that have, or are likely to have, a significant impact on MNES including listed threatened species, ecological communities and listed migratory species. Impacts to MNES associated with the terrestrial environment are assessed in this chapter. Any significant residual impacts on MNES as a result of the Project will be offset in accordance with the EPBC Act Environmental Offsets Policy.

14.1.3.2 Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) provides the key legislative framework for environmental management and protection in Queensland. The object of the EP Act is to 'Protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes on which life depends' (section 3). The Project will be assessed under the bilateral agreement between the Australian and Queensland Governments (section 45 of the EPBC Act) using the EIS prepared in accordance with the EP Act, and the ToR for the Environmental Impact Statement (EIS), which were prepared under the EP Act. The ToR addressed in this chapter are presented in Table 14-1.

14.1.3.3 Nature Conservation Act 1992

The object of the *Nature Conservation Act 1992* (NC Act) is 'the conservation of nature while allowing for the involvement of indigenous people in the management of protected areas in which they have an interest under Aboriginal tradition or Island custom' (section 4). Impacts of the Project on habitat for animals and plants that are listed under the NC Act have been addressed in this chapter. The taking or handling of protected animals is also authorised under the NC Act. If required, CQC will obtain approval to take wildlife prior to construction activities commencing. Permits under the Act will also be obtained for fauna spotter catchers, as required under the Project's Significant Species Management Plan (SSMP).

14.1.3.4 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of vegetation and provides protection for RE classified as endangered, of concern or least concern under the Act. Impacts on RE are addressed in this chapter. Where clearing of vegetation occurs within the Mining Lease Application (ML) it is exempt from the provisions of the VM Act, as stated in the Planning Regulation 2017 (Schedule 21 Part 1, item 1 [(6) a resource activity as defined under the EP Act, section 107]). Off-lease development and activities that require the clearing of vegetation will require approval

under the VM Act before clearing can commence. This includes any clearing of vegetation associated with the construction of the Mt Bison Road outside the western boundary of the ML.

14.1.3.5 Environmental Offsets Act

The *Environmental Offsets Act 2014*, Environmental Offsets Regulation 2014 and the Queensland Government Environmental Offsets Policy (QEOP) provide a streamlined framework for delivery of environmental offsets in Queensland. An environmental offset may be required as a condition of approval where an activity is likely to result in a significant residual impact on a MSES. Impacts to MSES associated with the terrestrial environment are assessed in this chapter. Significant residual impacts on MSES as a result of the Project will be offset in accordance with the QEOP.

14.1.3.6 Guidelines

The assessment presented in this chapter has been undertaken in accordance with a range of Queensland and Australian Government guidelines including:

- EIS Information Guideline – Flora and Fauna (DEHP n.d.)
- EIS Information Guideline – Matters of National Environmental Significance (DEHP n.d.)
- Independent Expert Scientific Committee (IESC) Information Guidelines – Explanatory Note for assessing GDE's (Doody et al. 2019)
- Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DE 2013)
- EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017a)
- Referral Guideline for 14 birds listed as migratory species under the EPBC Act (DE 2015a)
- EPBC Act referral guideline for the vulnerable Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) (DE 2014a) and
- Queensland Environmental Offsets Policy Significant Residual Impact Guideline (DEHP 2014).

14.1.4 Terminology

The Project Site refers to everything within the boundaries of ML 80187 and 700022. This covers an area of 2,661 ha. The Disturbance Area or Disturbance Footprint is everything within, and roads adjacent to, the MLs that will be disturbed. This covers an area of 1,372.5 ha and includes the earthworks footprint plus a 10 m buffer.

The term 'Project Site and Near Surrounds' refers to land (particularly relevant habitat) adjacent to, or within, approximately 3 km of the Project Site. The 'Study Area' refers to the Project Site, together with additional sites surveyed or assessed in the broader area surrounding the Project Site. The downstream environment refers to the Styx River and its estuaries and Broad Sound.

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 the Department of Environment and Science (DES) WildNet database taxonomy (for all other fauna), unless otherwise noted. All flora and fauna in this chapter is referred to initially by both common and scientific names and then only by common name.

The term migratory shorebird[1] is used in this chapter to describe a shorebird that migrates to Australia from other parts of the world. There are 37 international migratory shorebird species that regularly visit Australia each year (DEE 2017a). While Australia has additional species of shorebird that are listed as 'Migratory' under the EPBC Act, they migrate within Australia and are not referred to as migratory shorebirds within this chapter.

14.2 Methods

14.2.1 Desktop Assessement

The desktop assessment involved analyses of published ecological studies, database results, relevant literature, available field data and aerial imagery as outlined below.

14.2.1.1 Project Reports and Studies

Numerous reports and ecological studies have been prepared for the EIS and SEIS to inform the assessment presented in this chapter, including:

- Appendix 9a – A preliminary assessment of faunal values within and adjacent to EPC 1029, Styx Basin, central-east Queensland (Meyer 2011a)
- Appendix 9a – September 2011 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2011b)
- Appendix 9a – February 2012 fauna survey results for EPC 1029, Styx Basin, central-east Queensland (Meyer 2012)
- Appendix 9b – Flora and Vegetation Assessment Styx Coal (OBS 2011)
- Appendix 9c – Threatened Fauna Investigations Deep Creek, Central Queensland (Austecology 2020a)
- Appendix 9d – MNES and MSES Fauna Supplementary Impact Assessments, Central Queensland Coal Project (Austecology 2020b)
- Appendix 9e – Significant Species Management Plan, Central Queensland Coal Project (Austecology 2020c)
- Appendix 10a – Technical Report Groundwater Dependent Ecosystems, Aquatic Ecology, Marine Ecology and the Great Barrier Reef (ELA 2020a)
- Appendix 10d – Groundwater Dependent Ecosystem Assessment Central Queensland Coal Project (3D Environmental 2020)
- Appendix 10e – Draft Groundwater Dependent Ecosystem Management and Monitoring Plan (GDEMMP) (ELA 2020b)
- Appendix 11a – Biodiversity Offset Strategy (BOS) (CO2 Australia 2020a) and
- Appendix 11a – Draft Offset Delivery Plan (CO2 Australia 2020b).

14.2.1.2 Database Searches

Database searches were undertaken over a 50 km radius for State databases and a 25 km radius for the Australian Government EPBC Protected Matters Search Tool (PMST) report (DEE 2016a and 2020). The centre point used in the database searches was Latitude -22.706, Longitude 149.659. The

[1] Migratory shorebird is occasionally abbreviated to MS when differentiating between non-migratory shorebirds and migratory shorebirds listed under the EPBC Act.

PMST report and Queensland Government Wildlife Online reports were reviewed in both 2016 and 2020 and the complete reports are presented in Appendix A9f – 2016 and 2020 Database Searches.

14.2.1.2.1 Vegetation and flora

The desktop assessment for vegetation and flora within the Study Area involved:

- a review of the publicly available RE mapping including Version 10.0 (DNRME 2017) and Version 11.0 (DNRME 2020a)
- a search of the PMST report in 2016 and 2020 (DEE 2016a and DEE 2020)
- a review of the Wildlife Online report in 2016 and 2020 (DSITIA 2016 and 2020)
- a search of the WildNet Wildlife Records (DES 2020b)
- a search of Atlas of Living Australia species database (ALA 2018) and
- review of the Protected Plants Flora Survey Trigger Map (DES 2018a).

14.2.1.2.2 Wetlands

Mapped wetlands within the Study Area were identified based on a review of the following:

- Vegetation Management Wetlands Map (DNRME 2020b)
- Map of Great Barrier Reef wetland protection areas and map of Queensland Wetland Environmental Values (DES 2020a) and
- Directory of Important Wetlands in Australia (DIWA) (DEWHA 2008a).

14.2.1.2.3 Groundwater Dependent Ecosystems

Potential GDEs within the Study Area were identified based on a review of the GDE mapping on the Bureau of Meteorology's (BoMs) GDE Atlas (BoM 2020).

14.2.1.2.4 Fauna

To assess the potential presence of fauna species and their habitat within the Study Area the desktop assessment involved:

- a search of the PMST report in 2016 and 2020 (DEE 2016a and DEE 2020)
- a review of the Wildlife Online report in 2016 and 2020 (DSITIA 2016 and 2020)
- a search of the WildNet Wildlife Records (DES 2020b)
- a search of Atlas of Living Australia species database (ALA 2018)
- review of the vegetation management essential habitat map (DNRME 2020b) and
- review of migratory shorebird counts in Broad Sound (See Appendix 9h - Results of Migratory Shorebird counts in Broad Sound (Jaensch 2009 and Birdlife Capricornia 2018)).

14.2.1.2.5 Biodiversity Planning Assessment

DES has prepared a Biodiversity Planning Assessment (BPA) for the Brigalow Belt bioregion in order to provide broad scale ecological data and advise a range of planning and decision-making processes (DES 2018b). A review of the Brigalow Belt BPA within the Study Area has been undertaken.

14.2.1.2.6 Environmentally Sensitive Areas

Environmentally sensitive areas (ESAs) are defined under the EP Act and associated regulations. Category A and B areas are defined in the EP Regulation. Category C areas are defined within the

Code of Environmental Compliance for Exploration and Mineral Development Projects 2001. A review of the ESA data within the Study Area was completed as part of the desktop assessment.

14.2.1.2.7 Matters of State and Environmental Significance

In addition to the resources listed above, analysis of the following data was also undertaken to assess the potential presence of MSES:

- MSES Environmental Reports and associated data (DES 2019).

14.2.2 Field Surveys

A broad range of ecological field surveys were undertaken between 2011 and 2019 to verify the presence and quality of vegetation, wetlands, flora and fauna values within the Study Area. The surveys included preliminary studies carried out in 2011 and 2012 for the former incarnation of the CQC Project, which encompassed a much larger area (Exploration Permit for Coal [EPC] 1029), as well as more recent surveys which focused on the Project Site and Near Surrounds. 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 Study Area, based on the results of the desktop assessment.

14.2.2.1 Vegetation and Flora

A summary of the vegetation and flora surveys undertaken for the Project is provided in Table 14-2 including the scope of survey and methods of assessment. The location of vegetation and flora survey sites is illustrated in Figure 14-1. The field surveys resulted in the ground-truthing of all RE within the Project Site and Near Surrounds.

14.2.2.2 Fauna

A summary of the fauna surveys undertaken for the Project from 2011 to 2019 is provided in Table 14-2 including the scope of survey and methods of assessment. The location of fauna survey sites is illustrated in Figure 14-2. The 2019 field surveys resulted in remapping threatened fauna habitat within the Project Site and Near Surrounds for squatter pigeon (southern) (*Geophaps scripta scripta*), greater glider (*Petauroides Volans*) and koala (*Phascolarctos cinereus*).

14.2.3 Likelihood of Occurrence

Following field surveys all conservation significant species predicted as being potentially present from the desktop assessment were categorised as to their likelihood of occurrence within the assessment area. Four categories were used to classify the likelihood including:

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

14.2.4 Significant Impact Assessment

Based on the results of the desktop assessment and field surveys, for any MNES or MSES considered known or likely to occur within the Project Site or Near Surrounds, or in the downstream

environment, a significant impact assessment was undertaken in accordance with the following relevant guidelines:

- Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DE 2013)
- EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017a) and
- Queensland Environmental Offsets Policy Significant Residual Impact Guideline (DEHP 2014).

Table 14-2: Summary of terrestrial ecology field survey events

Date and duration	Consultant	Scope and survey extent	Method and limitations
• **Terrestrial vegetation and flora field survey events**			
21 to 25 March 2011 (five days)	Oberonia Botanical Services	• Baseline terrestrial vegetation and botanical assessment to assess ecological attributes and values within EPC 1029. • Summer (late wet season) flora survey of EPC 1029 (342 km^2).	• Literature review of PMST report, RE mapping, regrowth mapping, ESA mapping, Wildlife Online, HERBRECS specimen database, Fitzroy Natural Resource Region Back on Track Report (DERM 2010). • Targeted floristic surveys in remnant, high-value regrowth (HVR) and non-remnant vegetation in accordance with Neldner et al. (2005). • Flora sampling methods including: - CORVEG sampling in accordance with Neldner et al. (2005) - 31 wet season and 58 dry season survey sites - species lists – a comprehensive inventory at each survey site and - traverses in accordance with the random meander technique (Cropper 1993). • Due to a prolonged and extensive wet season, a number of sites were inaccessible during the late wet season surveys and the survey sites were confined to accessible roads and tracks. • For the dry season event, access was limited to some properties within the survey area due to a lack of landholder consent.
25 to 29 September 2011 (five days)	Oberonia Botanical Services	• Baseline terrestrial vegetation and botanical assessment to assess ecological attributes and values within EPC 1029. • Spring (dry season) flora survey of EPC 1029 (342 km^2).	
8 to 10 February 2017 (three days)	Terrestria	• Summer (wet season) flora survey of ML 80187 and immediate surrounds.	• Vegetation assessments 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).
17 to 20 July and 6 to 10 August 2018 (nine days)	3D Environmental	• Vegetation survey to refine certified regional ecosystem mapping within areas of Lot 10MC493 and Lot 11MC23. • Habitat quality assessments of proposed offset areas.	• Aerial photographic review with reference to certified RE Mapping (Version 10.1). • Field surveys by two ecologists over a nine-day period in accordance with Queensland herbarium standards as identified in Neldner et al. (2017) with quaternary and secondary sites used to verify RE mapping. • Collection of additional information to satisfy the Guide to Determining Terrestrial Habitat Quality Version 1.2 (2017) and facilitate BioCondition scoring. • 55 vegetation survey sites including 30 BioCondition assessment sites, 3 secondary sites, and 22 quaternary sites. • Mapping of verified REs.

Date and duration	Consultant	Scope and survey extent	Method and limitations
6 to 11 August and 28 to 31 August 2018 (10 days)	3D Environmental	• Identify the source of water utilised by trees for transpiration within areas identified as potential GDEs within the area of potential groundwater drawdown. • Assessments at five sites with potential to be terrestrial GDEs (Wetland 1, Wetland 2, Vine Thicket, Tooloombah Creek and Deep Creek GDE assessment areas).	• Assessment methods were focused on target tree species representative of potential phreatophytes including forest red gum, forest red gum (*Eucalyptus tereticornis*) vine thicket species and melaleuca species. • Assessment methods employed were: - Utilisation of drill core to provide evidence for tree rooting depth and characterise the local hydrogeological conditions - Soil moisture potential (SMP) measurement - Leaf water potential (LWP) measurement and - Stable isotope analysis of xylem water, soil moisture, surface water and groundwater. • Climatic conditions preceding the assessment were extremely dry, which offered ideal conditions for assessment of potential groundwater usage by vegetation.
23 to 27 September 2019 (five days)	Astrebla Ecological Services	• Ground truth regional ecosystem mapping at Mamelon outside of the ML (lots 11 MC23, 10 MC493 and 9 MC496) and lot 9 MC230, except for areas previously ground-truthed by 3D Environmental.	• Aerial photographic review with reference to certified RE Mapping (Version 11.1). • Field surveys by one ecologist over five days in accordance with Queensland Herbarium standards as identified in Neldner et al. (2019). • Mapping of verified REs.
13 to 16 November 2019 (four days)	3D Environmental	• Vegetation survey to refine certified regional ecosystem mapping within areas not captured in the 2018 survey including the haul road and Mt Bison Road.	• Aerial photographic review with reference to certified RE Mapping (Version 11.1). • Field surveys by two ecologists over four days in accordance with Queensland Herbarium standards as identified in Neldner et al. (2019) with quaternary sites to verify RE mapping. • Collection of additional information to satisfy the Guide to Determining Terrestrial Habitat Quality Version 1.2 (2017) and facilitate BioCondition scoring. • 26 vegetation survey sites including 7 BioCondition assessment sites and 19 quaternary sites. • Mapping of verified REs.

Date and duration	Consultant	Scope and survey extent	Method and limitations
September 2019 to June 2020	CO2 Australia	• Ground-truth of regional ecosystem mapping and BioCondition assessments to inform offsets analysis.	• Ground-truthing of RE, vegetation mapping and BioCondition assessments within ML 80187, including along Deep Creek. • Assessments along a tributary of Deep Creek located within ML 80187 and in the north of Mamelon, to support preparation of habitat condition impact assessments for ornamental snake, including three nights of spotlighting in May 2020, by CO2 Australia (led by Dr Jarrad Cousin).
Terrestrial fauna field survey events			
21 to 25 March 2011 (five days)	Ed Meyer	• Preliminary assessment to identify values for terrestrial fauna within and adjacent to EPC 1029 with a focus on fauna of conservation significance. • Detailed summer (wet season) fauna survey of EPC 1029	• Systematic surveys at four sites representative of mapped remnant vegetation within EPC 1029 with the following survey effort at each site: - Two 20 minute x 20 ha bird censuses at each site - Elliott trapping (with 20 baited Elliott A and B traps deployed over four nights at each site) - Camera trap surveys (with 5 camera traps deployed over four nights at each site) - Active diurnal searches (1 person hour at each site) - Nocturnal searches/spotlighting (1 person hour at each site) and - Anabat detection of ultrasonic bat calls (with a single Anabat unit deployed for one night at each site). • Supplementary surveys at 18 additional sites within EPC 1029 including bird censuses, diurnal and nocturnal searches, Anabat surveys, and call playback surveys (targeting barking owl, powerful owl, rufous owl and grass owl). • Systematic assessment of habitat values at 16 sites across EPC 1029 to collect information on vegetation structure, floristics, ground cover, disturbance and various other habitat attributes (e.g., presence of tree hollows, stags and exfoliating bark). • Road transects targeting nocturnal fauna and squatter pigeon. • Surveys were undertaken towards the end of an above average wet season with the high levels of rainfall resulting in thick grass cover and high flow of surface water in creeks and drainage lines. • Detectability of a terrestrial fauna and some migratory bird species was reduced as a result of the site conditions including high rainfall, a paucity of flowering eucalypts and bright moonlight.

Date and duration	Consultant	Scope and survey extent	Method and limitations
25 to 29 September 2011 (five days)	Ed Meyer	• Surveys targeting terrestrial threatened fauna within EPC 1029 to compliment March 2011 wet season fauna assessments (Meyer 2011b). • Detailed spring (dry season) fauna survey of EPC 1029.	• Systematic surveys at four sites broadly representative of mapped remnant vegetation within EPC 1029 with the following survey effort at each site: - Two 20 minute x 20 ha bird censuses at each site - 4 nights Elliott trapping at each site (with 20 baited Elliott A and B traps deployed at each site) - 4 days and 4 nights pitfall trapping at each site (with a single trap line comprising four 20 L buckets, 4 funnel traps and a 30 m drift fence at each site) - Camera trap surveys (with 2 camera traps deployed over four nights at each site) - Active diurnal searches (1 person hour at each site) - Nocturnal searches/spotlighting (1 person hour at each site using a headlamp and 50 W spotlight) and - Anabat detection of ultrasonic bat calls (with a single Anabat unit deployed for one night at each site). • Supplementary surveys at nine other sites within EPC 1029 including bird censuses, diurnal searches, Anabat surveys, and call playback surveys (targeting barking owl, powerful owl and yellow-bellied glider). • Systematic assessment of habitat values at 15 sites across EPC 1029 recording habitat values, information on vegetation structure, floristics, ground cover, disturbance and various other habitat attributes (e.g., presence of tree hollows, stags and exfoliating bark). • Drive transects targeting nocturnal fauna and squatter pigeon. • Due to mostly dry conditions during the survey access was improved, however there were still restrictions due to landholder providing access, with the land in the far north-east of EPC1029 unable to be surveyed.
7 to 10 February 2012 (four days)	Ed Meyer	• Surveys targeting threatened terrestrial fauna within EPC 1029 to compliment March 2011 wet season and September 2011 dry season fauna assessments.	• Surveys targeted conservation significant species known to occur, or potentially occurring, within EPC 1029 including squatter pigeon, ornamental snake (*Denisonia maculata*), brigalow scalyfoot (*Paradelma orientalis*), yellow chat (Dawson subspecies) (*Epthianura crocea macgregori*), black-breasted button-quail (*Turnix melanogaster*), collared delma (*Delma torquata*), and pale imperial hairstreak butterfly (*Jalmenus eubulus*).

Date and duration	Consultant	Scope and survey extent	Method and limitations
		• The purpose of the survey was to assess areas of EPC 1029 not assessed during previous surveys including in the far north-east and centre east of the EPC and to better assess values closer to the proposed mine area at the time.	• Surveys were undertaken at 10 sites and included a range of techniques including nocturnal searches and spotlighting, active diurnal searches (including log and rock-rolling) and drive transects. • Systematic assessment of habitat values at 10 sites across EPC 1029 recording habitat values, information on vegetation structure, floristics, ground cover, disturbance and various other habitat attributes (e.g., presence of tree hollows, stags and exfoliating bark). • Wet conditions affected access for vehicles, however, most sites were still accessible by foot. • Limited night light due to cloud cover is likely to have improved detectability of nocturnal fauna, however, a paucity of flowering eucalypts is likely to have affected the abundance of honeyeaters, lorikeets and flying-fox observed.
8 to 13 February 2017 (six days)	CDM Smith	• Detailed summer (wet season) fauna survey of ML 80187 and immediate surrounds. • The February 2017 surveys focused on the MLs and the immediate surrounds including the TLF area.	• 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*). Total of an additional 19.5 person hours of spotlighting. • 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 Total of an additional 400 camera trap nights.

Date and duration	Consultant	Scope and survey extent	Method and limitations
May 1 - 5;August 7 – 10; September 18 – 22; November 7 – 12 2017; January 15 – 19 2018	CDM Smith	• Supplementary fauna data obtained during water quality sampling events on ML 80187 and the wider surrounds.	• 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.
9 to 13 November 2019 (five days/four nights)	Austecology	• Additional threatened fauna surveys to address issues raised by DES regarding survey adequacy along sections of Deep Creek.	• Survey program focused on riparian vegetation within and adjacent to the section of Deep Creek downstream of the Bruce Highway, including the area of the proposed haul road crossing near the confluence of Barracks Creek. • The survey was implemented over five days and four nights by two ecologists and included diurnal and nocturnal searches to assess the presence of koalas and greater gliders. • Diurnal surveys were implemented between 8:00 am and 2:30 pm and included foot-based searches for diagnostic signs of presence (scats, tree trunk scratching), canopy searches for koala, presence of hollow-bearing trees. • Nocturnal searches were implemented between 8:00 pm and 12:30 am and including foot-based spotlight searches to detect presence of greater gliders and koalas. • For an observation of a koala or greater glider, the following was undertaken as a minimum: GPS location recorded and identification of the tree species. Additional information included an assessment of a koala's condition, and age and gender. All survey transects were also recorded with GPS units. • In addition, surveys for microchiropteran bats included deploying two Anabat Express detectors along Deep Creek to record between dusk and dawn for four consecutive nights. • Incidental records of other vertebrate species encountered were also recorded.
December 2019 (two days)	Austecology	• Habitat suitability assessments and target species surveys within the western parts of the Project Site and Near Surrounds	• Habitat suitability investigation and searches for evidence of koala scats, hollow-bearing trees for greater glider and their scats.

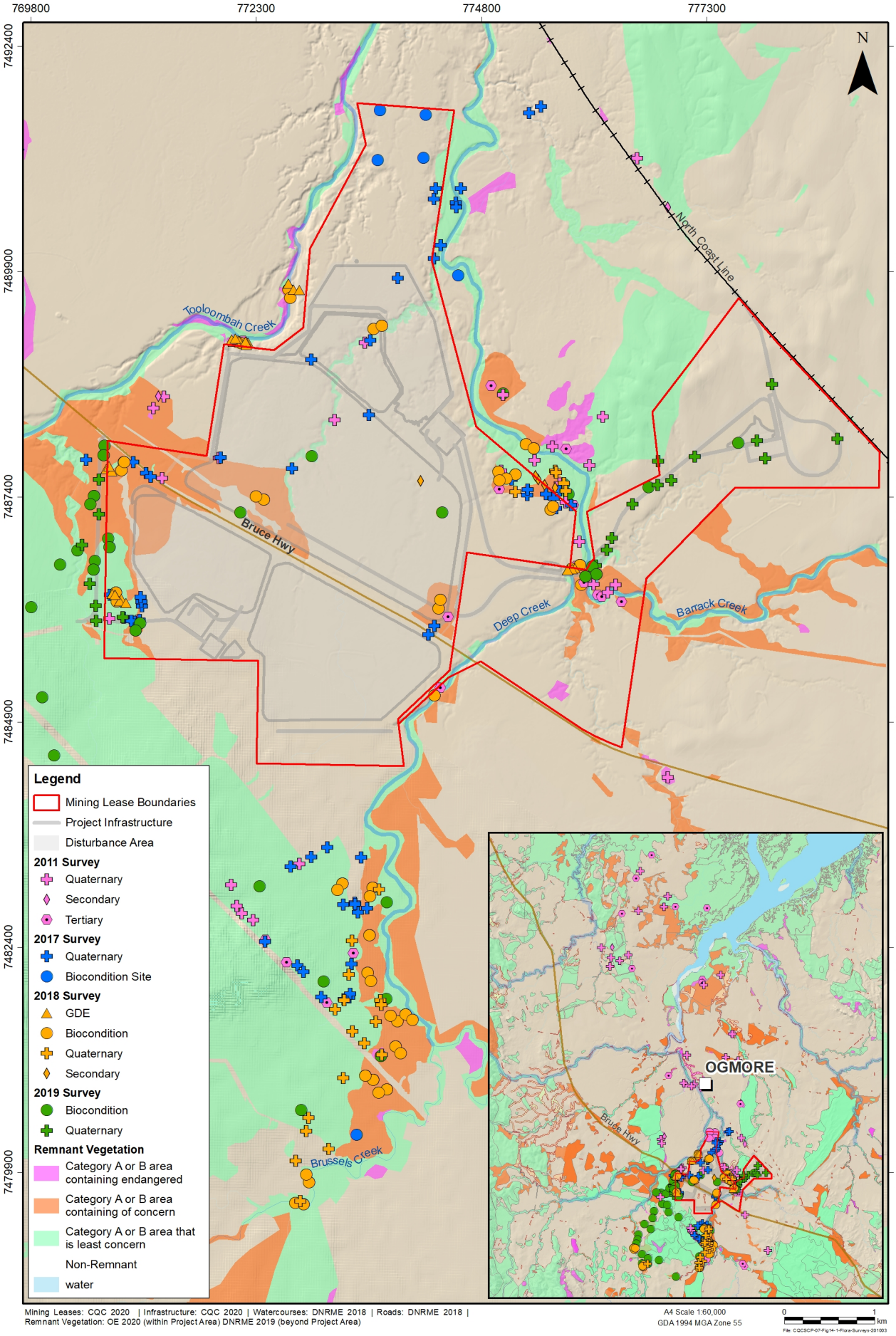


Figure 14-1: Vegetation and flora survey sites 2011 to 2019

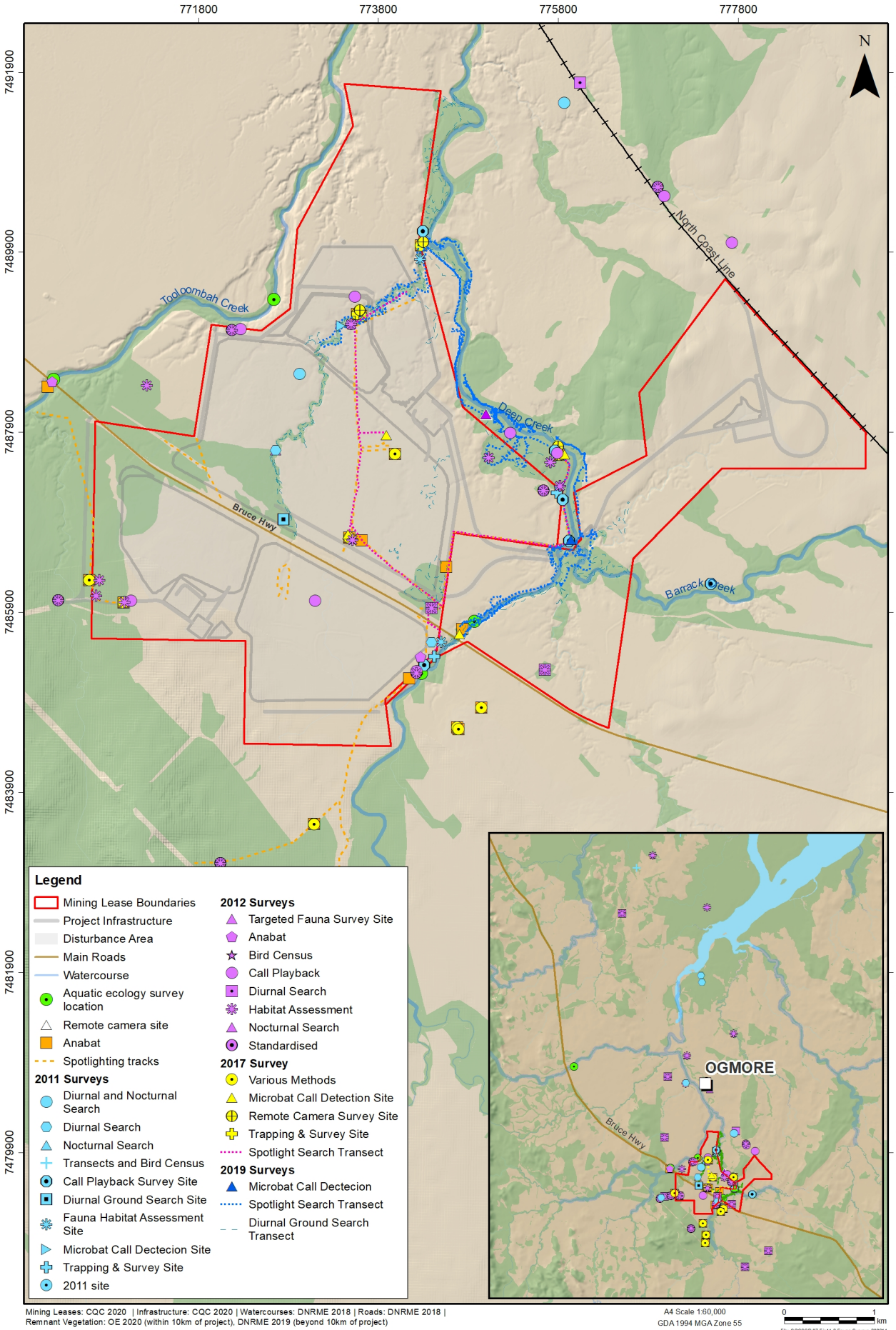


Figure 14-2: Fauna survey sites 2011 to 2019

14.3 Description of Environmental Values

14.3.1 Site Context

The Project Site is predominantly located within the Marlborough Plains subregion, one of the 14 subregions of the Brigalow Belt North bioregion. A small portion of the western Project Site and the Mount Bison Road realignment occurs in the adjacent Nebo-Connors Ranges subregion (Figure 14-3). The Project Site is located close to the boundary of the Brigalow Belt South bioregion.

The Project Site is wholly contained within the Styx River catchment and is bounded by Tooloombah Creek in the west and Deep Creek in the east (Figure 14-3). Minor ephemeral tributaries, ranked as first or second order drainage features, exist to both creeks and traverse the Project Site. Tooloombah and Deep Creek are ephemeral, and only flow approximately 24% of the time, following rainfall events. A number of pools exist along both creeks, with some considered to be permanent, while others have been observed to dry out during extended periods of low rainfall. Both creeks drain into the Styx River which is located 2.3 km north of the Project Site. The Styx River estuary discharges into Broad Sound DIWA and the Great Barrier Reef (GBR).

Large sections of the Brigalow Belt North bioregion have been cleared of remnant 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 Site have been substantially impacted by vegetation clearing associated with cattle grazing. Connectivity between remaining tracts of vegetation is maintained by thin strips of riparian vegetation along creek lines such as Tooloombah Creek and Deep Creek. However, vegetation remaining to the south and west of the Project Site is contiguous with an extensive tract of remnant vegetation, which includes Tooloombah Creek Conservation Park (Figure 14-3).

14.3.2 Biodiversity Planning Assessment

As illustrated in Figure 14-4, BPA analyses identified the majority of remnant vegetation within the Project Site as being of Regional significance. Two small patches of vegetation identified as endangered under the VM Act (DNRME 2020a) are considered of State significance. A small area of vegetation in the west of the Project Site is considered as locally significant (Figure 14-4). No wildlife corridors of any significance were mapped under the BPA within or surrounding the Project Site.

The BPA for the Brigalow Belt expert panel report (DES 2018b) describes two areas of special fauna biodiversity value – the Torilla Plain and Broad Sound, and the Southern Connors / Broadsound Range. The Torilla Plain and Broad Sound is located downstream of the Project Site. This area is regarded as a nationally important wetland system which supports substantial populations of waterbirds, including migratory shorebirds. The Southern Connors / Broadsound Range is located approximately 20 km west of the Project Site. DES (2018b) notes that the Southern Connors / Broadsound Range supports a high density and size range of hollow-bearing trees which are an important feature of this area for both the greater glider and yellow-bellied glider (*Petaurus australis*). Other threatened or priority taxa include the squatter pigeon (southern) and koala.

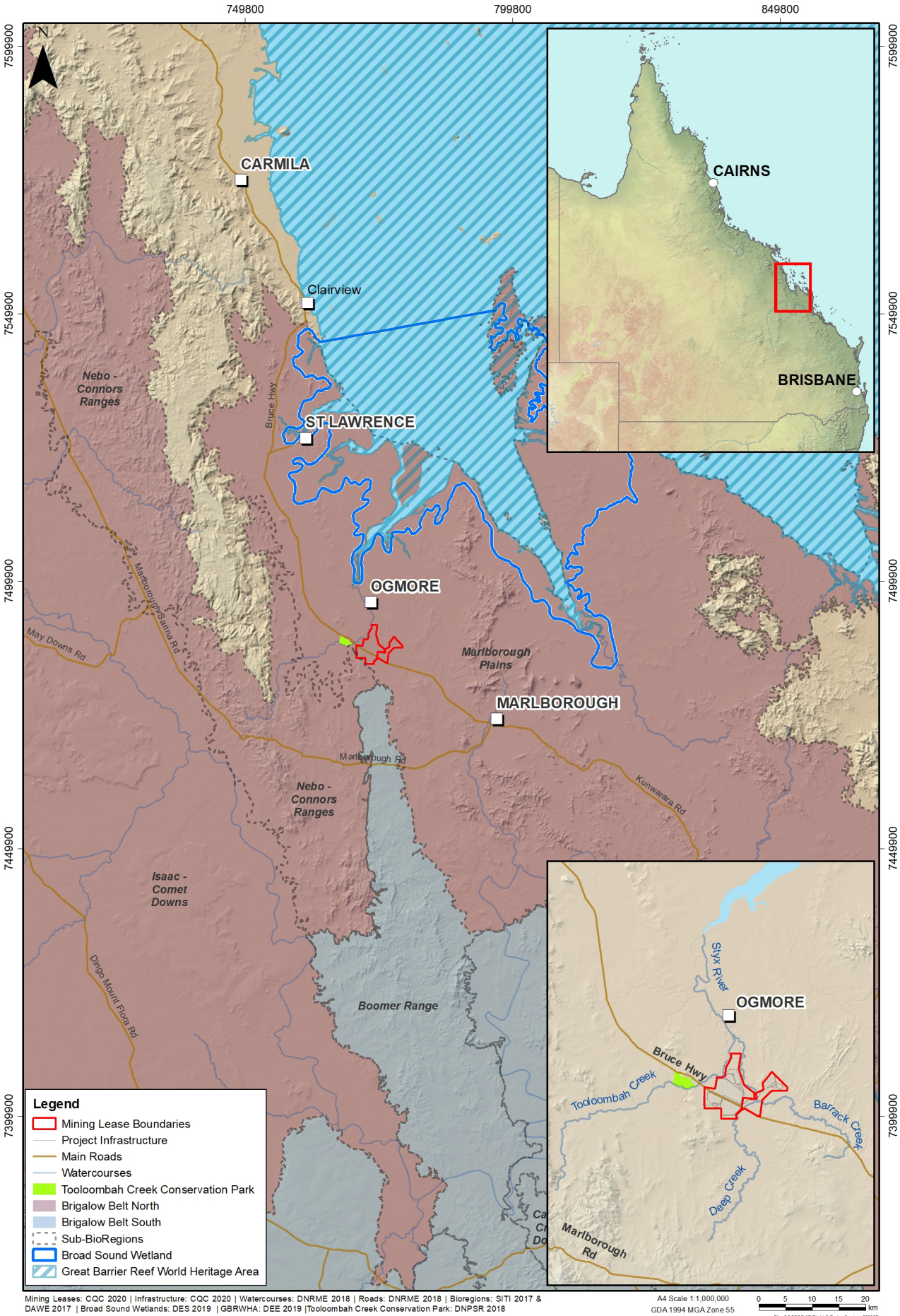


Figure 14-3: Project Site context

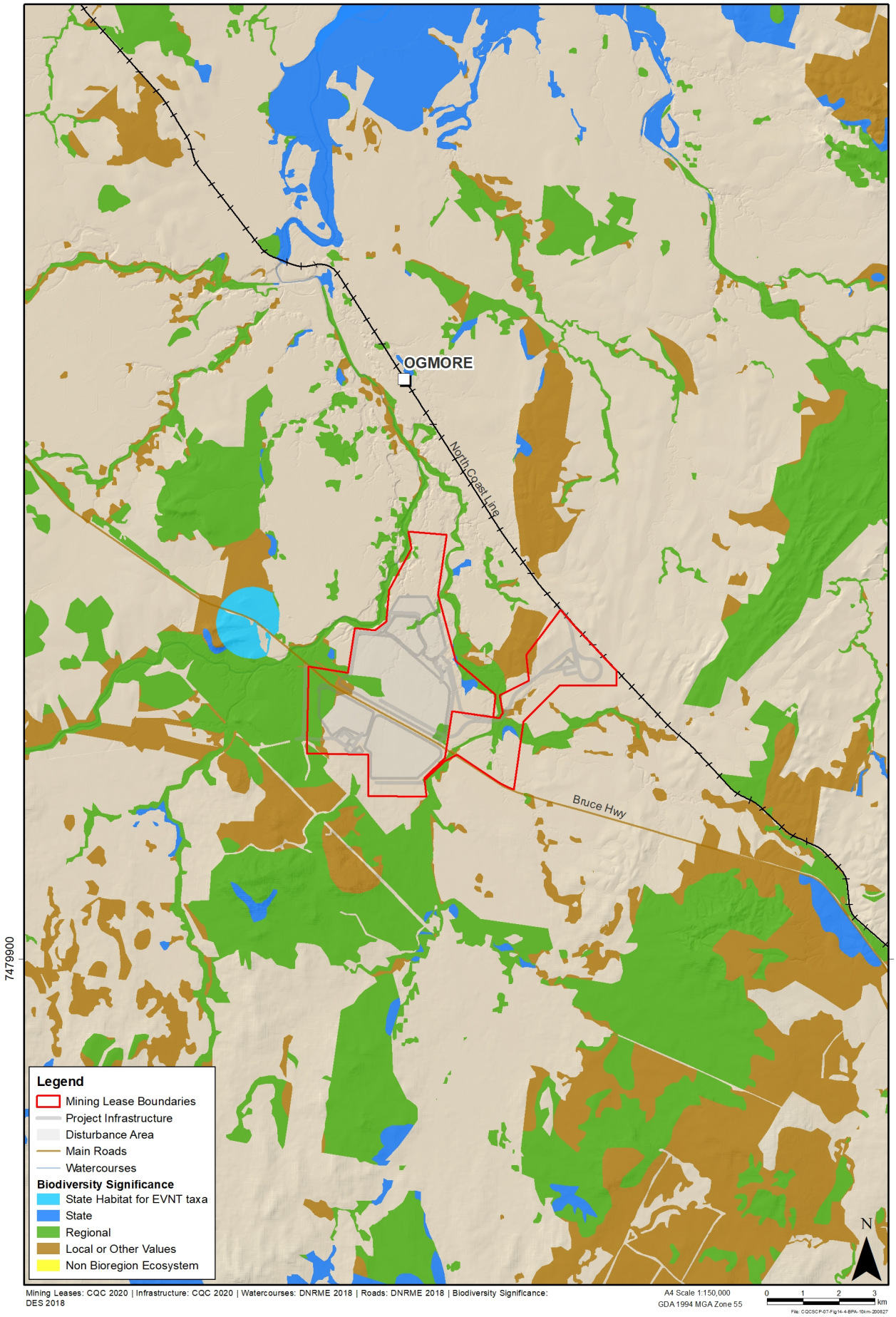


Figure 14-4: Biodiversity Planning Assessment

14.3.3 Environmentally Sensitive Areas

ESA mapping identified one Category B ESA within the Project Site (Figure 14-5). This Category B ESA is Endangered remnant vegetation (VM Act Status and Biodiversity Status). As described in Table 14-3, a number of Category A, B and C ESAs are located within the wider locality, including various protected areas and nature refuges. Waters associated with the Styx River are also designated as a 'coastal management district' which is a Category C ESA.

Table 14-3: Environmentally sensitive areas

Environmentally Sensitive Area	Category	Approximate distance from Project Site (km)
Tooloombah Creek Conservation Park	Category A	0.70
Great Barrier Reef World Heritage Area	Category B	9.70
Bukkula Conservation Park	Category A	14.50
Marlborough State Forest	Category C	14.20
Eugene State Forest	Category C	21.50
Mt Buffalo State Forest	Category C	21.80
Develin Nature Refuge	Category C	22.40
Burwood Nature Refuge	Category C	19.20
Great Barrier Reef Marine Park – general use area	Category B	9.70
Fish Habitat Area – Broad Sound	Category B	9.80
Endangered remnant vegetation	Category B	0.08
Marine Plants	Category B	4.00
Coastal Management District	Category C	3.80

14.3.4 Regional Ecosystems

Vegetation within the Marlborough Plains subregion is dominated by alluvial plains and colluvial slopes, usually supporting woodlands characterised by poplar gum (*Eucalyptus platyphylla*), ghost gum (*Corymbia aparrerinja*), forest red gum (*Eucalyptus tereticornis*) and paperbarks (*Melaleuca* spp.) with low rises supporting narrow-leaved ironbark (*Eucalyptus crebra*).

Regional ecosystems within the Project Site and Disturbance Footprint are listed in Table 14-4. This includes RE data based on the Vegetation Management Regional Ecosystem Map, Version 11.0 (DNRME 2020a) and ground-truthed RE data as a result of field surveys undertaken in 2018 and 2019. Figure 14-6 shows the extent of ground-truthed RE within the Project Site and Near Surrounds, as well as the source of the data, and Figure 14-7 shows the ground-truthed RE present. Eleven REs were identified within the Project Site during field surveys and a total of 339 ha of remnant vegetation was mapped. Of these 11 REs, four are mapped within the Disturbance Footprint including RE 11.3.25, 11.3.4, 11.4.2 and 11.5.8. These four REs are described below.

14.3.4.1 RE 11.3.25

Within the Project Site RE 11.3.25 is restricted to the immediate bed and banks of watercourses and is dominated by forest red gum and weeping tea tree (*Melaleuca leucadendra*). The sub-canopy includes carbeen (*Corymbia tessellaris*), Brigalow (*Acacia harpohylla*) and northern swamp mahogany (*L. grandiflorus*). The lower shrub layer includes *Hibiscus heterophyllus*, *Capparis loranthifolia*, wilga (*Geijera parviflora*), sandpaper fig (*Ficus opposita*), currant bush (*Carissa ovata*), and lantana (*Lantana camara*). RE 11.3.25 within the Project Site is in poor condition and has been heavily impacted by historical clearing of adjacent communities. Along Deep and Tooloombah

Creeks a mid-dense lower tree and upper shrub layer is characterised by river she-oak (*Casuarina cunninghamiana*), weeping bottlebrush (*Melaleuca viminalis*) as well as white cedar (*Melia azedarach*) and red ash (*Alphitonia exselsa*). There is 23.59 ha of RE 11.3.25 mapped within the Disturbance Footprint.

14.3.4.2 RE 11.3.4

RE 11.3.4, which is listed as of concern under the VM Act, occurs in patches across the eastern portion of the Project Site where it is associated with the alluvial plains adjacent to Deep Creek. This community occurs on shallow black self-mulching clays. It is characterised by a canopy of forest red gum, poplar gum with carbeen. An understorey is often present and comprised of species such as swamp box (*Lophostemon suaveolens*) and red ash. The lower shrub layer tends to be dominated by lantana, although native species present include coffee bush (*Breynia oblongifolia*) and boonaree (*Alectryon diversifolius*). The ground layer tends to be dense and dominated by grasses such as *Bothriochloa* spp., kangaroo grass (*Themeda triandra*) and black spear grass (*Heteropogon contortus*). This community is in a variable condition with evidence of past tree clearing or thinning for cattle grazing purposes. An understorey of lantana is common throughout. There is 1.39 ha of RE 11.3.4 mapped within the Disturbance Footprint.

14.3.4.3 RE 11.4.2

The majority of vegetation mapped within the Disturbance footprint is RE 11.4.2 (110.78 ha) which is listed as of concern under the VM Act. This community is dominated by poplar box (*Eucalyptus populnea*) and narrow-leaved ironbark as well as poplar gum, pink bloodwood (*Corymbia intermedia*) 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 (*Grewia retusifolia*). Where it borders regrowing Brigalow vegetation species such as Brigalow and belah (*Casuarina cristata*) occur. The ground layer tends to be characterised by grasses such kangaroo grass, black spear grass, *Eragrostis* spp. and *Bothriochloa* spp.

14.3.4.4 RE 11.5.8

This community occurs as extensive remnants along the western boundary of the Project Site (south of the Bruce Highway) on colluvial and residual deposits. It is characterised by emergent eucalypts such as pink bloodwood and Queensland peppermint (*E. exserta*), 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 (*Petalostigma pubescens*) and a variety of *Acacia* spp. Shrubs include *Canthium buxifolium*, orange box thorn (*Denhamia celastroides*) and scattered lantana. Species common in the ground layer include black spear grass, *Aristida* spp., *Bothriochloa* spp. and kangaroo grass. Cattle grazing has impacted vegetation within this community and Impacts on impacts from tree thinning evident. There is 5.61 ha of RE 11.5.8 mapped within the Disturbance Footprint.

Table 14-4: Desktop and ground-truthed regional ecosystems– Project Site and Disturbance Area

Regional Ecosystem	Description	VM Act Status	Biodiversity Status	DNRME V 11 RE (ha)		Ground-truthed RE (ha)	
				Project Site	Disturbance Footprint	Project Site	Disturbance Footprint
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland to open forest occuring fringing drainage lines and banks of major rivers	Least concern	Of concern	40.59	14.18	46.02	23.59
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp. woodland on Cainozoic alluvial plains and terraces, occurring on a variety of soils	Of concern	Of concern	19.67	0.00	18.92	1.39
11.3.11	Semi-evergreen vine thicket or semi-deciduous notophyll rainforest occurring on Cainozoic alluvial plains	Endangered	Endangered	0.00	0.00	0.0013	0.00
11.3.12	*Melaleuca viridiflora M. argentea* +/- *M. dealbata* woodland on older alluvial plains on strongly duplex clay soils with restricted drainage	Least Concern	No Concern at Present	0.00	0.00	4.18	0.00
11.3.27	Freshwater wetlands. Vegetation is variable including open water with or without aquatic species and fringing sedgelands and eucalypt woodlands. Occurs in a variety of situations including lakes, billabongs, oxbows and depressions on floodplains.	Least Concern	Of Concern	0.00	0.00	3.40	0.00
11.3.35	*Eucalyptus platyphylla*, *Corymbia clarksoniana* woodland occurring on Cainozoic alluvial plains	Least Concern	No Concern at Present	0.00	0.00	19.72	0.00
11.4.2	*Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains	Of concern	Of concern	191.46	100.85	192.36	110.78
11.4.9	*Acacia harpophylla* shrubby woodland with Terminalia oblongata on Cainozoic clay plains including weathered basalt	Endangered	Endangered	19.77	0.00	3.91	0.00
11.5.8	*Melaleuca* spp., *Eucalyptus crebra*, *Corymbia intermedia* woodland on Cainozoic sand plains and/or remnant surfaces	Least concern	No concern at present	0.00	0.00	33.51	5.61
11.5.8a/11.7.2	*Melaleuca* spp., *Eucalyptus crebra*, *Corymbia intermedia* woodland on Cainozoic sand plains and/or remnant surfaces/ *Acacia* spp. woodland	Least concern	No concern at present	17.70	7.58	0.00	0.00

Regional Ecosystem	Description	VM Act Status	Biodiversity Status	DNRME V 11 RE (ha)		Ground-truthed RE (ha)	
				Project Site	Disturbance Footprint	Project Site	Disturbance Footprint
	on Cainozoic lateritic duricrust. Scarp retreat zone						
11.11.1	*Eucalyptus crebra* or tall woodland often with *Acacia rhodoxylon*, occuring on sub-coastal hills and ranges on old sedimentary rocks with varying degrees of metamorphism and folding	Least concern	No concern at present	4.50	0.00	6.42	0.00
11.11.15	*Eucalyptus crebra* woodland that occurs on undulating rises and low hills on deformed and metamorphosed sediments and interbedded volcanics	Least concern	No concern at present	10.12	0.00	10.22	0.00
High Value Regrowth	-	-	-	13.73	11.02	0.00	0.00
Non-remnant	NA	-	-	2,343.73	1,238.98	2,322.51	1,231.13
Total		-	-	2,661.27	1,372.62	2,661.16	1,372.50

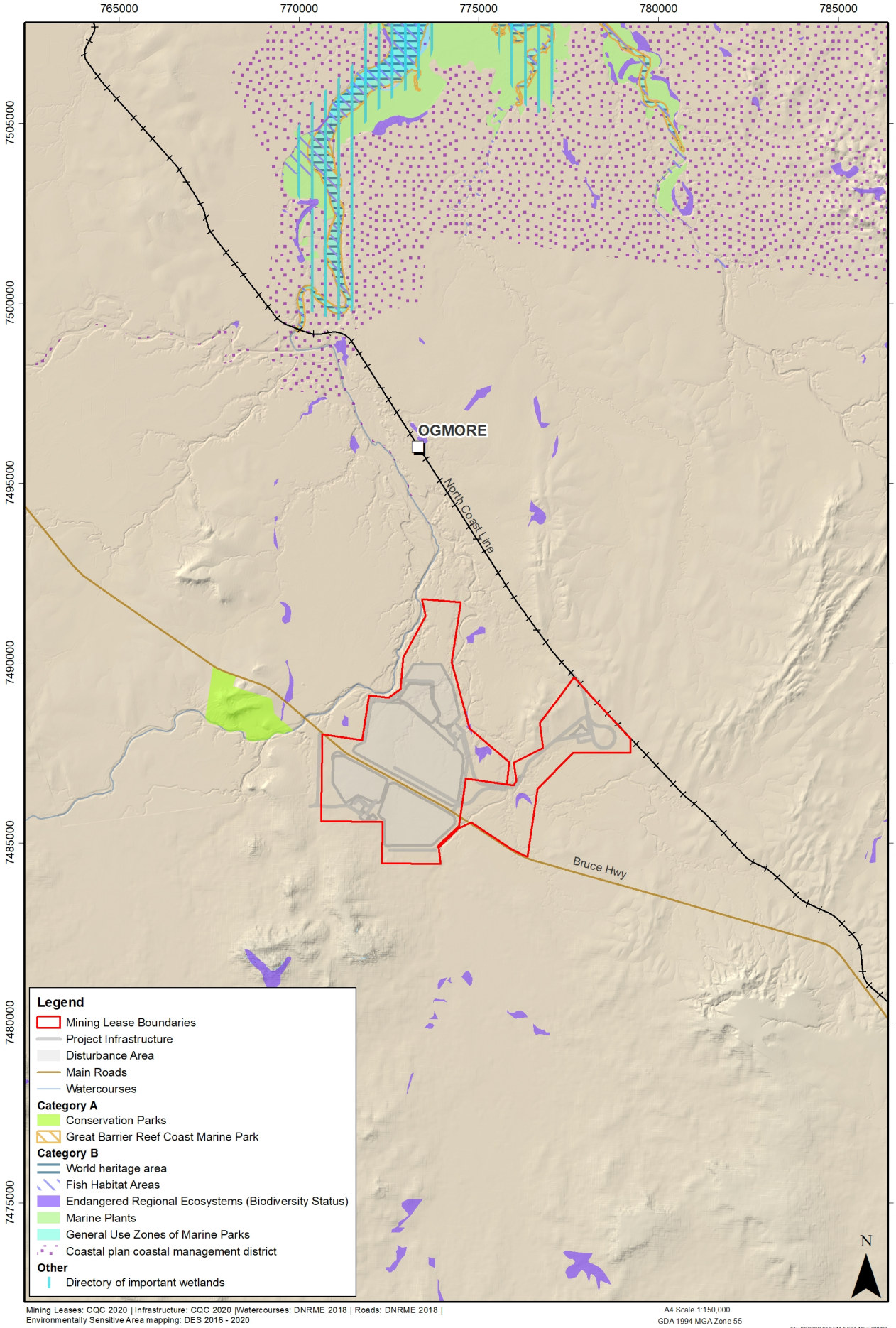


Figure 14-5: Environmentally sensitive areas

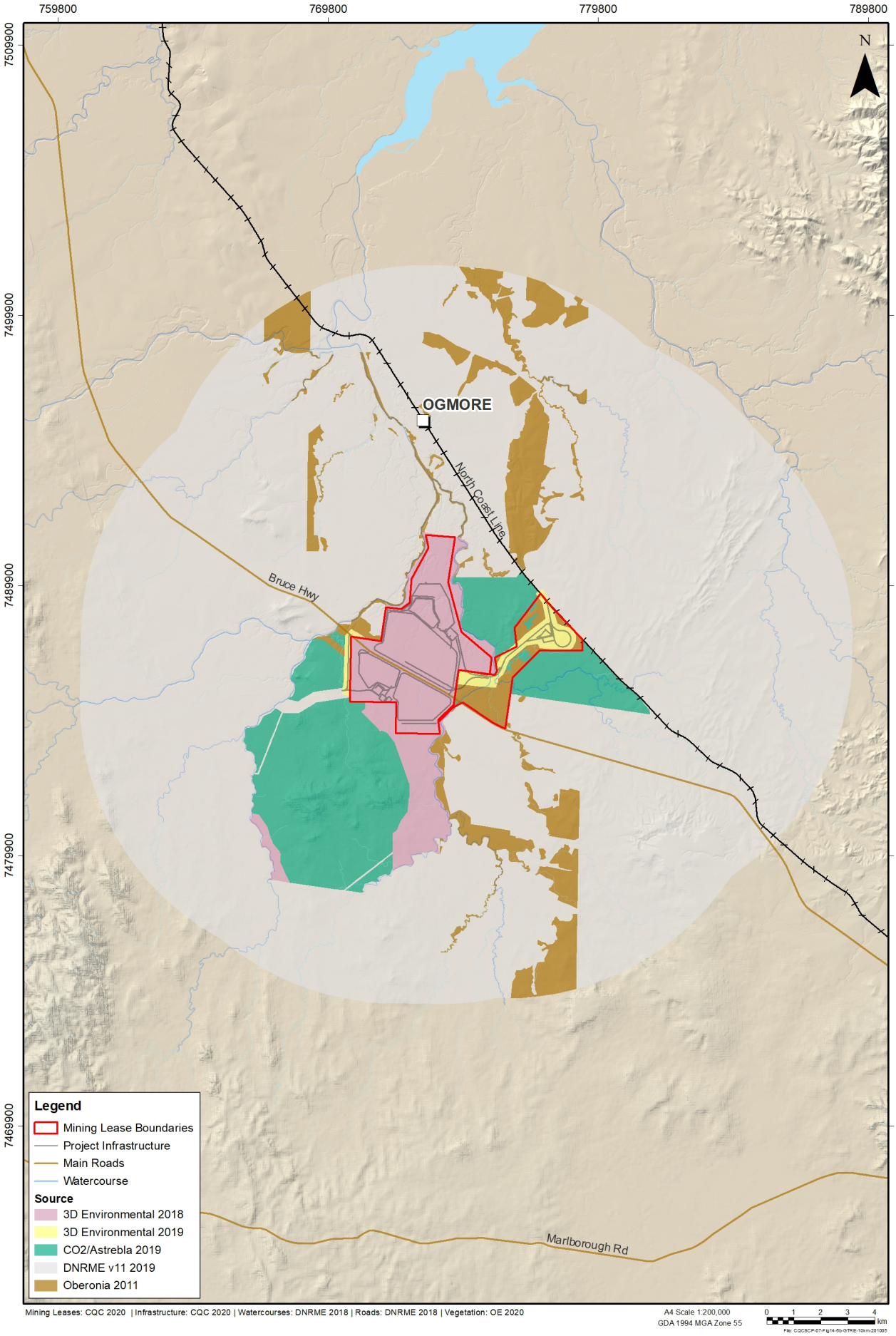


Figure 14-6: Extent of ground-truthed regional ecosystems and source of data

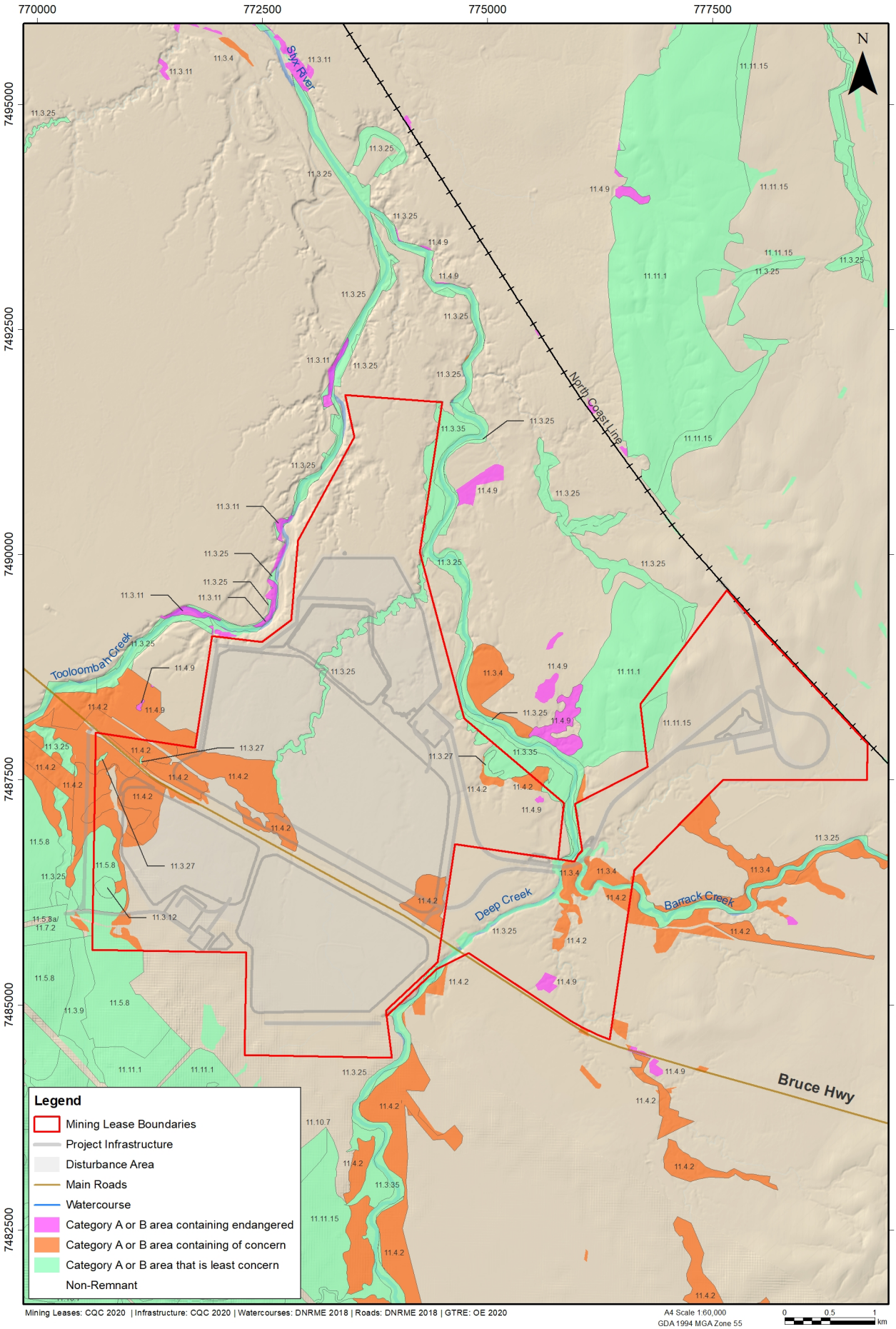


Figure 14-7: Ground-truthed regional ecosystems

14.3.5 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems are defined as ecosystems that require access to groundwater to meet all or some of their water requirements in order to maintain the communities of plants, animals and ecological processes they support, as well as the ecosystem services they provide (Doody et al. 2019). Two classes of GDEs are relevant to this chapter:

- Aquatic GDEs - Ecosystems dependent on the surface expression of groundwater. They include wetlands, lakes, seeps, springs, river baseflow, coastal areas and estuaries that constitute brackish water and marine ecosystems.
- Terrestrial GDEs - Ecosystems dependent on subsurface presence of groundwater. They include terrestrial vegetation that depends on groundwater fully or on a seasonal or episodic basis to prevent water stress and generally avoid adverse impacts to their condition.

14.3.5.1 Characterising Aquatic and Terrestrial GDEs

To characterise the types, nature, and location of Aquatic and Terrestrial GDEs within and surrounding the Project Site, a multidisciplinary assessment has been undertaken drawing on numerous studies completed for the EIS and SEIS's, and utilising multiple lines of evidence including:

- GDE investigations by 3D Environmental (2020) to identify the source of water utilised by trees for transpiration including:
  - drill cores to provide evidence for tree rooting depth and characterise the local hydrogeological conditions
  - soil moisture potential measurement
  - leaf water potential measurement and
  - stable isotope analysis of xylem water, soil moisture, surface water and groundwater.
- results of a stable isotope analysis undertaken by CDM Smith in 2018 to provide an indication of water sources supporting watercourse pools, which are hypothesised to be supported to some extent by groundwater discharge (CQC 2020a)
- ground-truthing of REs within and adjacent to the Project Site to determine the likelihood for them to be Terrestrial GDEs
- results of the transient electromagnetic (TEM) survey which mapped Electrical Conductivity (EC) at various depths across the Project Site to support of improved groundwater conceptualisation and modelling and assess salinity of groundwater sources (Allen 2019)
- outcomes of the revised regional numerical groundwater model which predicts drawdown depths of the water table across the Project site and surrounds (HydroAlgorithmics 2020)
- results of the revised flood study and site water balance by (WRM 2020)
- results of the fluvial geomorphology study to document the geomorphological character of the Project Site and Near Surrounds (Gippel 2020)
- analysis of surface water and groundwater data, including groundwater quality and water level data from several recently installed bores and stream flow data collected from gauges installed at Tooloombah and Deep Creek in 2019 (Orange Environmental 2020a and 2020b)
- assessment of the interactions between groundwater and surface water (ELA 2020a)
- data collected through geological coring of the soil profile including analysis of hydrogeological and geological data from alluvial drilling transects collected onsite from May to June 2020 (ELA 2020a)

- observational pools surveys of Tooloombah and Deep Creek (CQC 2020b) and
- examination of aerial photography to assess the persistence of pools over dry periods (ELA 2020b).

14.3.5.2 Definitions Relevant to the GDE Assessment

In characterising GDEs it is important to note that the Independent Expert Scientific Committee Guidelines (Doody et al. 2019, p13) state that the definition of **groundwater** includes '*water in the soil capillary zone (capillary fringe) but not the water held in the soil above this zone in the unsaturated or vadose zone. Within the saturated zone, pores are filled with water, whereas the capillary fringe and unsaturated zone increasingly have pores containing air as well as water. Water in caves that is sourced from groundwater is also included as groundwater, as are perched aquifers in the unsaturated zone.*'

This assessment also refers to the concept of **bank storage**. In the context of this assessment bank storage is a temporary source of groundwater stored within the banks of creeks or rivers which is derived from infiltration associated with flooding or rainfall. Water held in bank storage may be released to the adjacent creek or river over varying timescales following the recession of surface water levels. Water can also be held in bank storage for prolonged periods, where it may be accessed by Terrestrial GDEs.

In this assessment, the **water table aquifer** refers to an aquifer lying under the water table (as opposed to a perched aquifer). In most parts of the Project Site and surrounds, this is the alluvial aquifer. However, in some locations, particularly at Tooloombah Creek, the creek channel intersects the deeper weathered Styx Coal Measures. The term 'water table aquifer' therefore refers to the aquifer associated with the water table, regardless of which geological layer the aquifer is located within.

Enhanced leakage refers to the potential for water stored within the unsaturated zone to be depleted, due to the drawdown of the underlying water table aquifer, which can increase the rate of water infiltration from the unsaturated zone into underlying sediments.

The depiction of groundwater sources as relevant for this assessment is presented in Figure 14-8. The top row shows storm event or wet season conditions; the middle row shows post event conditions, and the bottom row shows dry season conditions. As can be seen from this figure:

1. Changes to the water table aquifer and bank storage occur in response to seasonal conditions (see differences between rows on Figure 14-8) and
2. in a given location, the response of the water table and the bank storage to seasonal conditions will differ, depending upon the distance between the base of the creek and the water table (see differences between columns on Figure 14-8).

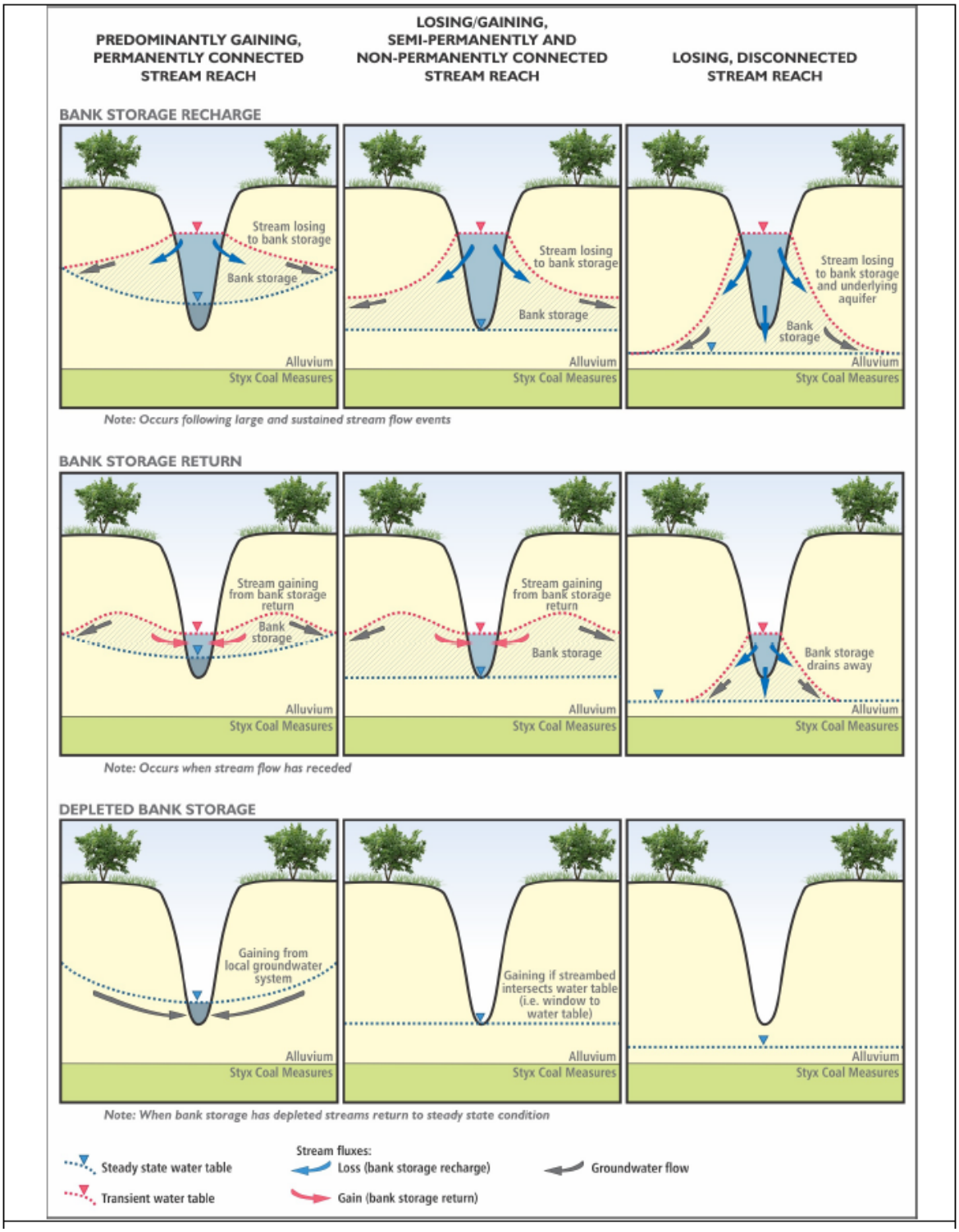


Figure 14-8: Conceptual groundwater figure for GDEs

14.3.5.3 Aquatic GDEs

GDE mapping on the Bureau of Meteorology's GDE Atlas (BoM 2020), presented in Figure 14-9, indicates the potential presence of Aquatic GDEs within and adjacent to the Project Site including the Styx River, Tooloombah Creek, Deep Creek, Barrack Creek, Wetland 1 and 2, and a number of small farm dams. Investigations undertaken as part of the EIS and SEIS also indicate that:

- There is potential for baseflow of groundwater into Tooloombah and Deep Creek and as such these waterways are consistent with the definition of Aquatic GDEs.
- Throughout the wet season, flows within Tooloombah and Deep Creek are primarily driven by rainfall-generated surface water runoff and associated baseflow.
- During the dry season, groundwater is expressed within some sections of Tooloombah Creek and, to a lesser extent, Deep Creek, sustaining some pools throughout part, or in some cases all, of the dry season.
- Each pool is likely to have a differing degree of groundwater input, which may be a permanent connection or a temporary one through the wet season and parts of the dry season. The differences in connectivity may be due to differences in elevation (i.e. distance from the creek bed to the water table aquifer) and permeability of the underlying geology, which varies spatially.
- Aquatic GDEs in the lower catchment are likely to have year-round access to groundwater, whereas those in the upper to middle reaches may only have seasonal connection to groundwater.
- As there is also spatial variability in the salinity of groundwater (as indicated through monitoring of groundwater bores), each pool is likely to have a unique pattern of water chemistry.
- *Melaleuca leucadendra* occurring along the riparian fringe of Tooloombah and Deep Creek, and near groundwater-fed pools, are consistent with the definition of an Aquatic GDE, as they are shallow rooted and utilising groundwater fed stream pools and fluvial sands.
- Wetland 1 and Wetland 2 are not supported by the surface expression of groundwater and are therefore not Aquatic GDEs. Water and associated soil moisture at Wetland 1 and Wetland 2 are derived from surface water, rather than the surface expression of groundwater.

The assessment concludes that Aquatic GDEs present within the Project Site and Near Surrounds include groundwater fed pools of Tooloombah and, to a lesser extent, Deep Creek. Groundwater fed pools that persist throughout dry periods may provide an important source of water for fauna, particularly koala and squatter pigeons. *Melaleuca leucadendra* occurring along the riparian fringe of Tooloombah and Deep Creek, and near groundwater-fed pools, are also consistent with the definition of an Aquatic GDE and contribute to habitat for a range of fauna species, providing shade and shelter.

The complete assessment of Aquatic GDEs is presented in Chapter 15 – Aquatic and Marine Ecology.

14.3.5.4 Terrestrial GDEs

GDE mapping on the Bureau of Meteorology's GDE Atlas presented in Figure 14-9 indicates the potential presence of Terrestrial GDEs within and adjacent to the Project Site including the Styx River, Tooloombah Creek, Deep Creek, Barrack Creek, Wetland 1 and 2 and remnant vegetation located to the south and west of the Project Site.

Field studies completed in 2018 examined the potential groundwater dependence of vegetation in a variety of locations, including Wetlands 1 and 2, and the riparian corridors of Tooloombah and Deep Creek. Based on the results of these field studies, the main vegetation types with potential to be Terrestrial GDEs are the riparian corridors along Tooloombah and Deep and Creek. These field studies concluded that:

- Wetland 1 meets the definition of a Terrestrial GDE, as *Melaleuca viridiflora* utilises sub-surface groundwater, in the form of a perched aquifer. As *Melaleuca viridiflora* is a key component of

the wetland, and its associated RE 11.3.12, the entire wetland can be considered a Terrestrial GDE.

- Any aquifer located beneath Wetland 2 is deeper than 15 metres below ground level (mbgl) and beyond the reach of tree roots. Vegetation within Wetland 2, and Wetland 2 itself, is not a Terrestrial GDE.
- A small patch of Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (north and south) and Nandewar Bioregions threatened ecological community (SEVT TEC) was found to not be a Terrestrial GDE, with the exception of emergent *Eucalyptus tereticornis* (forest red gums) (which are not a key component species of this community) which were found to be accessing fresh water in the shallow coal measures and Quaternary Alluvium Units. SEVT trees had shallower roots and were accessing soil moisture in the unsaturated zone. The SEVT TEC is not a Terrestrial GDE, as the key vegetation species comprising the community are not groundwater dependent.
- Forest red gums present on the upper terraces of both Tooloombah and Deep Creek were accessing fresh groundwater, likely held in a perched aquifer or on the capillary fringe, rather than in the water table aquifer itself. As such forest red gums present in the riparian corridors of Tooloombah and Deep Creek are Terrestrial GDEs.

The potential for vegetation communities to be groundwater dependent was also examined by reviewing the predominant tree species comprising each RE within and adjacent to the Project Site, and investigating previous records of the groundwater dependence of those species. The primary source of information was IESC (2018) as it includes a list of vegetation species that are likely to be GDEs, along with a range of depths to water table derived from various published studies. The assessment concludes that five REs within the Project Site and Near Surrounds have the potential to be Terrestrial GDEs including RE 11.3.4, RE 11.3.25, RE 11.3.12, RE 11.3.27 and RE 11.3.35. As illustrated in Figure 14-10, these REs occur along the riparian corridors comprising Tooloombah and Deep Creek or as isolated wetlands.

The depth to groundwater was examined at locations where these REs occur, to determine whether groundwater resources that may support vegetation are present. Only areas with a groundwater level deeper than 15 mbgl were excluded from further consideration. This approach is therefore considered to be conservative, as known depths to water table in published sources are generally reported as a maximum of 10 m for the vegetation species present within the Project Site and Near Surrounds (IESC 2018). Depth to groundwater was found to vary from approximately 10 to 15 mbgl across the majority of the Project Site and Near Surrounds.

The salinity of groundwater was also examined at locations where Terrestrial GDEs have the potential to occur. The upper soil salinity tolerance of key vegetation species present in the Project Site and Near Surrounds generally falls into the Moderately Saline category of DoA (2020), equivalent to an Electrical Conductivity (EC) of 4,000 to 8,000 µS/cm. Taking a conservative approach, for the purposes of this assessment, it is assumed that the maximum EC of groundwater that may sustain terrestrial vegetation at the site is 10,000 µS/cm. A series of monitoring bores installed across the Project Site and Near Surrounds and monitored since 2018 have demonstrated that at most locations along the riparian zone, the water table aquifer is too saline to meet the water requirements of vegetation. Of the ten existing shallow groundwater monitoring bores in place along the Styx River, Tooloombah and Deep Creek, four have a salinity concentration that is tolerable by terrestrial vegetation. The remaining six bores have a median EC above a conservative tolerance of 10,000 µS/cm, with minimal temporal variation in salinity. Water within the upper Quaternary Alluvium (Qa) is generally less saline than the underlying Quaternary Pleistocene

Alluvium (QPa). On the basis of these results, it can be concluded that the water table aquifer is generally unsuitable for utilisation by riparian vegetation in many locations adjacent to the Project Site, with groundwater of a quality suitable for use by vegetation occurring in some locations only, and most likely in the upper Qa layers.

Based on the above analysis, Terrestrial GDEs across the Project Site and Near Surrounds are considered to include Wetland 1 and vegetation communities existing along the riparian corridors of Tooloombah and Deep Creek comprising REs 11.3.4, RE 11.3.25, RE 11.3.12, RE 11.3.27 and RE 11.3.35, where they are accessing groundwater located less than 15 mbgl and that has an EC below the conservative tolerance of 10,000 µS/cm.

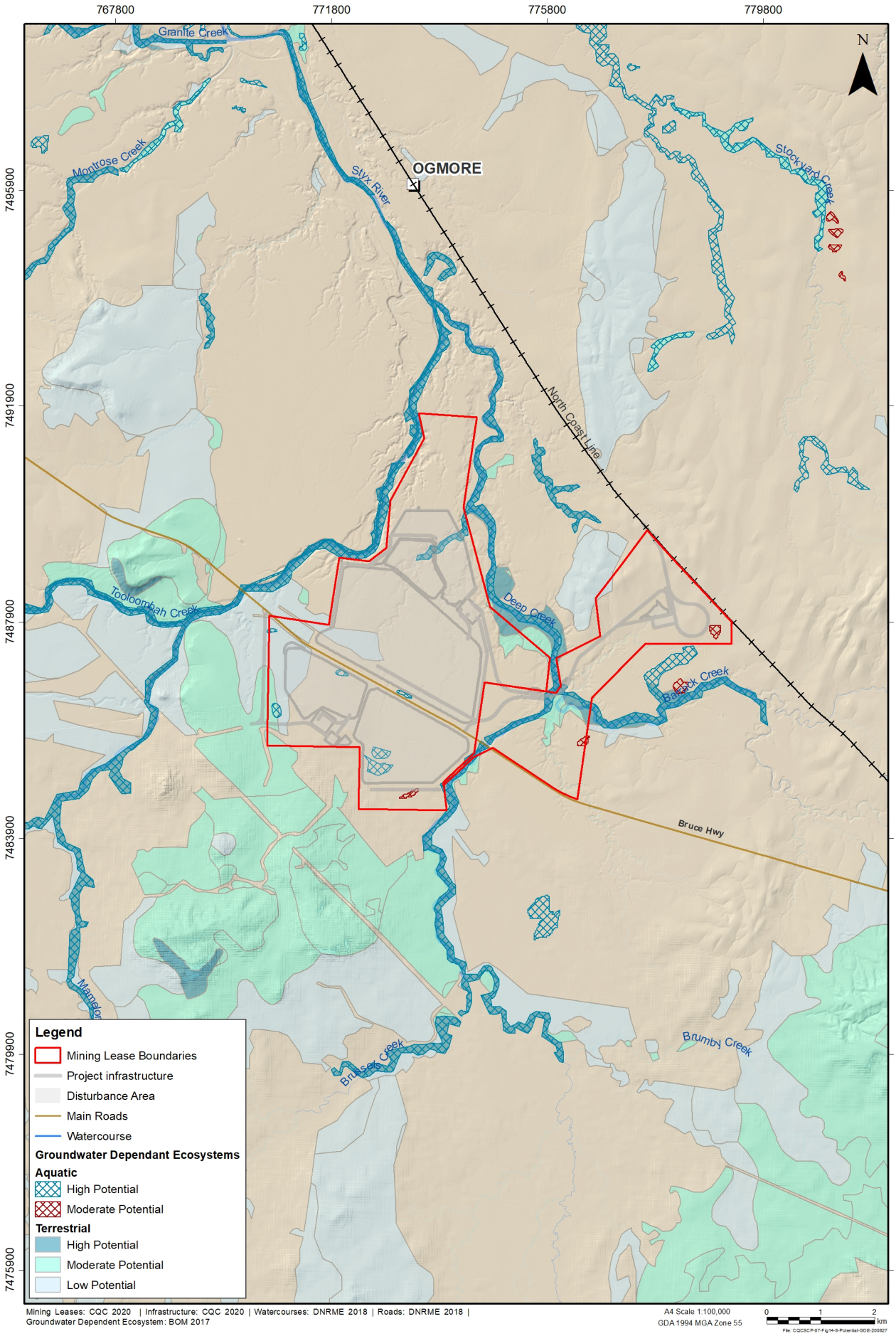


Figure 14-9: Potential GDEs within the Project site and near surrounds

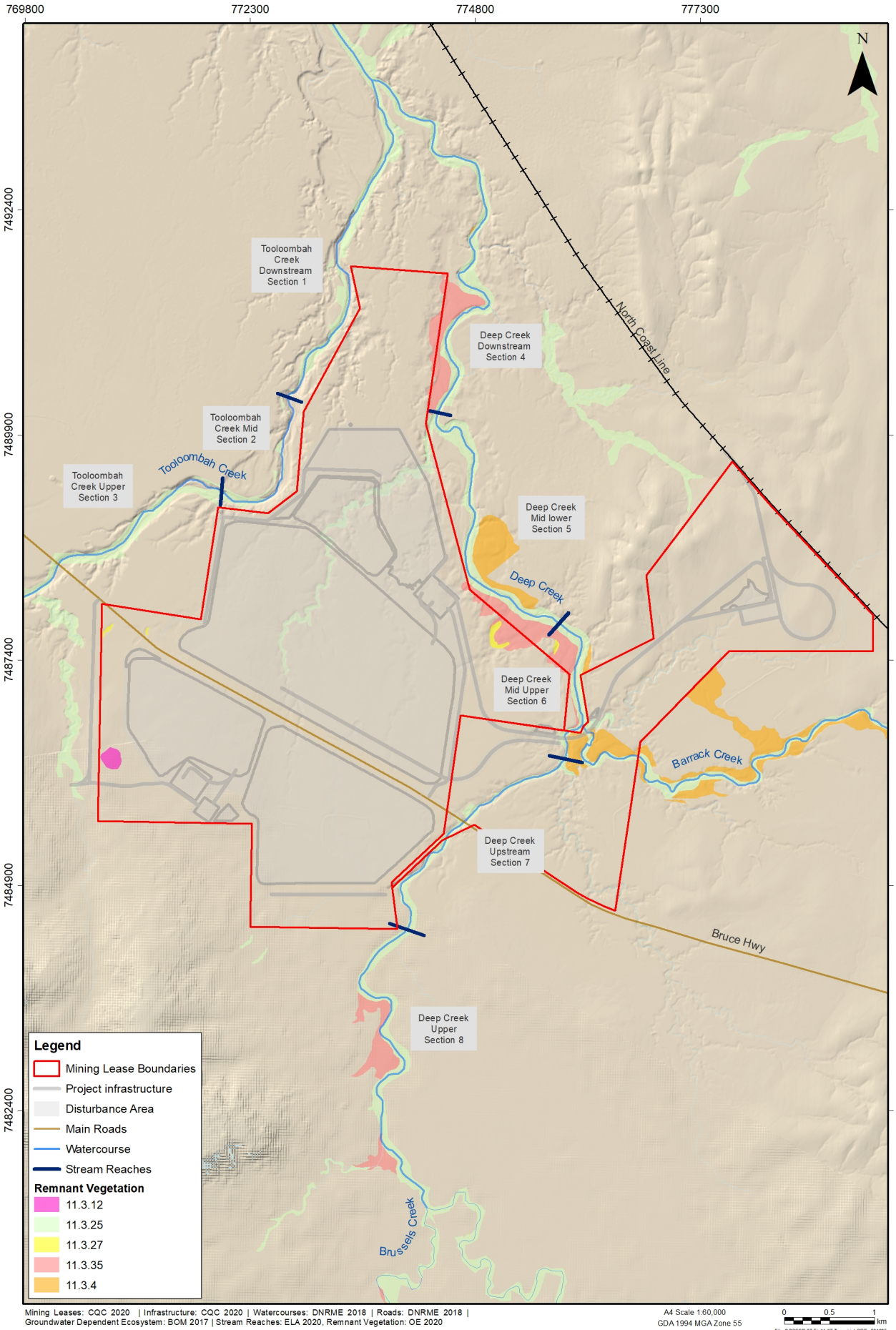


Figure 14-10: Potential terrestrial GDEs within the Project site and near surrounds

14.3.6 Threatened Ecological Communities

The 2016 PMST Report (DEE 2016a) identified five threatened ecological communities (TECs) as having the potential to occur within the search area. A subsequent search of the PMST in 2020 (DEE 2020) identified one additional TEC as having the potential to occur, the Poplar Box Grassy Woodland on Alluvial Plain. However, this TEC was listed under the EPBC Act on 4 July 2019 after the decision on referral was made and as such is not considered further as part of this assessment. The five TECs relevant to this assessment are listed under the EPBC Act as Endangered and include:

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

No other TECs were recorded within the Project Site during field surveys and no TECs were recorded within the Disturbance Footprint during field surveys. Detailed descriptions of the location, vegetation composition and condition for Brigalow TEC and SEVT TEC is provided below.

Table 14-5: Threatened ecological communities within or directly adjacent to the Project Site

Threatened Ecological Community	Regional Ecosystem	VM Act Status	EPBC Act Status	Area within Project Site (ha)
Brigalow (*Acacia harpohylla)* dominant and co-dominant ecological community	RE 11.4.9	Endangered	Endangered	0.54
				3.37
Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (north and south) and Nandewar Bioregions	RE 11.3.11	Endangered	Endangered	0.0013 is within Project Site, however total patch is 1.14

14.3.6.1 Brigalow TEC

Remnant Brigalow

Brigalow TEC identified within the Project Site occurs as two isolated remnant patches – one located near the eastern boundary of ML 80187 and a larger patch located to the south of the Deep Creek Haul Road in ML 700022 (Figure 14-11). These communities are characterised by an open forest canopy of Brigalow with occasional poplar box. Upper and lower shrub layers are mid-dense comprising false sandalwood (*Eremophila mitchellii*), currant bush, boonaree and Queensland ebony (*Disospyros humilis*). The ground layer is dominated by introduced pasture grasses, predominantly buffel grass (*Cenchrus ciliaris*). Remnant Brigalow within the Project Site shows obvious signs of cattle disturbance but is generally in good condition and satisfies the threshold conditions for Brigalow TEC. Isolated patches also occur outside the Project Site, particularly to the northeast (Figure 14-11).

Regrowth Brigalow

Regrowth Brigalow does not occur in the cleared areas to the south of the Bruce Highway. Much of the Project Site north of the Bruce Highway comprises extensive areas of Brigalow regrowth.

Requests were made by the Department of Agriculture, Water and Environment (DAWE) following the submission of the EIS for information regarding areas containing regrowth Brigalow located within ML 80187. To satisfy this request, an assessment was carried out using the criteria outlined in Butler (2007), historical aerial imagery, site observations in January 2017 and advice from the previous landowner.

High resolution aerial imagery of the site from 2004 (Figure 14-12) was compared to aerial imagery from 2016 (Figure 14-13). The 2004 imagery shows two areas where regrowth Brigalow occurred in relatively continuous patches. The remainder of the property was cleared and devoid of vegetation except for scattered trees. Further analysis of these areas using aerial imagery from 2004, 2012 and 2016 (Figure 14-14 and Figure 14-15) indicates that these areas were heavily impacted sometime after 2004.

These sites were inspected in January 2018 (CDM Smith 2018). Brigalow was found to be the dominant canopy tree in these areas. Generally, the Brigalow present was between 3 m to 5 m in height indicating a relatively young age given the seasonal rainfall in this area. The former landowner who owned the property until 2006 informed CDM Smith that these areas had been 'pulled' (i.e. cleared using a heavy chain dragged between two bulldozers) as was most of the country on that side of the highway to 'tidy up' the property prior to selling in 2006 (pers. comm. John McCartney, February 2018). As such, these areas, as well as the remainder of the property to the north of the highway have been comprehensively cleared within the past 15 years and do not fit the criteria for inclusion as Brigalow TEC.

14.3.6.1.1 Threats

The clearing of Brigalow, predominantly post 1960, is the primary reason for its listing as Endangered. Butler (2008) states that "with the exception of clearing, the most important threat to remnant and regrowth Brigalow is fire fuelled by exotic grasses". Invasive plant and animal species threaten the biodiversity of Brigalow TEC by affecting the ecosystem's suitability as habitat for native species, and they can significantly alter the structure or function of the community (Butler 2008). Trampling and grazing by large herbivores can have a detrimental impact on Brigalow TEC. Whilst grazing impacts plant recruitment and growth, it is also an important tool for the management of fuel loads, particularly the management of exotic pasture grasses (Butler 2008).

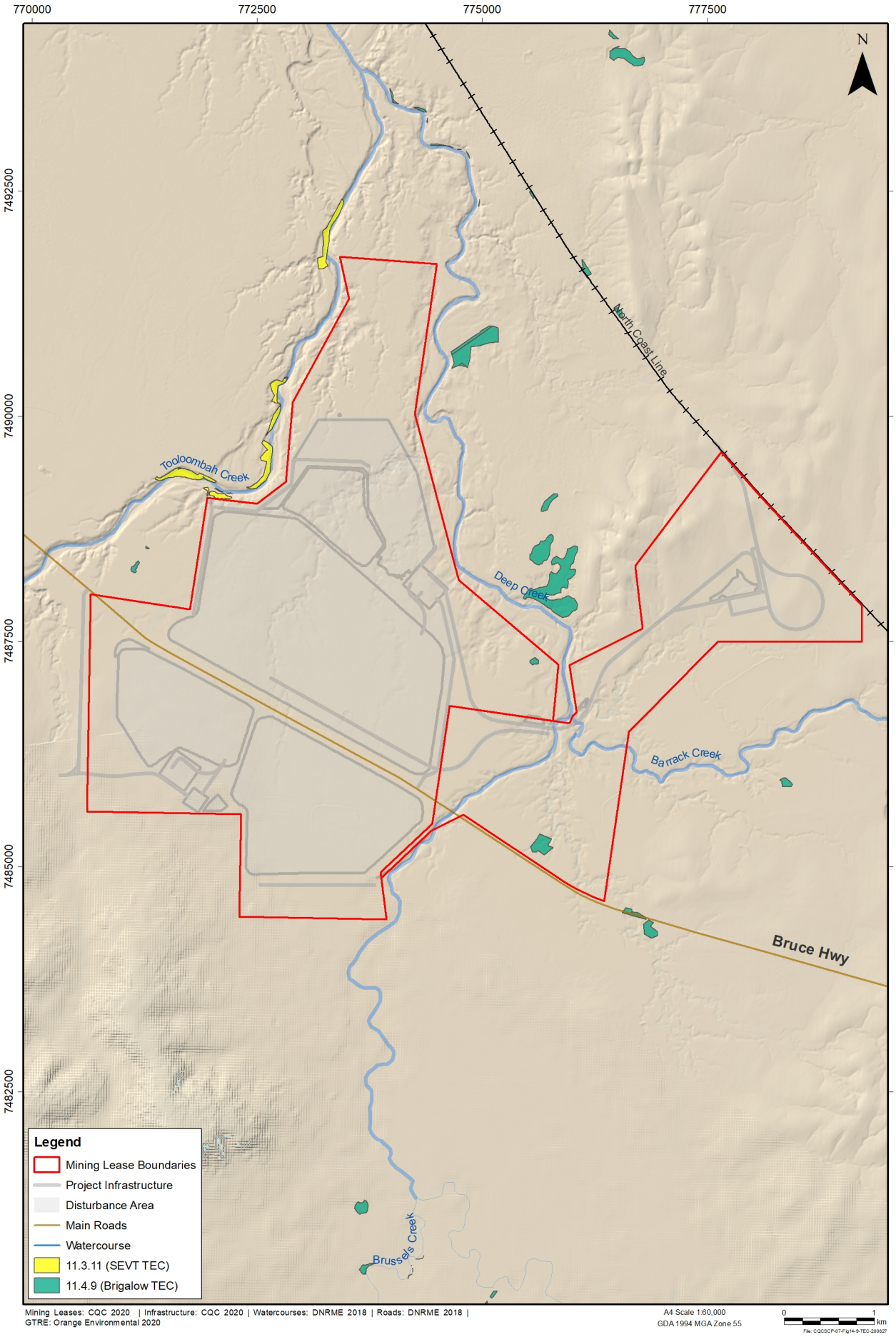


Figure 14-11: Threatened ecological communities within and adjacent to the Project Site

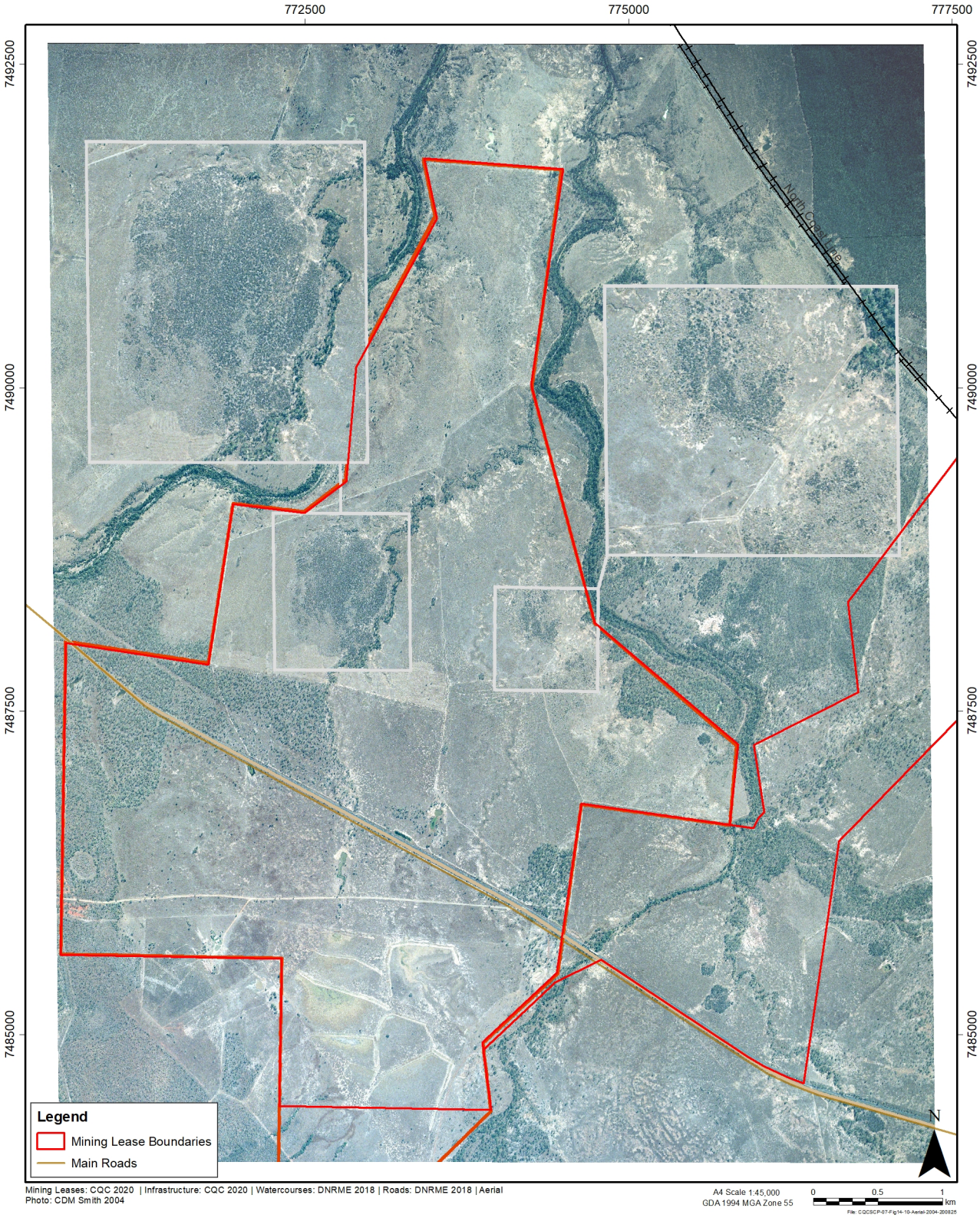


Figure 14-12: Aerial imagery of the northern Project site – June 2004

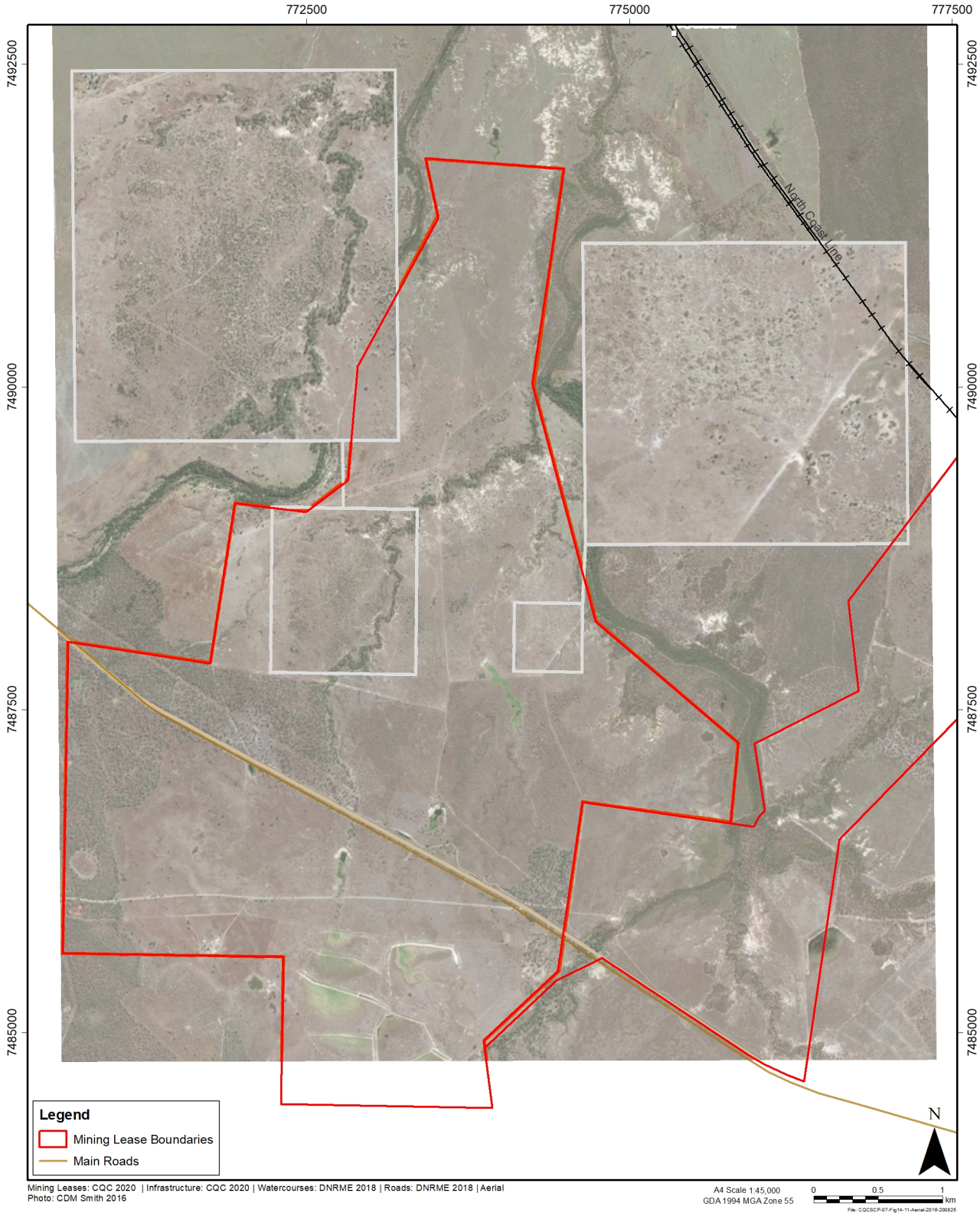


Figure 14-13: Aerial imagery of the northern Project site – March 2016

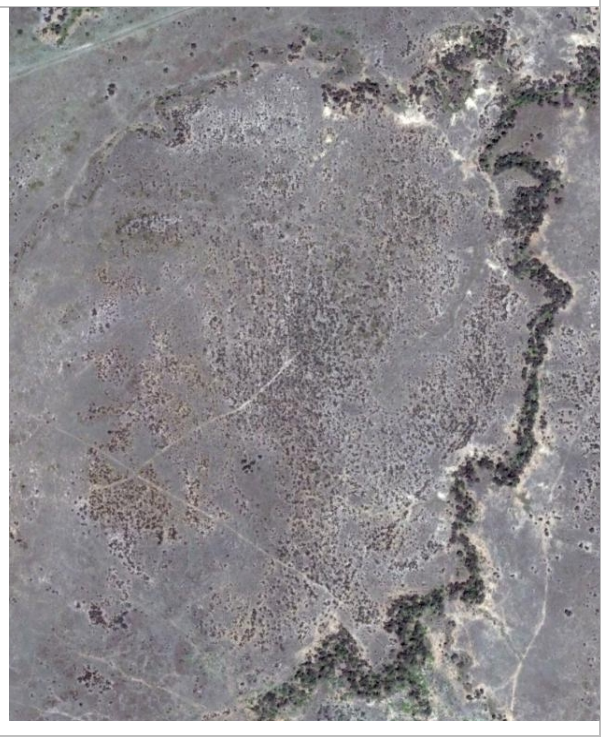
Aerial photograph regrowth – west area June 2004	Aerial photograph regrowth – west area October 2012	Aerial photograph regrowth – west area March 2016
		

Figure 14-14: Brigalow regrowth western ML 80187 – aerial imagery analysis

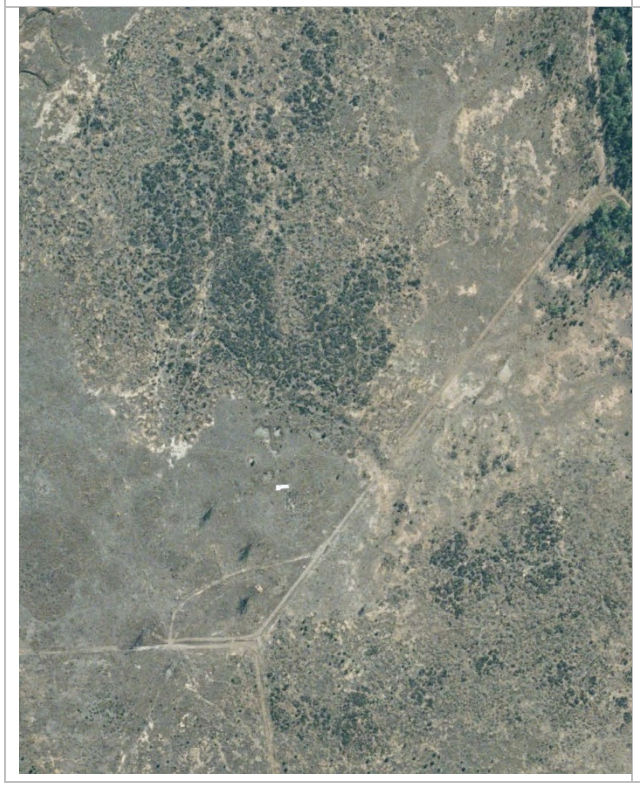
Aerial photograph regrowth – east area June 2004	Aerial photograph regrowth – east area October 2012	Aerial photograph regrowth – east area March 2016
		

Figure 14-15: Brigalow regrowth eastern ML 80187 – aerial imagery analysis

14.3.6.2 SEVT TEC

Field surveys by 3D Environmental in 2018 confirmed a small patch of SEVT TEC intersected by the western boundary of ML 80187, north of the Bruce Highway (Figure 14-11). Most of this patch of SEVT is located outside the Project Site and is associated with the alluvial terraces and riparian vegetation of Tooloombah Creek. The total patch size is 1.14 ha, however only 0.0013 ha is within the Project Site. This SEVT is characterised by a relatively low canopy (7 – 10 m) comprising a variety of species including python tree (*Gossia bidwillii*), red kamala (*Mallotus philippensis*), peanut tree (*Sterculia quadrifida*), white cedar (*Melia azedarach*) and tuckeroo (*Cupaniopsis anacardioides*) among other taxa. Forest red gum and carbeen occur as occasional emergent species. A varied understorey with abundant vines is present and comprised of species such as chain fruit (*Alyxia ruscifolia*), Queensland ebony (*Diospyros geminata*), sandpaper fig, broad-leaved cherry (*Exocarpos latifolius*), velvet mock-orange (*Notelaea microcarpa*) and currant bush. This SEVT is in a reasonable condition despite evidence of past clearing for cattle grazing, however rubber vine is commonly present on the fringes.

No other patches of SEVT were identified within the Project Site. Mapping amendments of RE within the Project Site were submitted to the Queensland Herbarium in 2018. The DES has confirmed that these mapping amendments have been largely accepted, including areas mapped as SEVT TEC, and Version 12 of the RE mapping will contain these changes once released (pers. comm. Michael Robinson, May 2020). As illustrated in Figure 14-11Figure 14-11, additional patches of SEVT TEC were mapped by OBS (2011) adjacent to Tooloombah Creek and outside of the Project Site.

14.3.6.2.1 Threats

The National Recovery Plan for SEVT TEC (McDonald 2010) notes that SEVT TEC in the Brigalow Belt Bioregion has been fragmented, reduced in area and degraded through land clearing and agricultural practices. SEVT is also subject to degradation and decline from inappropriate fire regimes, and potentially to a lesser extent, grazing by domestic stock, pest animals and weeds.

14.3.7 Native Flora

14.3.7.1 Desktop Assessment

The Project Site does not intersect any area considered to be 'high risk' under the flora survey trigger map (Figure 14-16). An area mapped as 'high risk' occurs approximately 1 km directly north of the Project. As described in Table 14-6, 26 flora species listed as threatened under the NC Act and/or the EPBC Act were identified in database searches in 2016 and 2020.

14.3.7.2 Field Surveys

Field surveys recorded a total of 245 native plant species within the Study Area. The full species list is presented in Appendix 9b - Styx Coal: Flora and Vegetation Assessment. No currently threatened flora species were recorded within the Study Area during field surveys.

14.3.7.3 Likelihood of Occurrence of Conservation Significant Species

As a result of desktop and field assessments, six of the species listed in Table 14-6 were identified as having the potential to occur within the Project Site and Near Surrounds. Three of the species may have the potential to occur in the rocky, elevated habitat south of the ML boundary in RE 11.10.3 and RE 11.10.7. No cycads were observed growing in this area during site traverses in the vicinity of tracks. The remaining three species have a low potential to occur on the cracking clay soils that dominate the Project Site to the north of the Bruce Highway.

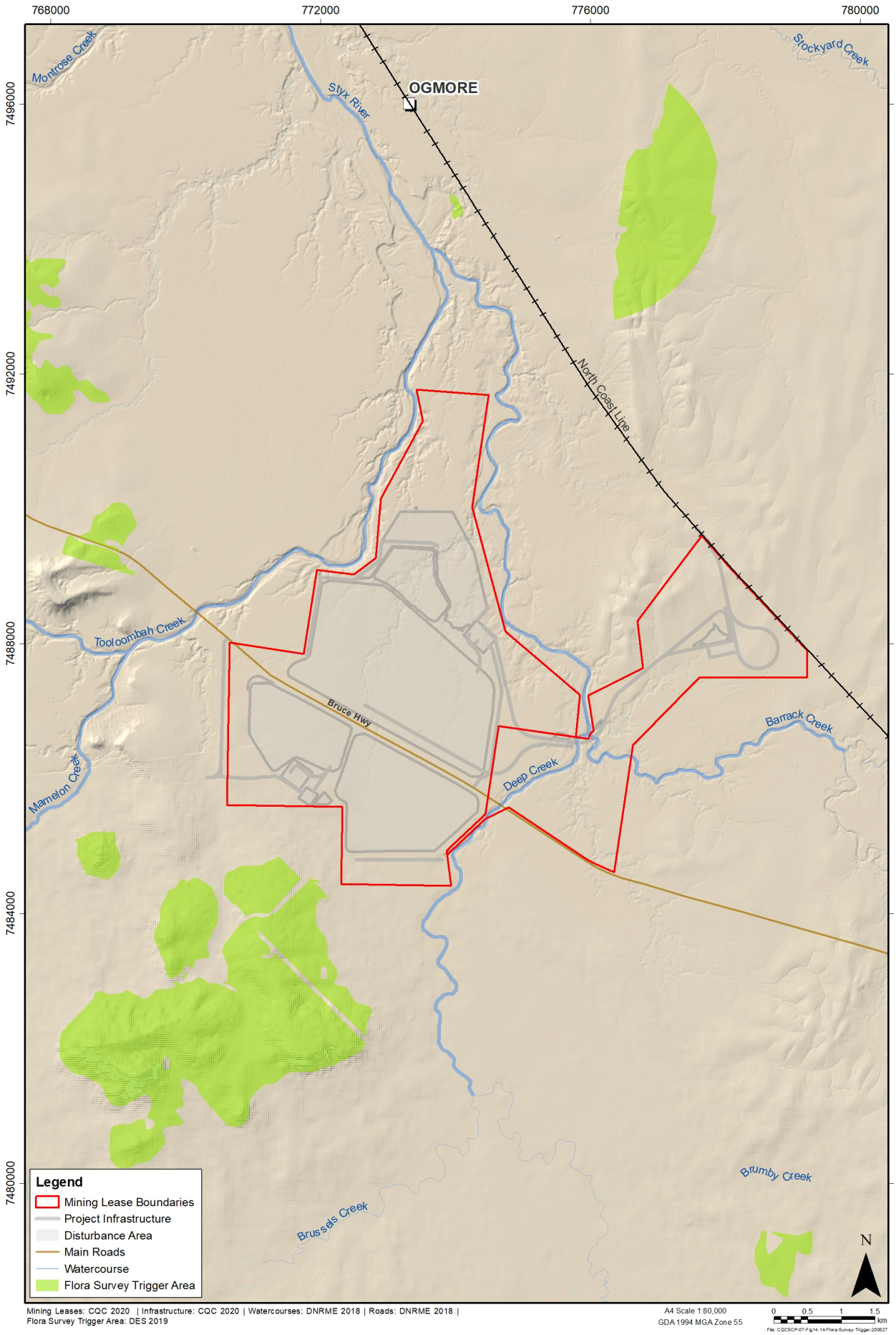


Figure 14-16: Flora survey trigger map

Table 14-6: Listed flora species – likelihood of occurrence Project Site and near surrounds

Species	Status		Database Search		Description and preferred habitat	Likelihood of Occurrence - Project Site and Near Surrounds
	NC Act[2]	EPBC Act[3]	Wildlife Online	PMST		
Potential						
Capparis humistrata	E		x		A spreading shrub to 1.5 m 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 Site and Near Surrounds as stony ridges occur to the south of the ML. Regrowth Brigalow forest occurs adjacent to sandy soils in several areas north of the Bruce Highway. Seven Wildlife online records from wider area.
Cerbera dumicola	NT		x		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 (*Corymbia dolichocarpa*); semi-deciduous notophyll-microphyll vine forest on rhyolite hillslopes; open-woodland of silver-leaved ironbark (*E. melanophloia*) with occasional lancewood, poplar box and brown's box (*E. brownie*); and in carbeen.	Potential. Suitable habitat occurs south of the site. Two Wildlife online records from wider area.
Lissanthe brevistyla	V		X		A spreading shrub growing to 1.5 m tall. Confined to steep hillsides in eucalypt woodlands, on red gravely soil or on loose stony slopes.	Potential. Low quality habitat for this species occurs south of the ML where rocky elevated habitat occurs. 14 Wildlife online records from wider area.
Sannantha brachypoda	V		x		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 records from wider area.

[2] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[3] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Species	Status		Database Search		Description and preferred habitat	Likelihood of Occurrence - Project Site and Near Surrounds
	NC Act[2]	EPBC Act[3]	Wildlife Online	PMST		
Solanum adenophorum	E		x		Perennial herb growing to 40cm high. Occurs mostly in brigalow woodland and on very gently inclined slopes. It also occurs in Gidgee (*Acacia cambagei*) 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 records from wider area.
Solanum elachophyllum	E		x		Known only from limited collections in the Leichhardt pastoral district, occurring on fertile cracking clay soils associated with Brigalow, Belah, *Eucalyptus thozetiana*, or woodland of Narrow-leaved Ironbark and narrow-leafed white mahogany (*E. tenuipes*).	Potential. Suitable habitat may occur on cracking clay soil north of the Bruce Highway. Single Wildlife online records from wider area.
Unlikely						
Bursaria reevesii	V		x		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 (*Eucalyptus fibrosa*) / Glen Geddes Bloodwood (*Corymbia xanthope*) open woodlands.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site. 11 Wildlife online records from wider area.
Capparis thozetiana	V	V	x	x	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 Site. 20 Wildlife online records from wider area.
Glen geddes bloodwood (*Corymbia xanthope*)	V	V	x	x	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 E. fibrosa subsp. fibrosa, Glen Geddes Bloodwood woodland on serpentinite).	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site. 16 Wildlife online records from wider area.
Trunked cycad (*Cycas megacarpa*)	E	E	x[4]	x	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.

[4] Not identified in the 2020 wildlife online search, however, was identified in the 2016 search

Species	Status		Database Search		Description and preferred habitat	Likelihood of Occurrence - Project Site and Near Surrounds
	NC Act[2]	EPBC Act[3]	Wildlife Online	PMST		
Marlborough blue (*Cycas ophiolitica*)	E	E	x	x	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.
Bluegrass (*Dichanthium setosum*)	V	V		x	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. PMST Report only.
Black ironbox (*Eucalyptus raveretiana*)	C	V	x		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.
Hakea trineura	V	V	x	x	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 Site. 13 Wildlife online records from wider area.
Macrozamia serpentina	E		x		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 Site. 24 Wildlife online records from wider area.
Marsdenia brevifolia	V	V	x	x	Erect or loosely scrambling sub-shrub up to 1 m tall. Plants occurring north of Rockhampton grow on serpentine rock outcrops or on black crumbly soils derived from serpentine in woodland dominated by glen geddes bloodwood and red ironbark. Despite this close association with serpentine, the species is not a serpentine endemic. Also grows in woodland on	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site. 17 Wildlife online records from wider area.

Species	Status		Database Search		Description and preferred habitat	Likelihood of Occurrence - Project Site and Near Surrounds
	NC Act[2]	EPBC Act[3]	Wildlife Online	PMST		
					granite soils dominated by granite ironbark (*Eucalyptus granitica*), Yellow Jacket (*Corymbia leichhardtii*) and white mahogany.	
Myrsine serpenticola	E		X		Shrub to small tree dark green glossy sub-opposite leaves. Known from gallery rainforest on serpentinic soils. Often associated with low woodlands of glen geddes bloodwood and red ironbark.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site. 12 Wildlife online records from wider area.
Neoroepera buxifolia	V	V	x	x	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 serpentitite 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 Site. 26 Wildlife online records from wider area.
Olearia macdonnellensis	E	V	x[4]	x	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 Site. Six Wildlife online records from wider area.
Olearia orientalis	E		x[5]		Restricted distribution in Queensland (Bean and Jobson 2017). Bushy shrub to 50–200 cm high. Restricted distribution northwest of Rockhampton. Confined to serpentinite hills and ridges, with shallow or skeletal soil, in woodland dominated by Eucalyptus fibrosa F.Muell. subsp. Fibrosa and/or Corymbia xanthope.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site.
Omphalea celata	V	V		x	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.	Unlikely. Well outside of known range of species. No database records. PMST Report only.
Lesser Swamp Orchid	E	E		x	Commonly associated with coastal wet heath / sedgeland wetlands swampy grassland or swampy forest and often where	Unlikely. No suitable habitat in Project Site. No database records. PMST Report only.

[5] Not identified in the 2016 wildlife online search, however, was identified in the 2020 search

Species	Status		Database Search		Description and preferred habitat	Likelihood of Occurrence - Project Site and Near Surrounds
	NC Act[2]	EPBC Act[3]	Wildlife Online	PMST		
(*Phaius australis*)					broad-leaved paperbark (*M. quinquinervia*) or swamp mahogany (*E. robusta*) 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.	
Pimelea leptospermoides	NT	V	x	x	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 (*Melaleuca bracteate*) subcanopy layer where prolonged flooding occurs.	Unlikely. No suitable habitat (serpentine landscapes) observed within the Project Site. 44 Wildlife online records from wider area.
Pultenaea setulosa	V	V	x	x	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 Site. 11 Wildlife online records from wider area.
Quassia (*Samadera bidwillii*)	V	V	x	x	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 (*Corymbia citriodora*), grey gum (*Eucalyptus propinqua*), white mahogany, forest red gum, pink bloodwood, northern grey ironbark (*E. siderophloia*), gum-topped box (*E. moluccana*), Gympie messmate (*E. cloeziana*) and red ironbark.	Unlikely. No suitable species associations observed within the Project Site. Two Wildlife online records from wider area.
Stackhousia tryonii	NT		x		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 Site. 12 Wildlife online records from wider area.

14.3.8 Weeds

Based on the results of the desktop assessment and field surveys, 17 declared weed species have the potential to occur within the Study Area (Table 14-7). Of these, 10 are Weeds of National Significance (WoNS) and all 17 are Category 3 Restricted Matters under the Queensland *Biosecurity Act 2014* (DSITIA 2020). Eleven of these species were confirmed as present during field surveys.

The results of surveys indicate that weeds are abundant within the Project Site and Near Surrounds, particularly along drainage lines such as Deep and Tooloombah Creek (Figure 14-17). Prickly pear (*Opuntia tomentosa*) is sparsely distributed throughout the Project Site although mainly occurs on the heavy clay soils north of the Bruce Highway within the regrowth Brigalow communities. Rubber vine (*Cryptostegia grandiflora*) and lantana are common, often forming dense infestations (up to 4m in height) along the creeks. Bellyache bush (*Jatropha gossypifolia*) also occurs in patches along the margins of both creeks. Parthenium (*Parthenium hysterophorus*) was only observed along Tooloombah Creek and not within the Project Site itself. Olive hymenachne (*Hymenachne amplexicaulis*) is a semi-aquatic species and was recorded in the northern extent of the Project Site 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 waterbodies. Away from watercourses, the ground layer within the northern section of the Project Site is dominated by buffel grass.

Table 14-7: Declared weed species identified through desktop assessment and field surveys

Species name	Common name	Biosecurity Act	WON	Wildlife Online	PMST	2011 survey	2017 survey
Aristolochia elegans	Dutchman's pipe	Category 3	No			x	
Bryophyllum delagoense and B. x houghtonii	Mother-of millions	Category 3	No	x		x	x
Cardiospermum grandiflorum	Heart seed vine	Category 3	No	x			
Cryptostegia grandiflora	Rubber-vine	Category 3	Yes	x	x	x	x
Dolichandra unguis-cati	Cat's claw creeper	Category 3	Yes	x			
Harrisia martinii	Harrisia Cactus	Category 3	No	x		x	
Hymenachne amplexicaulis	Olive Hymenachne	Category 3	Yes	x	x	x	x
Jatropha gossypifolia	Bellyache bush	Category 3	Yes	x	x	x	x
Lantana camara	Lantana	Category 3	Yes	x	x	x	x
Opuntia stricta	Prickly pear	Category 3	Yes	x	x	x	x
Opuntia tomentosa	Prickly pear	Category 3	Yes				x
Parkinsonia aculeata	Parkinsonia	Category 3	Yes	x	x		
Parthenium hysterophorus	Parthenium	Category 3	Yes	x	x	x	x
Sporobolus fertilis	Paramatta Grass	Category 3	No			x	
Sporobolus jacquemontii	Rat's tail grasses	Category 3	No	x			
Vachellia nilotica, form. Acacia nilotica	Prickly Acacia	Category 3	Yes	x	x		
Ziziphus mauritinia	Indian jujube	Category 3	No	x			

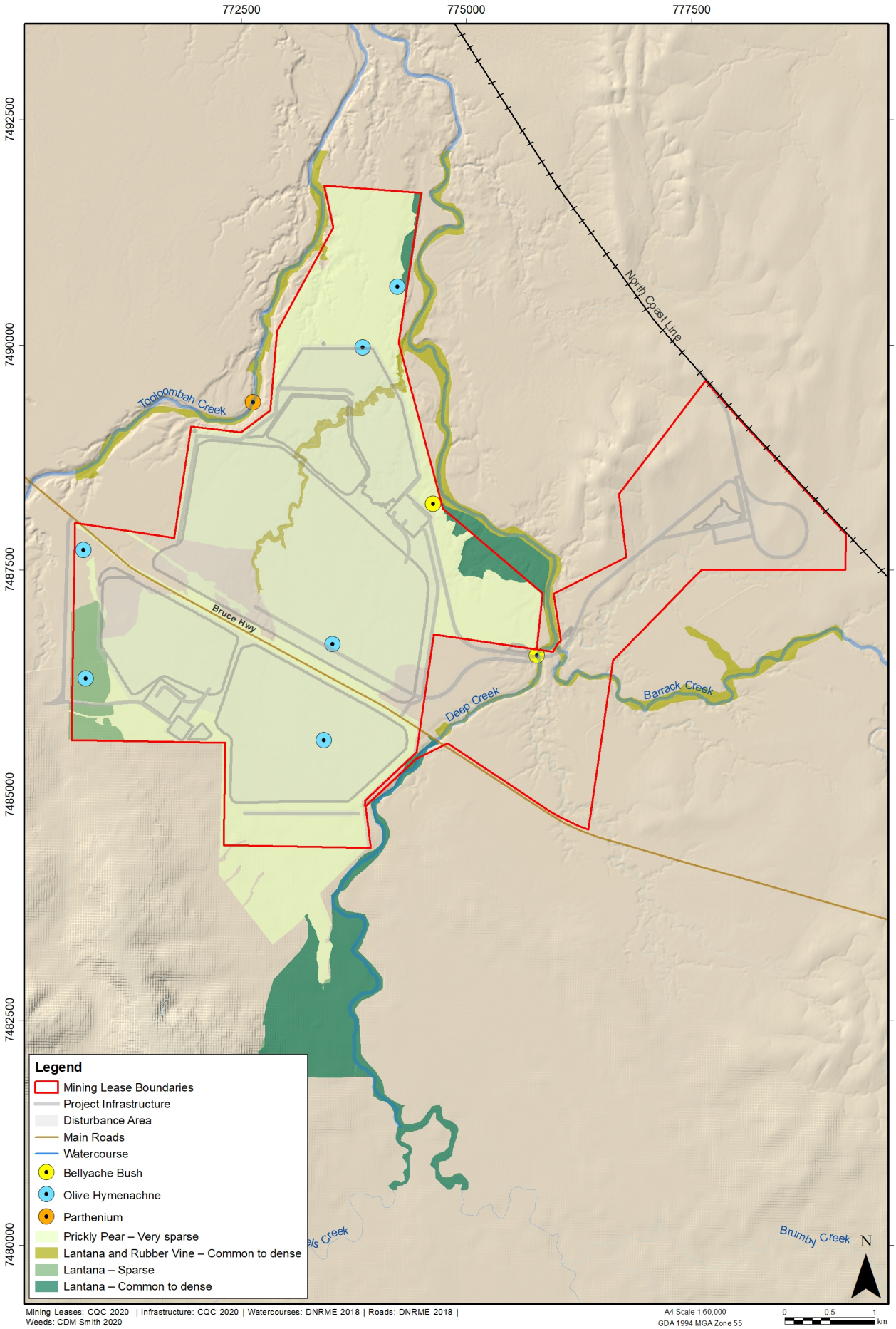


Figure 14-17: Distribution of weed species across the Project Site and near surrounds

14.3.9 Native Fauna

14.3.9.1 Habitat Types

There are four key terrestrial fauna habitat types present within the Project Site and Near Surrounds including:

- Eucalypt open woodland to open forest
- Brigalow open forest (remnant and regrowth)
- Wetland habitat and
- Non-remnant grassland with scattered trees and shrubs on previously cleared areas.

In addition, the following downstream habitats are also relevant for waterbirds considered in this chapter:

- Styx River Estuary and
- Broad Sound Wetlands

Descriptions of these habitat types in the context of terrestrial fauna and avifauna values are provided in the following sections.

14.3.9.1.1 Eucalypt Open Woodland to Open Forest

Eucalypt woodlands dominate the remnant vegetation remaining within the Project Site. Within the central part of ML 80187 RE 11.4.2 is dominated by narrow-leaved ironbark with poplar box and ghost gum also present. Where larger trees occur, this habitat may provide tree hollows although mature trees are scarce. Vegetation in this area has a relatively open canopy, sparse shrub layer with little to no understorey present. Large fallen timber is also sparse providing little cover for ground fauna. The grass layer is a mixture of native species (such as kangaroo grass, black spear grass, *Eragrostis* spp. and *Bothriochloa* spp.) and buffel grass. This area is heavily impacted by cattle grazing.

In the western portion of the Project Site a more varied woodland of RE 11.4.2 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.

Riparian open forest classified as RE 11.3.25 with forest red gum occurs along Deep and Tooloombah Creeks (largely outside of the Project Site). Adjacent floodplain woodland (RE 11.3.4) occurs in ML 700022 and is contiguous with RE 11.3.25 associated with Deep Creek and the Haul Road crossing. These forests provide the most varied habitat values in the area providing abundant foraging and sheltering values for a wider range of bird species than is found elsewhere within the Project Site and Near Surrounds. The banks of Tooloombah Creek (Plate 14-1) and sections along Deep Creek are often dominated by a patchy understorey of dry rainforest tree / shrub species providing additional seasonal fruiting resources. 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. RE 11.3.25 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.

Plate 14-1: Western bank of Tooloombah Creek with dry rainforest understorey

14.3.9.1.2 Brigalow Open-forest

As previously described, a single small patch of remnant Brigalow open-forest habitat (RE 11.4.9) occurs close to the western boundary of ML 80187. This is a small patch (0.54) ha and is unlikely to provide substantial habitat value for fauna. A second larger patch (3.37 ha) is located close to the southern boundary of ML 700022 to the south of Deep Creek.

Much of the ML located north of the Bruce Highway comprises extensive but patchy areas of regrowth generally 3 m to 5 m in height. 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.

14.3.9.1.3 Mapped Wetlands

Mapped wetlands identified within the Project Site are illustrated on Figure 14-18.

Wetland 1

Wetland 1 is a GBR wetland of high ecological significance (HES) located in a GBR wetland protection area (WPA) and mapped on the vegetation management wetlands map under the VM Act. Wetland 1 is a palustrine wetland mapped as a GDE in the BoMs GDE Atlas as a high potential aquatic GDE and low/moderate potential terrestrial. It is characterised by coastal/sub-coastal non-floodplain tree swamps (melaleuca and eucalypt). Wetland 1 is approximately 4 ha in size and 200 m wide. Field surveys confirmed vegetation within Wetland 1 consists of a central woodland of broad-leaved paperbark 12 to 18 m tall with 30% canopy cover and a single red gum located within the centre of the swamp. Ground-truthing in 2018 confirmed that Wetland 1 is consistent with RE 11.3.12 and is surrounded by mixed eucalypt woodlands of RE 11.5.8 and 11.4.2. Wetland 1 is ephemeral. It shows signs of impact by cattle and feral pigs (*Sus scrofa*).

Wetland 2

Wetland 2 is a wetland of general ecological significance (GES) mapped on the vegetation management wetlands map under the VM Act. Wetland 2 is mapped on the GDE Atlas as a high potential aquatic GDE and low potential terrestrial GDE on a coastal/sub-coastal floodplain swamp reliant on surface expression of groundwater. Wetland 2 is approximately 0.6 ha in size, 180 m in length and 40 m wide. It is a palustrine wetland.

Water levels within the wetland appear to be relatively constant, indicating water may be permanent. Water depth in the centre of the wetland is likely to be more than 1 m based on the water depth encountered around the vegetated edges during field surveys. Wetland 2 forms a narrow internally draining depression located on a floodplain.

The wetland is characterised by dense fringing erect aquatic plant species including giant sedge (*Cyperus exaltatus*), *Eleocharis sphacelata*, *Digitaria divaricatissima*, and olive hymenachne. Open water comprises the remainder of the wetland with floating aquatic vegetation present. The wetland is bordered by sparse forest red gum and ironbark. Ground-truthing in 2018 confirmed that Wetland 2 is consistent with RE 11.3.27 and that the wetland is surrounded by intact woodland of RE 11.4.2. Evidence of feral pig damage was observed around the edges of the wetland in January 2018.

14.3.9.1.4 Other Wetland Habitat

In addition to Wetland 1 and Wetland 2 there are several natural and artificial wetlands of varying size present across the Project Site. The majority of these have been artificially created ('turkey nest' dams and dammed creek lines), although there are small natural freshwater wetlands of RE 11.3.27. Analysis of aerial imagery indicates large portions of the Project Site are likely to retain water for substantial periods following heavy rains. Many of these waterbodies appear relatively shallow, providing suitable habitat for a range of wetland bird species and amphibians.

14.3.9.1.5 Non-remnant Vegetation

Non-remnant areas dominate the Project Site (87%), covering an area of 2,322.51 ha. These areas are generally dominated by introduced pasture grasses, including buffel grass. South of the highway remains largely cleared and there are few and scattered taller shade trees (Plate 14-2). ML 700022 remains mostly cleared. With limited structural and floristic diversity, non-remnant habitats supported limited fauna diversity in comparison to remnant habitats.

Plate 14-2: Typical cleared areas south of the Bruce Highway

14.3.9.1.6 Downstream Habitat

The Styx River begins at the confluence of Tooloombah and Deep Creek, 2.3 km downstream of the Project Site. Sparse occurrences of marine couch (*Sporobolus virginicus*) have been observed at the confluence of the creeks, however, a major assemblage of marine couch is located closer to the Ogmore Bridge which is 4.8 km downstream of the Project Site. Although peak tides have been recorded at the confluence of the creeks, the Ogmore Bridge represents the normal high tide limit.

The Styx River estuary flows into Broad Sound, a protected Fish Habitat Area (FHA) listed in the DIWA. Broad sound encompasses an area of approximately 2,100 km^2 comprising a complex aggregation of tidal marine and estuarine wetlands. The southern boundary of the wetland lies close to the boundary of the GBR World Heritage Area (GBRWHA) (Figure 14-19). The wetland area includes the Torilla Plain, a large marine plain to the east of the Project formed on the southern side of the Torilla Peninsula.

Broad Sound comprises a range of wetland habitats including seagrass beds, lower intertidal and supratidal mudflats, and mangroves. There are also small areas of beach habitat, and brackish and freshwater coastal swamps and lagoons. These have been formed in a sheltered embayment and have a very large tidal range of approximately 9 m. Broad Sound is the largest shallow, macro-tidal bay on Australia's east coast. The area is very shallow, with depths of less than 10 m.

Broad Sound (with Shoalwater Bay) is considered one of the five main centres within the GBR for saltmarsh and mangrove communities. Saltpans and saltmarsh communities occupy 372 km^2 of the Broad Sound wetland area (Figure 14-19). Current vegetation mapping indicates large areas of saltpans and mudflats with saltmarsh species along the Styx River beginning approximately 14 km downstream (or 10.5 km directly north) of the Project Site. These become extensive further downstream extending 5 km to 6 km inland on the northern bank of the river as the channel splits around Rosewood Island.

Mangroves occupy 216 km^2 within the Broad Sound wetland boundary. In some areas these form bands over 1 km wide, largely in the western section of the wetland (Torilla Peninsula) but also in the lower reaches of the Styx River around Rosewood Island. Mangrove communities occur along the banks of the Styx River beginning 20 km downstream (or 15 km directly north) of the Project boundary becoming more extensive near Rosewood Island. There are no specific references to the mangrove species occurring in Broad Sound. Based on vegetation mapping, dominant species are expected to be grey mangrove (*Avicennia marina*), *Rhizophora* and *Bruguiera* species, spurred mangrove (*Ceriops tagal*) and black mangrove (*Aegiceras conrniculatum*).

Seagrass mapping data from the past 30 years has been collated across the GBR area (Carter et al. 2016). The only mapped seagrass beds known in the Broad Sound area are small patches located in the north-east corner of the wetland (Figure 14-19). There are no seagrass beds mapped near the Styx River estuary or surrounds. Extensive seagrass beds occur to the northwest in the Clairview area (approximately 53 km north of the Project) and in Shoalwater Bay, including small patches near the islands off Stanage Bay approximately 70 km north-east of the Project. It appears the extreme tidal range in Broad Sound may influence the lack of seagrass present due to high turbidity levels and prolonged exposure of tidal flats during low tides.

The Broad Sound wetland is noted as providing significant habitat for waterbirds including substantial aggregations of a range of migratory shorebirds listed under the EPBC Act (DEE 2017b; GBRMPA 2015).

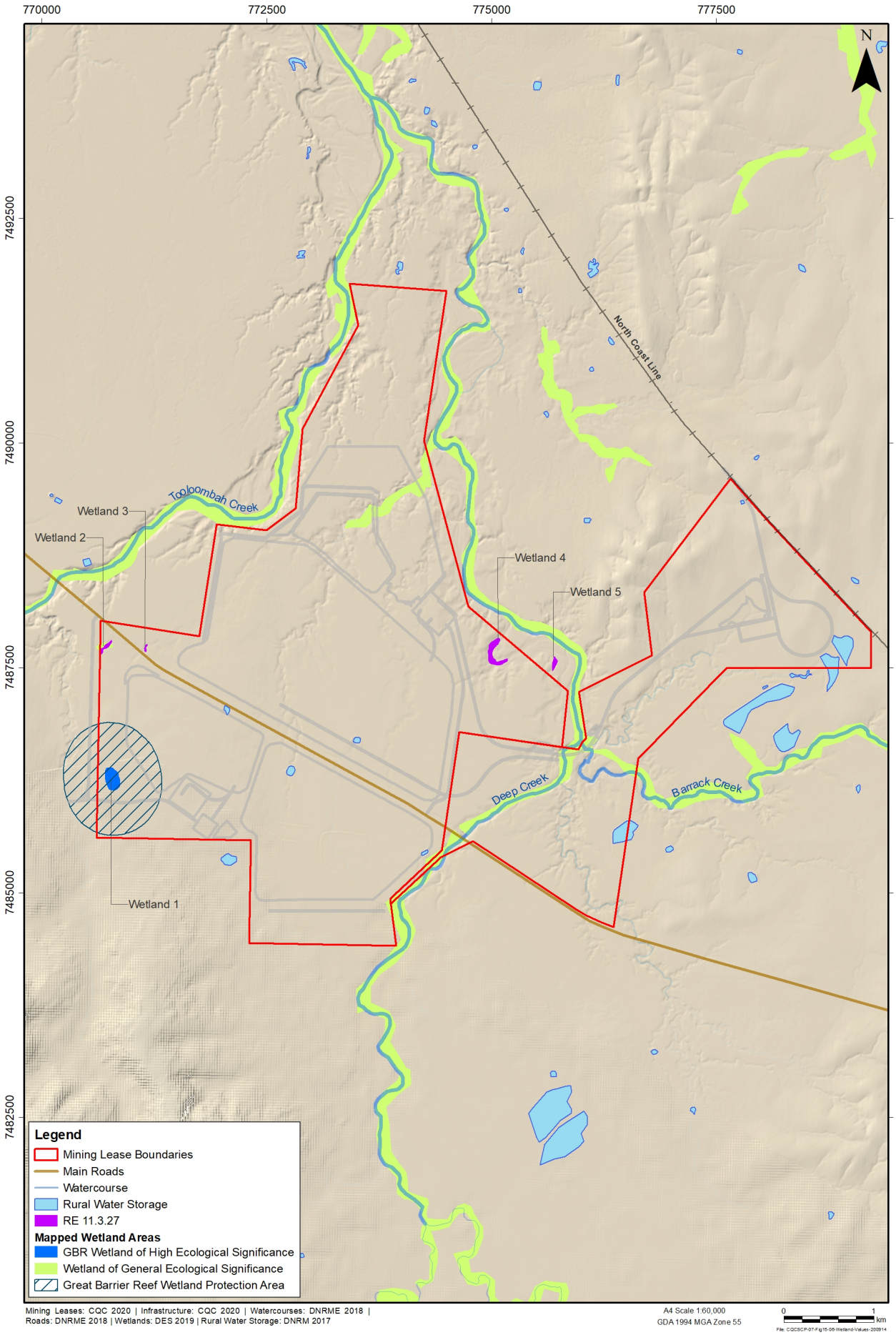


Figure 14-18: Wetland habitat within the Project site

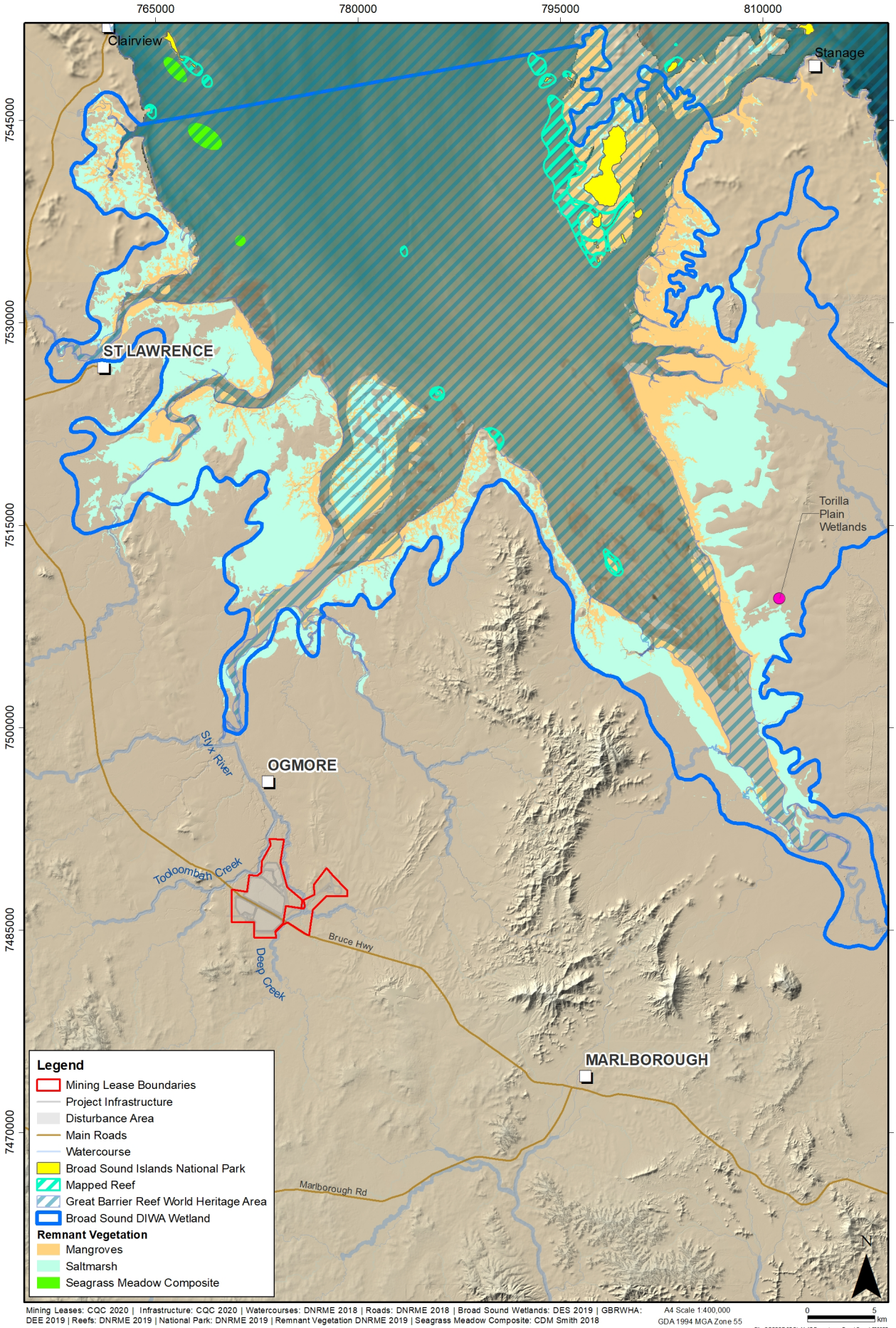


Figure 14-19: Downstream environment – Broad Sound

14.3.9.2 Desktop Assessment

The Wildlife Online report identified 396 native terrestrial species known to occur within a 50 km radius of the Project comprising 266 birds, 56 reptiles[6], 51 mammals, 20 frogs, two insects and one arachnid species (DSITIA 2020). 42 were identified as conservation significant species under the NC Act (Table 14-8). The PMST Report identified 24 listed threatened species, 23 migratory birds and 29 marine birds with the potential to occur within a 25 km radius of the Project, noting that some species, such as curlew sandpiper (*Calidris ferruginea*), are listed as threatened, migratory and marine species (DEE 2020) (Table 14-8). As birds listed solely as 'marine species' under the EPBC Act do not constitute MNES they are not considered further in this chapter. For the complete list of species identified through the desktop assessment see Appendix A9f – 2016 and 2020 Database Searches.

Based on the results of desktop assessments 65 conservation significant species listed under the NC Act and/or the EPBC Act have been identified as known to occur, or having the potential to occur, within the Project Site and Near Surrounds, or the downstream environment (Table 14-8). This includes 51 birds, 9 mammals, 4 reptiles and 1 insect. Eight of these species are additional to those presented in SEIS v2.

Under the NC Act, 13 of these species are listed as endangered, 17 as vulnerable, one as near threatened, four as least concern and 31 as special least concern. Under the EPBC Act five of these species are listed as critically endangered, seven as endangered, 20 as vulnerable, 39 as migratory and 20 are classified as migratory shorebirds as per DEE (2017a).

In addition, a review of the Queensland Government essential habitat data (DNRME 2020b) identified essential habitat for a number of threatened fauna species located within the Project Site and Near Surrounds including squatter pigeon, koala, greater glider and ornamental snake (Figure 14-20).

Table 14-8: Listed fauna species with the potential to occur based on the desktop assessment

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[7]	EPBC Act[8]					
Birds							
Australian painted snipe (*Rostratula australis*)	E	E		x	x		
Bar-tailed godwit (baueri) (*Limosa lapponica baueri*)	V	V,M	x	x	x	x	x
Bar-tailed godwit (menzbieri) (*Limosa lapponica menzbieri*)	E	CE,M	x		x		
Beach stone-curlew (*Esacus magnirostris*)	V			x		x	
Black-breasted button-quail (*Turnix melanogaster*)	V	V		x	x	x	
Black-faced monarch (*Monarcha melanopsis*)	SL	M		x	x		

[6] Turtle species identified through the desktop and field assessment are discussed in Chapter 15 - Aquatic and Marine Ecology
[7] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[8] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[7]	EPBC Act[8]					
Black-throated finch (southern) (*Poephila cincta cincta*)	E	E			x		
Campbell albatross (*Thalassarche impavida)*	SL	V,M			x		
Caspian tern (*Hydroprogne caspia*)	SL	M		x		x	x
Common greenshank (*Tringa nebularia*)	SL	M	x	x		x	
Common sandpiper (*Actitis hypoleucos*)	SL	M	x		x[11]		
Crested tern (*Thalasseus bergii*)	SL	M		x		x	
Curlew sandpiper (*Calidris ferruginea*)	E	CE,M	x	x	x	x	
Eastern curlew (*Numenius madagascariensis*)	E	CE, M	x	x	x	x	x
Eastern osprey (*Pandion cristatus*)	SL	M			x	x	
Flesh-footed shearwater (*Ardenna carneipes)*	SL	M			x		
Fork-tailed swift (*Apus pacificus*)	SL	M		x	x		x
Glossy black-cockatoo (*Calyptorhynchus lathami*)	V			x			
Glossy ibis (*Plegadis falcinellus*)	SL	M		x			x
Great knot (*Calidris tenuirostris*)	E	CE,M	x	x	x	x	
Greater sand plover (*Charadrius leschenaultia*)	V	V,M	x	x		x	
Grey falcon (*Falco hypoleucos*)	V	V		x			
Grey plover (*Pluvialis squatorola*)	SL	M	x	x		x	
Grey-tailed tattler (*Tringa brevipes*)	SL	M	x	x		x	
Gull-billed tern (*Gelochelidon nilotica*)	SL	M		x		x	x
Kermadec petrel (*Pterodroma neglecta neglecta*)	LC	V			x		
Latham's snipe (*Gallinago hardwickii*)	SL	M	x	x	x	x	x
Lesser sand plover (*Charadrius mongolus*)	E	E,M	x	x		x	
Little tern (*Sternula albifrons*)	SL	M		x	x	x	
Marsh sandpiper (*Tringa stagnatilis*)	SL	M	x	x		x	
Oriental cuckoo (*Cuculus optatus*)	SL	M			x		x
Pectoral sandpiper (*Calidris mealnotos*)	SL	M	x		x[11]		
Red goshawk (*Erythrotriorchis radiatus*)	E	V		x	x		
Red knot (*Calidris canutus*)	E	E,M	x	x			
Red-necked stint (*Calidris ruficollis*)	SL	M	x	x		x	
Rufous fantail (*Rhipidura rufifrons*)	SL	M		x	x	x	x
Satin flycatcher (*Myiagra cyanoleuca*)	SL	M			x		

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[7]	EPBC Act[8]					
Sharp-tailed sandpiper (*Calidris acuminata*)	SL	M	x	x	x[11]	x	
Short-tailed shearwater (*Ardenna tenuirostris*)	SL	M		x[10]		x	
Southern giant petrel (*Macronectes giganteus*)	E	E,M			x		
Spectacled monarch (*Symposiachrus trivirgatus*)	SL	M		x	x	x	
Squatter pigeon (southern subspecies) (*Geophaps scripta scripta*)	V	V		x	x	x	x
Star finch (*Neochmia ruficaunda ruficauda*)	E	E			x	x	
Streaked shearwater (*Calonectris leucomelas*)	SL	M			x[11]		
Terek sandpiper (*Xenus cinereus*)	SL	M	x	x		x	
Whimbrel (*Numenius phaeopus*)	SL	M	x	x	x	x	x
White-bellied storm-petrel (*Fregetta grallaria grallaria*)	LC	V			x		
White-throated needletail (*Hirundapus caudacutus*)	V[9]	V[9],M		x[10]	x[11]		x
Wood sandpiper (*Tringa glareola*)	SL	M	x	x[10]		x	
Yellow chat (Dawson) (*Epthianura crocea macgregori*)	E	CE		x	x		
Yellow wagtail (*Motacilla flava*)	SL	M			x		
Mammals							
Coastal sheathtail bat (*Taphozous australis*)	NT			x[10]			
Ghost bat (*Macroderma gigas*)	E	V		x[10]	x		
Greater glider (*Petauroides Volans*)	V	V		x	x	x	x
Grey-headed flying-fox (*Petropus poliocephalus*)	LC	V			x		
Koala (*Phascolarctos cinereus*)	V	V		x	x	x	x
Large-eared pied bat (*Chalinolobus dwyeri*)	V	V			x		
Northern quoll (*Dasyurus hallucatus*)	LC	E		x[10]	x		
Short-beaked echidna (*Tachyglossus aculeatus*)	SL			x		x	x
South-eastern long-eared Bat (*Nyctophilus corbeni*)	V	V			x		

[9] In 2019 the white-throated needletail was listed as Vulnerable under the EPBC Act and NC Act, adding to its existing listing as Migratory under the EPBC Act.
[10] Not identified in the 2016 wildlife online search, however, was identified in the 2020 search
[11] Not identified in the 2016 PMST report, however, was identified in the 2020 report

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[7]	EPBC Act[8]					
Reptiles							
Collared delma (*Delma torquata*)	V	V			x		
Dunmall's snake (*Furina dunmalli*)	V	V			x		
Ornamental snake (*Denisonia maculata*)	V	V			x		x
Yakka skink (*Egernia rugosa*)	V	V			x		
Insects							
Pale imperial hairstreak (*Jalmenus eubulus*)	V			x[10]			

14.3.9.2.1 Broad Sound Migratory Shorebird Data

The Broad Sound wetland is noted as providing significant habitat for waterbirds including substantial aggregations of a range of migratory shorebirds listed under the EPBC Act (DEE 2017b). Shoalwater Bay and Broad Sound are noted as sites of international importance (based on survey data from 1995) for the following migratory shorebirds; bar-tailed godwit, whimbrel, eastern curlew, terek sandpiper, grey-tailed tattler and great knot.

Detailed shorebird counts were carried out in western Broad Sound in late 2008 and early 2009 for the Fitzroy Basin Association (Jaensch 2009). Six high-tide roosts were documented. Roosts sites extended north from Charon Point (32 km north-east of the Project) to Oyster Creek (south of Clairview and approximately 48 km north of the Project area) (Figure 14-21). The surveys recorded 14 migratory shorebird species across the six sites. This included nationally important numbers at individual roost sites of great knot, red knot, lesser sand plover, red-necked stint, sharp-tailed sandpiper, curlew sandpiper and eastern curlew (Table 14-9). When considering all sites combined, western Broad Sound also supported nationally important numbers of bar-tailed godwit and whimbrel. All four surveys recorded greater than 2,000 migratory shorebirds across the region. The Charon Point roost site alone supported more than 2,000 shorebirds during the February and March 2009 surveys.

Table 14-9: Migratory shorebird data - nationally important count species (Jaensch 2009)

Survey	Site	Species	Count	Flyway estimate – 0.1%	Flyway estimate – 1%
September 2008	Charon Point	Eastern Curlew	92	35	350
	Hoogly Point	Eastern Curlew	50	35	350
	Bar Plains Point	Eastern Curlew	68	35	350
		Red Knot	350	110	1,100
	Oyster Creek	Curlew Sandpiper	120	90	900
November 2008	Hoogly Point	Eastern Curlew	50	35	350
		Red-necked Stint	802	475	4,750
		Sharp-tailed Sandpiper	95	85	850
February 2009	Charon Point	Great Knot	2,300	425	4,250
	Bar Plains Point	Lesser Sand Plover	240	180	1,800
March 2009	Charon Point	Great Knot	2,200	425	4,250

Following the 2008/2009 surveys Birdlife Capricornia carried out annual surveys at three of the Broad Sound roost locations (Charon Point, Hoogly Point and Bar Plains Point) (Figure 14-21). Surveys were restricted to the early part of the migration season (September or October) due restricted site access, particularly to Charon Point. Table 14-10 provides the more substantial count data collected at each site (for all data see Appendix A9h).

Table 14-10: Broad Sound migratory shorebird data 2010 - 2017 (Birdlife Capricornia 2018)

Survey period	Site	Species	Count	Flyway estimate – 0.1%	Flyway estimate – 1%
September 2010	Charon Point	Eastern Curlew	50	35	350
September 2011	Charon Point	Eastern Curlew	60	35	350
September / October 2013	Hoogly Point	Eastern Curlew	505	35	350
		Red-necked Stint	290	475	4,750
		Whimbrel	35	65	650
	Bar Plains Point	Eastern Curlew	94	35	350
		Red-necked Stint	280	475	4,750
		Sharp-tailed Sandpiper	75	85	850
October 2014	Hoogly Point	Eastern Curlew	251	35	350
		Red-necked Stint	171	475	1,800
		Whimbrel	45	65	650
October 2015	Bar Plains Point	Great Knot	464	425	4,250
September / October 2017	Bar Plains Point	Eastern Curlew	62	35	350
	Hoogly Point	Eastern Curlew	231	35	350
		Red-necked Stint	155	475	4,750

Although patchy, the Birdlife Capricornia (2018) survey data indicates roost sites in western Broad Sound provide 'important habitat' for migratory shorebirds including the following:

- Charon Point provides nationally important habitat for eastern curlew and in some years may be an important staging point for great knot on their return migration passage to the northern hemisphere in late summer. At these times Charon Point alone may support nationally important numbers of migratory shorebirds (>2,000 individuals). The Charon Point roost is located to the south of the mouth of the Styx River estuary and is 33 km north-north-east of the Project Site.
- Other roost sites in western Broad Sound also support nationally important numbers of species at times, in particular eastern curlew. Hoogly Point on one occasion has supported internationally significant numbers of eastern curlew. Hoogly Point and Bar Plains Point roost sites are 33 km north and 40 km north of the Project Site respectively.
- When summarised collectively the habitat across western Broad Sound is likely to consistently support nationally important numbers of migratory shorebird species including eastern curlew, great knot, red-necked stint, whimbrel, and sharp-tailed sandpiper.

The Birdlife Capricornia surveys also recorded both gull-billed tern and caspian tern at all three sites. Unlike the migratory shorebird species there are no population estimates for these species. Both species are for the most part resident within Australia.

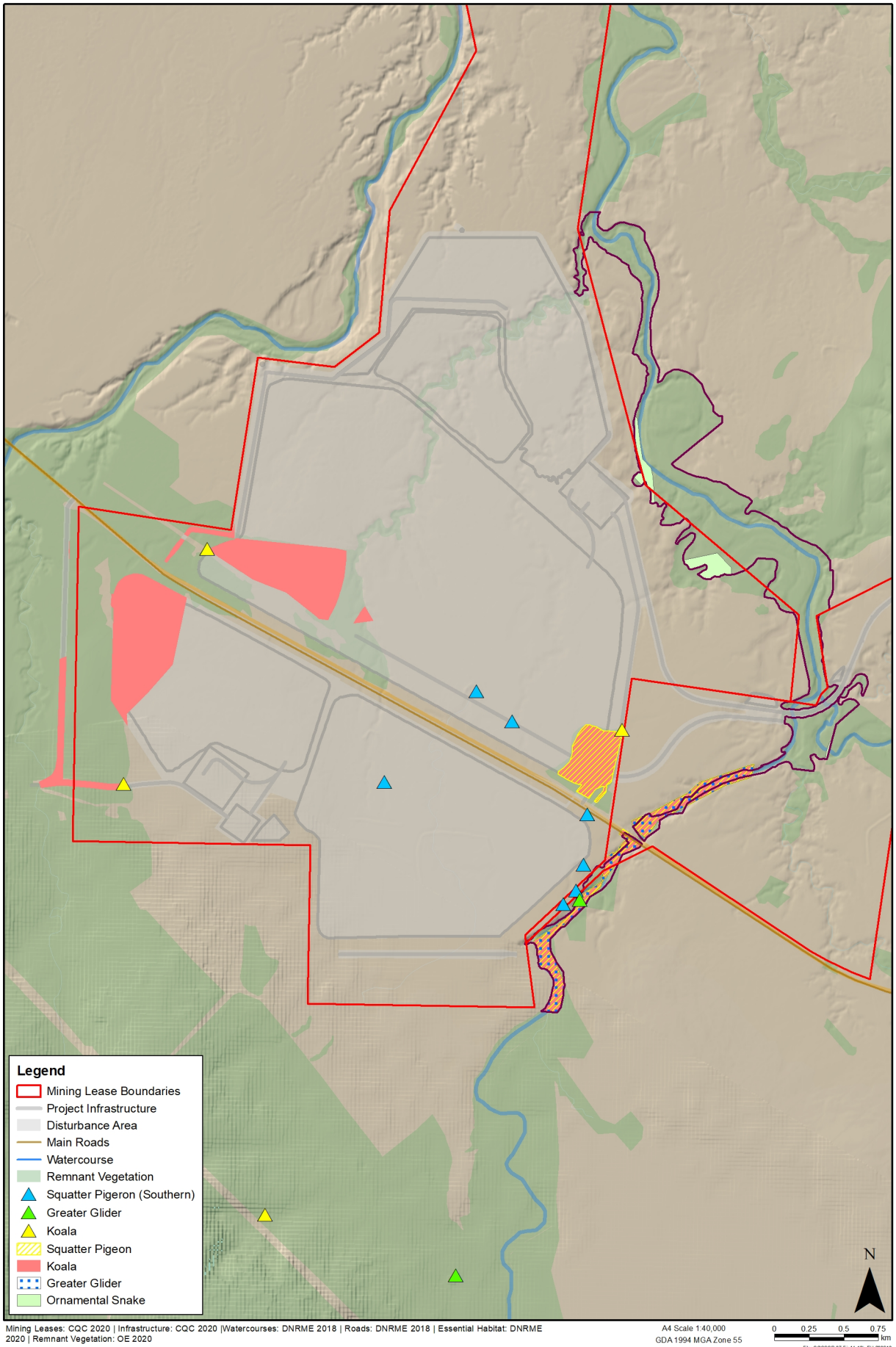


Figure 14-20: Essential habitat mapping within the Project Site and Near Surrounds

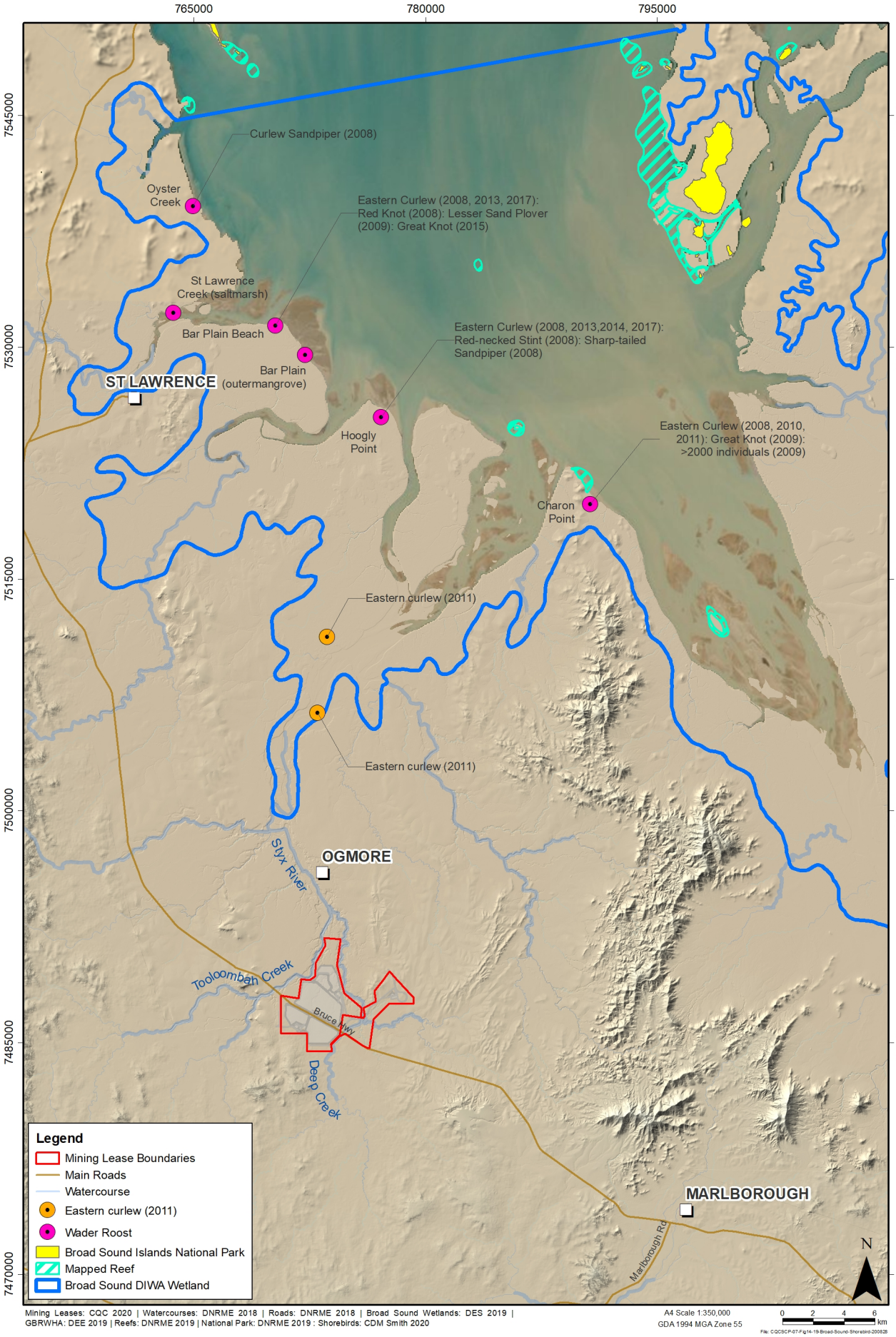


Figure 14-21: Broad Sound shorebird survey locations and significant count data

14.3.9.3 Field Surveys

Field surveys of the Study Area from 2011 to 2019 identified a total of 264 native terrestrial species including 170 birds, 40 mammals, 36 reptiles and 18 frogs. An updated list of species recorded during all surveys from 2011 to 2019 is provided in Appendix A9g. The total number of species recorded is likely to be an overestimation of that existing within the Project Site due to most of the survey events including areas outside of Project Site and within the broader EPC 1029. A general overview of the field survey results for herpetofauna, birds and mammals is provided below.

14.3.9.3.1 Herpetofauna

Fifteen common and widespread amphibian species were recorded within or near the Project Site during field surveys. The only species encountered at trap sites were the cane toad (*Rhinella marina*) and scarlet pobblebonk (*Limnodynastes terraereginae*).

A total of 36 reptile species were recorded during field surveys. This included 27 species recorded within or near the Project Site and nine recorded from the wider region. Species recorded indicate the presence of a relatively diverse fauna, largely comprised of common species. Records within or near the Project Site include three gecko species, seven snakes, 12 skinks, four dragons and one pygopodid (legless lizard). Most reptiles were observed or trapped in the eucalypt woodlands and 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.

14.3.9.3.2 Birds

A total of 170 native bird species were recorded from field surveys across the Study Area with 128 species recorded within or near the Project Site. In general, the bird fauna assemblage observed is typical of drier habitats, along with a range of wetland species that periodically use wetlands available across the wider area following wet periods.

The cleared pasture grasslands dominating the Project Site were relatively species poor, 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*).

Few waterbirds were observed in Wetland 1 during field surveys with only pacific black duck (*Anas superciliosa*) recorded. Low numbers of bird species were also recorded at Wetland 2. However, other wetland habitats across the Project Site was found to support 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 and purple swamphen (*Porphyrio porphyrio*) as well as less common species such as cotton pygmy-goose (*Nettapus coromandelianus*). The February 2017 survey recorded several Latham's snipe (*Gallinago hardwickii*) congregated around a vegetated farm dam. 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 utilising the area during winter migration including Australian reed-warbler (*Acrocephalus australis*) and grey fantail (*Rhipidura albiscapa*).

14.3.9.3.3 Mammals

Thirty-seven mammal species were recorded within or near the Project Site during field surveys and an additional three species were recorded from the broader Study Area. Macropods were abundant, particularly in the vicinity of remnant vegetation close to Deep Creek, where agile wallaby (*Macropus agilis*) and swamp wallaby (*Wallabia bicolor*) were commonly encountered due to the shrubby cover provided. The dense shrub and grass layers of Tooloombah and Deep Creek provides shelter for a range of ground fauna including small and medium-sized mammals such as common planigale (*Planigale maculata*), and northern brown bandicoot (*Isoodon macrourus*) and fawn-footed melomys (*Melomys cervinipes*), both of which were only recorded in this habitat on Tooloombah Creek.

Remote cameras recorded six macropod species using woodland habitat to south of the Project Site. Eastern grey kangaroo (*Macropus giganteus*) were common in cleared habitat. Echidna scats were commonly recorded at several sites during the 2011 surveys and several individuals were recorded on remote cameras south of the Project Site from September to December 2017. Spotlighting surveys in 2017 recorded a range of species including rufous bettong (*Aepyprymnus rufescens*) and water rat (*Hydromys chrysogaster*) at farm dams.

The microbat fauna was relatively diverse with 15 species recorded during microbat call recordings. 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 and 2019 site surveys. No flying-fox species were recorded onsite.

14.3.9.3.4 Conservation Significant Species

Of the 264 native terrestrial species recorded during field surveys, 16 species are listed as conservation significant under the NC Act and/or the EPBC Act. These species are indicated in Table 14-8. Where the locations of conservation significant species records from field surveys are available, they are presented on Figure 14-22.

14.3.9.4 Likelihood of Occurrence of Conservation Significant Species

Following field surveys all conservation significant species predicted as being potentially present from the desktop assessment were categorised as to their likelihood of occurrence within the assessment area (refer to Section 14.2.4). As the Project has the potential to impact on habitat within the Project Site and Near Surrounds, as well as habitat located downstream, three likelihood assessments were undertaken for: 1) Project Site and Near Surrounds, 2) Styx River estuary, and 3) Broad Sound. The detailed results of this assessment are presented in the following tables:

- Table 14-11 - known species within the Project Site and Near Surrounds
- Table 14-12 - likely species within the Project Site and Near Surrounds
- Table 14-13 - potential species within the Project Site and Near Surrounds and
- Table 14-14 - unlikely species within the Project Site and Near Surrounds.

The final two columns of each table present the results of the likelihood assessment for the Styx River estuary and Broad Sound.

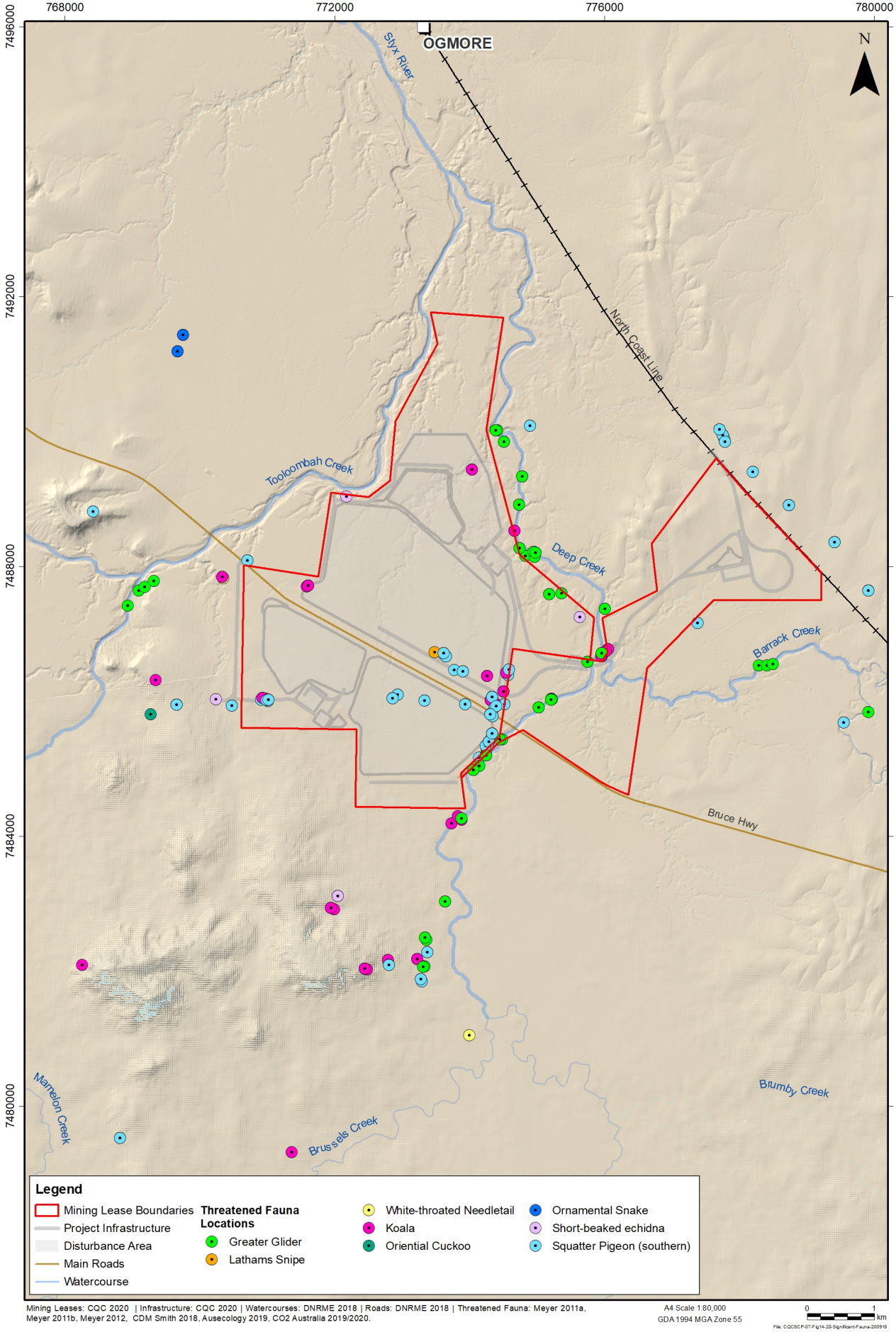


Figure 14-22: Field survey records for conservation significant fauna

Table 14-11: Listed fauna species known to occur at the Project Site and Near Surrounds

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[12]	EPBC Act[13]	Wildlife Online	PMST		Project Site and Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
Birds								
Latham's snipe (*Gallinago hardwickii*)	SL	M	x	x	Occurs on swamp and marsh margins and in wet pasture (Pringle 1987). This species inhabits open, freshwater wetlands with low, dense vegetation including swamps, flooded grasslands, heathlands, around bogs and other water bodies (DAWE 2020a).	Known. Up to 15 individuals observed at farm dam within the Project Site in February 2017. Single individual observed at large dam to the south of Project in September 2017. Individuals were also recorded on farm dams in the wider area in September 2017 and January 2018. Single Wildlife Online record (DSITIA 2020).	Unlikely. Prefers freshwater habitat.	Known. A single WildNet record adjacent to the upper reaches of Saint Lawrence Creek (DES 2020b).
Oriental cuckoo (*Cuculus optatus*)	SL	M		x	Rainforest, vine thickets, wet sclerophyll forest and open forest and woodland (Higgins 1999). The species may also occur in relatively cleared areas such as leafy trees in paddocks (Pizzey and Knight 2012).	Known. A single record of this species recorded 1.3 km east of the Project Site during the March 2011 survey at the systematic survey site 4. May be occasional visitor to denser woodlands (such as riverine and adjacent woodland) in the Project Area.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Squatter pigeon (southern subspecies) (*Geophaps scripta scripta*)	V	V	x	x	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 Project Site. Species is relatively common in the wider area and there are 65 Wildlife Online database records (DSITIA 2020).	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
White-throated needletail (*Hirundapus caudacutus*)	V	V,M	x[14]	x[15]	An aerial non-breeding summer visitor may occur over any habitat type (remnant, non-remnant, urban, pastures), including cleared land and infrastructure.	Known. Recorded in November 2017 3.5 km south of the Project Site. Wide ranging aerial species which migrates from the northern hemisphere to eastern Australia typically in October. May occur over the broader Project Area in the summer months. Single Wildlife Online record (DSITIA 2020).	Unlikely. Almost an exclusively aerial species, preferring wooded areas for feeding, roosting and breeding (DAWE 2020b). They are sometimes seen flying over sandy beaches or mudflats in coastal areas, or around coastal cliffs, and have been recorded well out to sea.	Unlikely. Almost an exclusively aerial species, preferring wooded areas for feeding, roosting and breeding (DAWE 2020b). They are sometimes seen flying over sandy beaches or mudflats in coastal areas, or around coastal cliffs, and have been recorded well out to sea.
Mammals								
Greater glider (*Petauroides Volans*)	V	V	x	x	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. Greater gliders were recorded during the 2011 and 2017 surveys within riparian habitat (RE 11.3.25) along Deep Creek and nearby woodland (RE 11.11.15a) to the south of the Project Site. The 2019 survey event provided records for 21 individual greater gliders (Austecology 2020a). The majority of these records were from riparian vegetation fringing Deep Creek on the eastern side of the Project Site, downstream of the Bruce Highway. 11 Wildlife Online records within 50 km of the Project Site (DSITIA 2020).	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Koala (*Phascolarctos cinereus*)	V	V	x	x	Feed almost entirely on eucalypts (Martin et al. 2008); most likely in riverine and riparian habitats.	Known. Scats recorded in both 2011 surveys. The species recorded on six occasions within in 2017 including within RE 11.4.2 and RE 11.5.8. Two individuals were recorded on remote camera south of the Project Site in 2017. The supplementary survey in 2019 provided widespread evidence of koala presence, including observations of eight individual	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

[12] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[13] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)
[14] Not identified in the 2016 wildlife online search, however, was identified in the 2020 search
[15] Not identified in the 2016 PMST report, however, was identified in the 2020 report

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[12]	EPBC Act[13]	Wildlife Online	PMST		Project Site and Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
						koalas, as well as an adult female with joey (Austecology 2020a). Fifty-six Wildlife Online records from wider area (DSITIA 2020).		
Short-beaked echidna (*Tachyglossus aculeatus*)	SL		x		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 locations within Project Site during 2011, 2012 and 2017 surveys. Recorded in September 2017. Recorded on several occasions on remote cameras (September to December 2017). Common and widespread species. 16 Wildlife Online database records within 50 km of the Project Site (DSITIA 2020).	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

Table 14-12: Listed fauna species likely to occur at the Project Site and Near Surrounds

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[16]	EPBC Act[17]	Wildlife Online	PMST			Downstream Environment	
						Project Site or Near Surrounds	Styx River Estuary	Wider Broad Sound
Birds								
Fork-tailed swift (*Apus pacificus*)	SL	M	x	x	An aerial non-breeding summer visitor, may occur over any habitat type, including cleared land and infrastructure.	Likely. Recorded within EPC 1029 during survey events in March 2011 and February 2012, location unknown. 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. Suitable foraging habitat over much of EPC 1029 (Meyer 2011a and 2012). Single Wildlife Online record from wider area.	Unlikely. Almost an exclusively aerial species, preferring open and dry habitats (DAWE 2020c).	Unlikely. Almost an exclusively aerial species, preferring open and dry habitats (DAWE 2020c).
Glossy ibis (*Plegadis falcinellus*)	SL	M	x		Terrestrial wetlands, preferring inland freshwater wetlands with abundant aquatic flora (Pringle 1985; and Marchant and Higgins 1990).	Likely. Recorded in September 2011 north-east of the Project Site on estuarine sedge swamp. Seasonal wooded wetlands and shallow dams near the Project Site may provide suitable foraging habitat for this species. Single Wildlife Online database record (DSITIA 2020).	Unlikely. Suitable foraging habitat is located within EPC 1029 (wooded wetland and ponded pasture) (Meyer 2011b).	Unlikely Suitable foraging habitat is located within EPC 1029 (wooded wetland and ponded pasture) (Meyer 2011b).
Rufous fantail (*Rhipidura rufifrons*)	SL	M	x	x	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).	Likely. Recorded on March 2011 survey although sighting location unknown. May occur throughout the Project Area. Eight Wildlife Online records from wider area (DSITIA 2020). Four records are located 12 km to the east-west of the Project Site in Marlborough State Forest (DES 2020b). Most suitable habitat near the Project Site for this species is the closed canopy forest along Tooloombah Creek and Deep Creek.	Unlikely. Prefers densely vegetation forests and woodlands (DAWE 2020d).	Unlikely. Prefers densely vegetation forests and woodlands (DAWE 2020d).
Reptiles								
Ornamental snake (*Denisonia maculata*)	V	V		x	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 a frog predator 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). Common REs in which the species has been recorded are: RE 11.4.3, 11.4.6, 11.4.8 and 11.4.9 (DAWE 2020e). It has also been recorded in RE 11.3.3 and 11.5.16 (DAWE 2020e).	Likely. Species has not been recorded within the Project Site despite extensive targeted searches throughout 2017. Recorded on three occasions during the 2011 fauna surveys. All specimens recorded in areas associated with remnant RE 11.4.9 outside of the current Project Site: two records 3.5 km west and one record 5.8 km north-west of the Project Site. No Wildlife Online records from the wider area. A single ALA record located approximately 24 km north of the Project Site. Soils in the Project area are generally suitable and gilgai habitat is widespread in the Project Site north of the Bruce Highway.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

[16] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[17] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Table 14-13: Listed fauna species with potential to occur at the Project Site and Near Surrounds

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[18]	EPBC Act[19]	WO	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
Birds								
Australian painted snipe (*Rostratula australis*)	E	E	x	x	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. The species is endemic to Australia, with increasing evidence of species dispersal from the east to central and norther Australia for part of the year to exploit favourable conditions. It is also probable that a significant proportion of the eastern Australian population migrates to coastal tropical Queensland in February and to August (TSSC 2013).	Potential. Species has not been recorded within Project Site or Near 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.	Potential. Potential habitat (mapped as RE 11.1.3) adjacent mouth of Styx River (c. 5 km NNE of Styx) (Meyer 2011a).	Known. Three database records from wider region recorded on wetlands to the north of Project Site associated with the Broad Sound region (including St Lawrence wetlands).
Black-faced monarch (*Monarcha melanopsis*)	SL	M	x	x	Mainly occurs in dense vegetation such as rainforests and wet sclerophyll forests. Occasionally occurs in mangroves. Sporadically occurs in drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	Potential. There are two Wildlife Online records in the wider region (DES 2020b). In general, the habitat in the Project Site 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.	Potential. Species may potentially utilise mangrove areas, although it generally inhabits rainforest ecosystems.	Potential. Species may potentially utilise mangrove areas, although it generally inhabits rainforest ecosystems.
Caspian tern (*Hydroprogne caspia*)	SL	M	x		Mostly coastal habitats but also inland terrestrial wetlands including lakes, reservoirs and large rivers (Higgins and Davies 1996). Caspian tern is widely distributed at scattered sites across North America, Europe, Africa, Asia and Australasia. In Australia, widespread on coast and eastern interior. Mainly nests on offshore coastal islands as solitary pairs or small colonies. The species tends to be resident or partly dispersive within Australia (Menkhorst et al. 2017).	Potential. Recorded on 2012 survey to the north of the Project Site associated with estuarine habitat (exact location unknown). Dams / wetlands within the Project Site are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas.	Likely. Species may forage along the Styx River. Recorded during Project surveys in February 2012. Location unknown but likely to be along Styx River.	Known. Recorded regularly in low numbers at roost sites in western Broad Sound in recent years (refer Appendix A9h).
Common greenshank (*Tringa nebularia*)	SL	M	x		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). The species occurs along the entire mainland coast as well as inland sites.	Potential. Preferred estuarine habitat does not occur on or near the Project Site, however species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.	Likely. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. However, extensive tracts of saltmarsh and brackish wetlands associated with the river will provide good foraging habitat for this species.	Known. Recorded irregularly at roost sites in western Broad Sound in recent years (refer Appendix A9h).
Curlew sandpiper (*Calidris ferruginea*)	E	CE,M	x	x	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). May be found around the entire Australian coastline as well as inland sites. Was formerly	Potential. Preferred estuarine habitat does not occur on or near the Project Site, however species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Species generally prefers coastal habitat. Habitat around	Known. Survey records show this species irregularly occurs at roost sites in western Broad Sound (Appendix A9h). On one occasion recorded in 'nationally important'

[18] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[19] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[18]	EPBC Act[19]	WO	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
					common but has declined sharply in recent decades (Menkhorst et al. 2017).		Rosewood Island is likely to be more suitable.	numbers at Oyster Creek roost site (Table 14-9).
Eastern osprey (*Pandion cristatus*)	SL	M		x	Mainly coastal habitats but can occur on inland rivers and lakes (Debus 2012). In Australia, generally they are found in tropical and temperate environments along the northern and eastern coasts including terrestrial wetlands and offshore islands, occasionally ranging inland along rivers.	Potential. Suitable habitat adjacent to Project Site along Tooloombah Creek and Deep Creek. One record located 43 km to the north-east of the Project Site (DES 2020b).	Potential. Favours coastal areas.	Known. One WildNet record within the Torrilla Plain in the eastern Broad Sound (DES 2020b).
Gull-billed tern (*Gelochelidon nilotica*)	SL	M	x		Gull-billed tern inhabits a range of areas including shallow coastal environments (such as beaches and mudflats) lakes, dams, salt lakes, sewage farms, floodwaters, irrigated crops and sometimes grasslands. Rarely seen in offshore waters. The species is widespread in Australia although is more common in the north.	Potential. Recorded on September 2011 survey although sighting location unknown. Dams / wetlands within the Project Site are generally small. More likely to occur downstream of the Project foraging along the Styx River and associated extensive wetland areas.	Likely. Species may forage along the Styx River.	Known. Recorded regularly at roost sites, sometimes in large numbers, in western Broad Sound (refer Appendix A9h).
Marsh sandpiper (*Tringa stagnatilis*)	SL	M	x		The marsh sandpiper is found mainly in freshwater or brackish wetlands, including lakes, rivers, ponds and swamps, and occurs far inland such as parts of central Australia. They sometimes occur on tidal wetlands, particularly in the north during the incoming migration period. The species is generally solitary or occurs in small parties, sometimes with other species of wader. It feeds on aquatic insects, molluscs and crustaceans. Roosts in mixed flocks, especially common greenshank (Pringle 1987 and Menkhorst et al. 2017). Occurs throughout coastal Australia extending inland in the east and north.	Potential. Preferred estuarine habitat does not occur on or near the Project Site, however, species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.	Likely. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for these species. However, extensive tracts of saltmarsh and brackish wetlands associated with the river will provide good foraging habitat for this species.	Known. One record approximately 37 km to the north-west of the Project Site within Saint Lawrence Creek and the Broad Sound (DES 2020b).
Red goshawk (*Erythrotriorchis radiatus*)	E	V	x	x	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 Project Site or surrounds despite extensive searches throughout 2017. One ALA/Birdlife Australia database record (1999) from wider search area (17 km north-west of Project). Preferred riverine nesting habitat adjacent to Project Site although local landscape is heavily cleared so generally unsuitable. South of the Project Site remains well vegetated. Species may utilise these areas for foraging should it occur in the area.	Unlikely. Favours wooded and forested areas, including riverine forests of intermediate density (DAWE 2020f). Immature birds have been irregularly reported from mangroves and open river floodplains.	Unlikely. Favours wooded and forested areas, including riverine forests of intermediate density (DAWE 2020f). Immature birds have been irregularly reported from mangroves and open river floodplains.
Red-necked stint (*Calidris ruficollis*)	SL	M	x		Species 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). The species may be found around the entire coastline as well as inland.	Potential. Preferred estuarine habitat does not occur on or near the Project Site, however, species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.	Likely. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. However, extensive tracts of saltmarsh and brackish wetlands associated with the river will provide good foraging habitat for this species.	Known. Recorded regularly at roost sites in western Broad Sound in recent years (refer Appendix A9h). Recorded in 'nationally important' numbers on at least one occasion (Table 14-9).
Satin flycatcher (*Myiagra cyanoleuca*)	SL	M		x	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 areas close to the Project Site during autumn / spring migrations. No database records. EPBC online search only.	Unlikely. Prefer eucalypt forests near wetlands and watercourses.	Unlikely. Prefer eucalypt forests near wetlands and watercourses.

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[18]	EPBC Act[19]	WO	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
Sharp-tailed sandpiper (*Calidris acuminata*)	SL	M	x	x[15]	The sharp-tailed sandpiper is one of the more common sandpiper species to visit Australia. It occurs in a wide variety of habitats, both saline and freshwater, including reefs, estuaries, mangroves, beaches, marshes, lagoons, flooded pasture and sewage ponds. It often associates with other species of wader and feeds mainly on aquatic insects, polychaete worms, molluscs and crustaceans (Pringle 1987). May occur throughout Australia (including far inland) although many inland records are likely to be birds on the southward migration.	Potential. Preferred estuarine habitat does not occur on or near the Project Site, however, species occasionally occurs on inland freshwater wetlands close to the coast, particularly during migration periods.	Likely. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. However, extensive tracts of saltmarsh and brackish wetlands associated with the river will provide good foraging habitat for this species.	Known. Recorded irregularly at roost sites in western Broad Sound in recent years (refer Appendix A9h). Recorded in 'nationally important' numbers on at least one occasion (Table 14-9).
Spectacled monarch (*Symposiachrus trivirgatus*)	SL	M	x	x	Species generally occurs in dense vegetation such as rainforests, wet sclerophyll forests and other dense vegetation such as mangroves. Sporadically occurs in drier sclerophyll forests, woodlands, parks and gardens (Higgins et al. 2006).	Potential. There are two WildNet records located 12 km to the east of the Project Site. In general, the habitat in the Project Site is open, dry and unsuitable. Potentially suitable habitat occurs in denser and wider sections of riparian vegetation along Deep Creek, mainly downstream of the proposed haul road crossing, and upstream of the Bruce Highway (Austecology 2020c). Potentially this species could occur within such habitat, though unlikely to be resident. Given the extent of potentially suitable habitat within Tooloombah Creek Conservation Park, the species may be resident there. There is a higher likelihood for occurrence within potentially suitable habitats during passage migration periods.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Reptiles								
Collared delma (*Delma torquata*)	V	V		x	The collared delma is endemic to Queensland with highly restricted, disjunct populations extending from the outer Brisbane western suburbs north to near Blackwater (Blackdown Tablelands NP) and west to Roma, central Queensland (Austecology 2020b). The total number of known localities for this species has increased with surveys (since ~ 2000) but population sizes are unknown. It is regarded as a cryptic reptile, typically associated with rocky sloped or ridge-top areas, often westerly-facing, in eucalypt and acacia dominated woodland with ground cover comprising native grasses, thick leaf litter, and an abundance of loose surface rocks. The Draft referral guidelines (DSEWPaC 2011a) describes 'suitable habitat' for collared delma as: 'Open-forests, woodlands and adjacent exposed rocky areas in QLD RE Land Zones 3, 9 and 10.'	Potential. The collared delma has not been recorded within the Project Site or Near Surrounds. Nearest records from south of Rockhampton (approx. 145 km southeast of the Project) and Blackdown Tablelands National Park. Specific target species searches (active ground searches) were included in the 2012 fauna surveys for collared delma (Meyer 2012). Target surveys were implemented in what was considered to be potentially suitable habitat within the elevated areas of Mamelon Station. The habitat was described as a rocky hill slope with remnant mixed eucalypt woodland with abundant loose rock, leaf litter and fallen timber in the west of Mamelon station. Meyer (2012) concluded that the area appeared highly suitable for the collared delma, although no species were recorded. The surveyed habitat is located to the south of the Project Site. Habitat suitability assessments across the Project Site and Near Surrounds demonstrate that Land Zone 3 habitats do not support suitable conditions or resources for collared delma (L. Agnew & E. Meyer, December 2019, unpub. data)[20]. Conversely, those assessments indicate that potentially suitable habitat occurs offsite, and south-west of the Project Site, i.e. RE 11.10.7. Habitat within RE 11.10.7 includes the habitat searched by Meyer (2012) and described then as highly suitable for the collared delma. These habitats do not appear to have been subjected to low stock grazing pressure and weeds are uncommon	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

[20] Essential microhabitat characteristics which are either absent or in such depauperate states due to unsuitable geology and / or a long history of land degradation, include: rock slabs; logs; and mats of leaf litter (3 to 10 cm thick). Further, cattle grazing has resulted in soil compaction, degraded understorey characteristics (i.e. native tussock grass ground cover, leaf litter and woody debris), and invasion of weeds (invasive grasses and woody weeds).

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[18]	EPBC Act[19]	WO	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
						(S. Danielsen, 2019 *pers comm.*). It should be noted that there is no habitat which occurs on Land Zone 9 within the Project Site.		
Dunmall's snake (*Furina dunmalli*)	V	V		x	Rarely encountered. Occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland, and records indicate sites at elevations between 200–500 m above sea level (DAWE 2020g). Occurs in a variety of habitats including forests to woodlands on sandy soils, cracking soils with Brigalow scrub, and dry vine scrub.	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 (DAWE 2020g). 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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Yakka skink (*Egernia rugosa*)	V	V		x	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 south of the Project Site 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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Mammals								
Ghost bat (*Macroderma gigas*)	E	V	x[14]	x	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).	Potential. One Wildlife Online record from wider area (DSITIA 2020). Well known maternity colony known to occur at Mt Etna caves approximately 90 km southeast of Project Site. No suitable habitat observed within Project Site but jump-up to the south of the ML may provide suitable rocky crevices for roosting.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Grey-headed flying-fox (*Petropus poliocephalus*)	LC	V		x	Nomadic species that generally roosts at sites near water and within 50 km of the coast (Eby and Roberts 2012). Canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. Generally, occurs further south but regular roost site found near Finch Hatton (Eungella area) in recent years (Roberts et al. 2008).	Potential. No database records from the wider area. Little red and black flying-fox were recorded during the 2011/2012 surveys. Little red and black flying-fox were observed roosting seasonally at a large colony site in the township of Marlborough 50 km southeast of the Project. Surveys of the colony have not identified grey-headed flying-fox. There are no roost sites where the species is known to occur in the region surrounding the Project. Current 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). 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 Site along Tooloombah and Deep Creek although no camp sites were observed or are known from the wider area.	Potential – within known range and suitable habitat present. However, would expect Roost site to be known.	Potential – within known range and suitable habitat present. However, would expect Roost site to be known.
Large-eared pied bat (*Chalinolobus dwyeri*)	V	V		x	Species has been recorded roosting in disused mine tunnels, rock overhangs, caves and fairy martin (*Petrochelidon ariel*) nests (Eyre et al. 1997, Thompson 2002). Appears to be closely associated with the presence of sandstone escarpment country for roost sites.	Potential. No database records from search area. EPBC Online search only. Records from the 1990s to the east of the Project Site associated with the mainland adjacent to Shoalwater Bay. No suitable habitat observed within Project Site but jump-up to the south of the ML may provide suitable rocky crevices for roosting.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Northern quoll (*Dasyurus hallucatus*)	LC	E	x[14]	x	Formerly occurred in a variety of habitats across northern Australia and Queensland. Now most common	Potential. One Wildlife Online record from the search area within 50 km of Project Site. Historical records from 65 km west in the Middlemount area (1969 record) and in Stanage Bay 110 km and 130 km to the	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[18]	EPBC Act[19]	WO	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
					in rocky eucalypt woodland and open forest within 200 km of the coast (Menkhorst and Knight 2004).	northeast (1929 record and 1990 record). More 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. Habitat within the Project Site is mostly cleared and unsuitable for the species. Habitat located to the south-west of the Project Site 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. This is well outside of the Project Site. Species requires access to permanent freshwater and none is nearby this area (nearest waterhole of any permanence approximately 1.5 km away). This area 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).		

Table 14-14: Listed fauna species unlikely to occur at the Project Site and Near Surrounds

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
Birds								
Bar-tailed godwit (baueri) (*Limosa lapponica baueri*)	V	V,M	x	x	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. May occur around the entire coast of Australia where suitable habitat occurs (Menkhorst et al. 2017). Breeds in north-east Siberia and north-west Alaska. Many immature birds overwinter in Australia for their first two or three years (TSSC 2016b).	Unlikely. Species recorded in western Broad Sound area well to north of the current Project during the 2012 fauna surveys. 28 Wildlife Online records from the wider area (DSITIA 2020). There is no suitable estuarine / marine habitat for these species located within or near the Project Site.	Known. Species recorded foraging on mudflats adjacent to the Styx River approximately 14 km north of the Project area in February 2012.	Known. Recent survey records show this species occurs regularly at roost sites in western Broad Sound (Appendix A9h).
Bar-tailed godwit (menzbieri) (*Limosa lapponica menzbieri*)	E	CE,M		x	Subspecies migrates from breeding grounds in North America. Same habitat as bar-tailed godwit (baueri) (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.	Unlikely. No database records. EPBC Online search only. Species does not occur in this region of Australia	Unlikely. No database records. EPBC Online search only. Species does not occur in this region of Australia
Beach stone-curlew (*Esacus magnirostris*)	V		x		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). Known as one of Australia's resident shorebirds. This species has been recorded around the north coast of Australia and associated islands from near Onslow in Western Australia to the Manning River in New South Wales. They have largely disappeared from the south-eastern part of its former range and	Unlikely. Four database records from wider area. However, there is no suitable habitat for this species on or near the Project Site.	Potential. Could also potentially utilise tidal flats along the Styx River for foraging (Meyer 2012).	Known. Recent survey records show this species occurs regularly at roost sites in western Broad Sound (Appendix A9h).

[21] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[22] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
					is now rarely observed on New South Wales beaches (Birdlife Australia 2020a).			
Black-breasted button-quail (*Turnix melanogaster*)	V	V	x	x	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 Site (DES 2020b). 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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Black-throated finch (southern) (*Poephila cincta cincta*)	E	E		x	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 Site is southeast of the species current known range. No database records. PMST online search only.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Campbell albatross (*Thalassarche impavidal*)	SL	V,M		x	Pelagic marine sea bird species that forage in offshore open waters and nest on remote offshore islands. Campbell Albatross does not breed in Australian waters and is most reported in open waters of the continental shelf off Tasmania, Victoria and New South Wales (DAWE 2020h).	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this marine sea bird. No database records from the broader region.	Unlikely. Not suitable habitat for the species (DAWE 2020h).	Unlikely. The waters of Broad Sound downstream of the Project are very unlikely to provide suitable foraging habitat for these species.
Common sandpiper (*Actitis hypoleucos*)	SL	M		x[15]	Non-breeding summer migrant. Widespread throughout all of Australia in small numbers, including the coast and inland areas (DAWE 2020i). In Queensland, areas with nationally important numbers are the south-eastern Gulf of Carpentaria and the Cairns foreshore. Species is found in a wide range of coastal wetlands and some inland wetlands, predominantly on the muddy margins or rocky shores and rarely on mudflats (DAWE 2020i). Occurs in estuaries, deltas of streams and upstream banks. Can be associated with mangroves. Forages in shallow water at the edges of wetlands. Roosts in mangroves.	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this species. No Wildlife Online records (DSITIA 2020), no WildNet records (DES 2020b).	Potential. No records from the wider area. Potentially suitable habitat is present - muddy river margins, mangrove-lined creeks and wetlands (Meyer 2011a).	Potential. No records from the wider area. Potentially suitable habitat is present - muddy river margins, mangrove-lined creeks and wetlands (Meyer 2011a).
Crested tern (*Thalasseus bergii*)	SL	M	x		Crested tern generally inhabits coastal waters but also forages in offshore waters. It roosts on sandy beaches, rocky areas and man-made structures. It nests in colonies on sparsely vegetated sandy or rocky islands. The species occurs around the entire coast of Australia as well as being widespread in the Pacific and Indian Oceans (Menkhorst et al. 2017).	Unlikely. One Wildlife Online record (DSITIA 2020), one WIldNet record from western Broad Sound (DES 2020b).	Likely. Species may forage along the Styx River.	Known. One Wildlife Online record (DSITIA 2020), one WIldNet record from western Broad Sound (DES 2020b).
Eastern curlew (*Numenius madagascariensis*)	E	CE, M	x	x	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). Within Australia the species occur in suitable habitat on all coasts (Higgins and Davies 1996).	Unlikely. There is no suitable estuarine / marine habitat for this species within the Project Site or Near Surrounds.	Known. Species recorded foraging on mudflats adjacent to the Styx River approximately 14 km north of the Project Site in February 2012. Eastern Curlew also observed on associated estuarine plains 16 km north of the Project	Known. Survey records show this species regularly occurs at roost sites in western Broad Sound and in nationally important numbers. On one occasion (September 2013) recorded in internationally important numbers at a single roost site (Table 14-10).

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
							Site during fauna surveys in September 2011.	
Flesh-footed shearwater (*Ardenna carneipes*)	SL	M		x[23]	Pelagic bird species that forage in offshore open waters and nest on remote offshore islands. On the east coast of Australia, the species is known breed on Lord Howe Island and has been recorded on Norfolk Island (DAWE 2020j).	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this marine sea bird. No database records from the broader region.	Unlikely. Not suitable habitat for the species (DAWE 2020j).	Unlikely. There are no database records in the wider region. The waters of Broad Sound are very unlikely to provide suitable foraging habitat for this species.
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V		x		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 Site and Near Surrounds is heavily disturbed and unsuitable. Two Wildlife Online records from wider area (DSITIA 2020).	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Great knot (*Calidris tenuirostris*)	E	CE,M	x	x	This shorebird species occurs on intertidal habitats in sheltered coastal areas, and may occasionally occur on inland wetlands. Prefer areas of extensive tidal flats. Gregarious species which often occur together in large numbers at roost sites (Menkhorst et al. 2017). The species occurs sporadically along the entire Australian coast but is more common in the north.	Unlikely. There are database records for this species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km downstream of the northern boundary of the Project Site. Preferred habitat does not occur on the Project Site or Near Surrounds.	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Species generally prefers coastal habitat. Habitat around Rosewood Island is likely to be more suitable.	Known. The extensive Broad Sound wetland area is known to support nationally important populations of several migratory shorebird species including Great Knot (Bamford et al. 2008). Great Knot may regularly use the area in large numbers (Table 14-9 and Table 14-10).
Greater sand plover (*Charadrius leschenaultia*)	V	V,M	x		Greater sand plovers prefer sandy substrates inhabiting beaches and dunes, tidal flats, sandy spits, reefs, saltmarsh and sometimes paddocks, predominantly along the coastal zone (Marchant and Higgins 1993; Pizzey and Knight 2012).). It occurs patchily along much of the Australian coastline with larger numbers found at northern sites.	Unlikely. There are database records for this species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km downstream of the northern boundary of the Project Site. Preferred habitat does not occur on the Project Site or Near Surrounds.	Likely. Sandy substrate in the Styx River downstream of the rail bridge may be utilised by these species for foraging.	Known. Species has been recorded at roost sites in western Broad Sound in recent years (refer Appendix A9h).
Grey falcon (*Falco hypoleucos*)	V	V	x		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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Grey plover (*Pluvialis squatorola*)	SL	M	x		The species is exclusively coastal preferring sheltered embayments with large tidal flats. They occur along much of the Australian coast with larger numbers occurring along the south and west coasts, particularly at sites in South Australia.	Unlikely. Preferred habitat does not occur on the Project Site or Near Surrounds.	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Grey plover generally prefer coastal habitat. Habitat around Rosewood Island is likely to be more suitable.	Known. Recent survey records show species irregularly occurs at roost sites in western Broad Sound and generally in low numbers (Appendix A9h).
Grey-tailed tattler (*Tringa brevipes*)	SL	M	x		Shorebird species that occurs on intertidal habitats in sheltered coastal areas. Prefer areas of extensive tidal flats. Gregarious with other species at roost sites (Menkhorst et al. 2017). The species occurs along the entire mainland coast but is more common in the north.	Unlikely. Preferred habitat does not occur on the Project Site or Near Surrounds.	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Grey-tailed tattler generally prefer coastal habitat. Habitat	Known. Recent survey records show species irregularly occurs at roost sites in western Broad Sound and generally in low numbers (Appendix A9h).

[23] Listed in 2016 under different name (i.e. *Puffinus carneipes*)

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
							around Rosewood Island is likely to be more suitable.	
Kermadec petrel (*Pterodroma neglecta neglecta*)	LC	V		x	Pelagic bird species that forage in offshore open waters and nest on remote offshore islands. In Australia the Kermadec Petrel breed in the Lord Howe Island group and on Phillip Island (offshore from Norfolk Island) (DAWE 2020k).	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this marine sea bird. No database records from the broader region.	Unlikely. Not suitable habitat for the species (DAWE 2020k).	Unlikely. There are no database records in the wider region. The waters of Broad Sound are very unlikely to provide suitable foraging habitat for this species.
Lesser Sand Plover (*Charadrius mongolus*)	E	E,M	x		Shorebird species that occurs on intertidal habitats in sheltered coastal areas. Utilises sandy habitats for foraging although Lesser Sand Plover is more likely to forage on muddier substrates (Menkhorst et al. 2017). Occurs patchily along much of the Australian coastline although it is more common along the eastern coast.	Unlikely. There are database records for this species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km downstream of the northern boundary of the Project Site. Preferred habitat does not occur on the Project Site or Near Surrounds.	Likely. Sandy substrate in the Styx River downstream of the rail bridge may be utilised by this species for foraging.	Known. Species has been recorded at roost sites in western Broad Sound in recent years (refer Appendix A9h). Lesser Sand Plover has been recorded in 'nationally important' numbers on at least one occasion (Table 14-9).
Little tern (*Sternula albifrons*)	SL	M	x	x[24]	Coastal species that also occurs on shallow coastal areas and sometimes adjacent waterbodies such as brackish lakes, salt fields and sewage ponds (Menkhorst et al. 2017). This species is widespread in Australia with breeding sites widely distributed from north-western Western Australia around the north and eastern Australian coasts.	Unlikely. No suitable habitat present for this species on the Project Site or Near Surrounds (records from Turtle Island in Broad Sound downstream of Project).	Potential. Habitat along the Styx River is generally unsuitable for this species. Recorded during Project surveys in September 2011. Location unknown but likely to be along Styx River.	Known. Several WildNet records in Broad Sound area on and near Turtle Island.
Pectoral sandpiper (*Calidris mealnotos*)	SL	M		x[15]	Typically, in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands In Queensland, most records occur around Cairns (DAWE 2020l).	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this species. No Wildlife Online records (DSITIA 2020), no WildNet records (DES 2020b).	Potential. Most records in Qld are from Cairns, with scattered records elsewhere. Suitable habitat present.	Potential. Most records in Qld are from Cairns, with scattered records elsewhere. Suitable habitat present.
Red knot (*Calidris canutus*)	E	E,M	x		Shorebird species that occurs on intertidal habitats in sheltered coastal areas. Prefer areas of extensive tidal flats. Gregarious species which often occur together in large numbers at roost sites (Menkhorst et al. 2017). It occurs along the entire Australian coast and is more common in the south than the more numerous great knot (Geering et al. 2008; Menkhorst et al 2017).	Unlikely. There are database records for this species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km downstream of the northern boundary of the Project Site. Preferred habitat does not occur on the Project Site or Near Surrounds	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Species generally prefers coastal habitat. Habitat around Rosewood Island is likely to be more suitable.	Known. Species has been recorded at roost sites in western Broad Sound in recent years. Red knot has been recorded in 'nationally important' numbers on at least one occasion (Table 14-9).
Short-tailed shearwater (*Ardenna tenuirostris*)	SL	M	x[14]		Australia's most abundant seabird (DPIPWE 2020). Occurs in large numbers along the south and south-east coast of Australia in the summer months. They spend the southern winter at sea in the northern Pacific, off Japan, Siberia and Alaska.	Unlikely. Project Site is outside of the known distribution for this species (DAWE 2020m). No suitable habitat within the Project Site or Near Surrounds for this species.	Unlikely. There is one record from Saint Lawrence Creek, however this is likely to be a vagrant as the Project Area is well outside of the	Unlikely. There is one record from Saint Lawrence Creek, however this is likely to be a vagrant as the Project Area is well outside of the known distribution for this species (DAWE 2020m).

[24] Listed in 2016 under different name (i.e. Stern albifron)

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
							known distribution for this species (DAWE 2020m).	
Southern giant petrel (*Macronectes giganteus*)	E	E,M		x	Pelagic bird species that forage in offshore open waters and nest on remote offshore islands. Southern giant petrel breeds in Antarctica and sub-Antarctic islands and occurs mainly over the Southern Ocean but also ventures into subtropical waters (DAWE 2020n).	Unlikely. Two ALA records for Southern Giant Petrel of uncertain provenance off Yeppoon approximately 120 km southeast of the Project Site.	Unlikely. Not suitable habitat for the species (DAWE 2020n).	Unlikely. There are no database records in the wider region. The waters of Broad Sound are very unlikely to provide suitable foraging habitat for this species.
Star finch (*Neochmia ruficaunda ruficauda*)	E	E		x	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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Streaked shearwater (*Calonectris leucomelas*)	SL	M		x[15]	Pelagic bird species that breed on islands off the southern Russian Far East, and Japan, east China, Korea and Taiwan. In the non-breeding season they migrate to waters off New Guinea and northern Australia and the South China Sea.	Unlikely. No database records. EPBC online search only.	Unlikely. Rare vagrant. Only recorded from the PMST bioclimatic modelling, which is not based on species records.	Unlikely. Rare vagrant. Only recorded from the PMST bioclimatic modelling, which is not based on species records.
Terek sandpiper (*Xenus cinereus*)	SL	M	x		Terek sandpiper occurs along the coast preferring to forage on exposed seagrass flats or tidal mudflats close to mangroves. The species may occur at scattered sites along the entire mainland coast but is much more common in the north and east.	Unlikely. There are database records for this species in the wider area (known from western Broad Sound). The boundary of Broad Sound occurs approximately 8 km downstream of the northern boundary of the Project Site. Preferred habitat does not occur on the Project Site or Near Surrounds.	Potential. Sandy substrate in the Styx River downstream of the rail bridge is less suitable for this species. Terek Sandpiper may occur along estuaries. Habitat around Rosewood Island is likely to be more suitable.	Known. Recent survey records show species irregularly occurs at roost sites in western Broad Sound and generally in low numbers (Appendix A9h).
Whimbrel (*Numenius phaeopus*)	SL	M	x	x	The species is almost exclusively coastal preferring areas of extensive tidal flats with mangroves. At high tide may roost in flocks with other waders (often eastern curlew) but is also well known to roost in mangroves or other prominent locations. Widespread along coastal Australia but more common in north where preferred habitat occurs (Menkhorst et al. 2017).	Unlikely. 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. There is no suitable estuarine / marine habitat for this species located within the Project Site or Near Surrounds.	Known. Recorded foraging on mudflats adjacent to the Styx River approximately 14 km north of the Project area in February 2012.	Known. Recorded regularly at roost sites in western Broad Sound in recent years (refer Appendix A9h).
White-bellied storm-petrel (*Fregetta grallaria grallaria*)	LC	V		x	Pelagic bird species that forage in offshore open waters and nest on remote offshore islands. In Australia the White-bellied Storm-petrel breed in small offshore islets and rocks of the Lord Howe Island group (DAWE 2020o). In the non-breeding season, it reaches and forages over near-shore waters along the continental shelf of mainland Australia.	Unlikely. No suitable habitat within the Project Site or Near Surrounds for this marine sea bird. No database records from the broader region.	Unlikely. Not suitable habitat for the species (DAWE 2020o).	Unlikely. There are no database records in the wider region. The waters of Broad Sound are very unlikely to provide suitable foraging habitat for this species.
Wood sandpiper (*Tringa glareola*)	SL	M	x[14]		Non-breeding summer migrant, relatively uncommon, occurring mainly on inland freshwater wetlands and rarely on intertidal mudflats. In Australia the largest numbers recorded are in north-west Australia (DAWE 2020p). Sparsely scattered records in Queensland.	Unlikely. This species is relatively uncommon and only sparsely recorded in Queensland.	Unlikely. Prefers freshwater wetlands and rarely use brackish wetlands or coastal flats (DAWE 2020p).	Unlikely. Prefers freshwater wetlands and rarely use brackish wetlands or coastal flats (DAWE 2020p).

Species	Status		Database Search		Habitat Preference	Likelihood of Occurrence		
	NC Act[21]	EPBC Act[22]	Wildlife Online	PMST		Project Site or Near Surrounds	Downstream Environment	
							Styx River Estuary	Wider Broad Sound
Yellow chat (Dawson) (*Epthianura crocea macgregori*)	E	CE	x	x	Endemic to area and known from Curtis Island, the Torilla Plain and Fitzroy River Delta, though seasonally mobile and possibly also occurs in other localities. Known from freshwater and saline wetlands on marine plains including swampy grassland, saline herbland, salt marshes, Cyperus sedgelands. All sites where the Chat has been found to persist year-round are associated with drainage channels on coastal marine plains connected to tidally influenced wetlands.	Unlikely. 50 Wildlife Online database records from wider area. These records are likely to be associated with the extensive Torilla Plains. There is no suitable habitat within the Project Site or Near Surrounds. Targeted surveys in 2011/2012 located in potential habitat to the north of the Project did not record the species.	Potential. Potentially suitable habitat present. Species is endemic to the area.	Known. Species is endemic to the area and is known from the Torilla Plains located approximately 40 km east of the Project Site.
Yellow wagtail (*Motacilla flava*)	SL	M		x	Sporadic visitor to coastal areas. Prefers short grass or bare ground close to swamps, sewage ponds and saltmarsh. May occur on airfields, playing fields or town lawns (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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Mammals								
Coastal sheathtail bat (*Taphozous australis*)	NT		x[14]		Distributed along the north-east coast of Queensland from Shoalwater Bay to Cape York, extending no further than a few kilometres inland (DES 2020d). Forages within 1 km of the ocean in sand dune scrub, mangroves, melaleuca swamps, coastal heathlands, open eucalypt forest and grasslands (DES 2020d). Dependent on coastal roosts with a preference for sea caves and rocky clefts. Has been observed to roost in disused mines, boulder piles, rock fissures, concrete bunkers and buildings (Hourigan 2011). Unevenly distributed throughout its range due to reliance on coastal roosts.	Unlikely. No suitable roosting habitat within or nearby EPC 1029 (Meyer 2011a).	Unlikely. No suitable roosting habitat within or nearby EPC 1029 (Meyer 2011a).	Unlikely. No suitable roosting habitat within or nearby EPC 1029 (Meyer 2011a).
South-eastern Long-eared Bat (*Nyctophilus corbeni*)	V	V		x	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). Churchill (2008) notes the distribution of the species is largely restricted to the Murray Darling Basin and western slopes of the Great Dividing Range from south central Queensland, central western New South Wales, north-western Victoria and eastern South Australia. TSSC (2015a) note that, in Queensland, the species is largely recorded in the Brigalow Belt South Bioregion which lies well south of the Project Site.	Unlikely. While there is suitable habitat for this species, the Project Site is located substantially north of its current known distribution. There are no database records from the area for this species. There are 596 records of this species in the ALA database and the nearest record is approximately 400 km south of the Project in the Expedition Range. The nearest records from the DES species database comes from the same area and is likely to be the same record.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.
Insect								
Pale imperial hairstreak (*Jalmenus eubulus*)	V		x[14]		Species is confined to vegetation communities containing mature Brigalow which the larvae feed on (Valentine and Johnson 2012).	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.	Unlikely. No suitable habitat present.	Unlikely. No suitable habitat present.

14.3.9.5 Species Known or Likely to Occur (Project Site and Near Surrounds)

This assessment presented above concludes that there are 11 conservation significant species which are known or likely to occur within the Project Site and Near Surrounds including greater glider, koala, ornamental snake, squatter pigeon, short-beaked echidna, fork-tailed swift, glossy ibis, Latham's snipe, oriental cuckoo, rufous fantail and white-throated needletail.

14.3.9.5.1 Greater Glider

NC Act – V, EPBC Act – V

Habitat

The greater glider is arboreal and nocturnal and is largely restricted to eucalypt forests and woodlands. Greater glider habitat has been broadly defined as open forest or woodland with a diversity of myrtaceous trees for foraging. In these habitats, living 'old growth' trees (including 'over mature' trees) and dead stags which support hollows are essential denning habitat resources for greater gliders. Favoured tree species vary depending on stand composition, but gliders appear to prefer myrtaceous species that have relatively higher concentrations of foliar nutrients.

Greater gliders shelter in tree hollows by day, favouring large hollows in large, old trees. The species requires a variety of den trees which are used at different times. Greater gliders used older living "over mature' trees more than expected by their availability (scarce in study forest), presumably because of the hollows they contained (Autecology 2020b). They are considered to be poor dispersers across open / cleared areas and vegetation that is not native forest.

Distribution and Population

The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in North Queensland through to central Victoria. An isolated inland subpopulation occurs in the west of Townsville (Gregory Range), and another in the Einasleigh Uplands. There is no reliable estimate of population size across its total distribution (TSSC 2016a).

Occurrence in the Project Site and Near Surrounds

Greater gliders were recorded during the 2011 and 2017 surveys within riparian habitat (RE 11.3.25) along Deep Creek and nearby woodland (RE 11.11.15a) to the south of the Project Site (Figure 14-23). A supplementary survey undertaken in 2019 provided records for 21 individual greater gliders. The majority of these records were from riparian vegetation fringing Deep Creek on the eastern side of the Project Site, downstream of the Bruce Highway (Figure 14-23). A high proportion of the records were of gliders observed within carbeen, a feed tree species which is common along Deep Creek. Other glider records were mostly observed in large, hollow-bearing forest red gum which were also relatively common along Deep Creek. Several greater gliders were also recorded in woodland extending west from the central section of Deep Creek (Figure 14-23).

Following the 2019 survey event suitable habitat for the greater glider across the Project Site was re-mapped. As favoured, breeding and/or foraging habitat for greater gliders may only be potentially discernible as a result of long-term site-specific studies, it has not been separately mapped. Figure 14-23 shows the extent of known or potentially suitable greater glider habitat within the Project Site. Figure 14-24 also shows known or potentially suitable greater glider habitat within 10 km of the Project Site.

Threats

The key threats to greater glider includes habitat loss and fragmentation due to clearing, logging and prescribed burning (TSSC 2016a). Other threats include intense or frequent fires, entanglement in barbed wire fencing, competition for hollows with species which are increasing in abundance (e.g. sulphur-crested cockatoos) and hyper-predation by owls. There is no Commonwealth or State recovery plan for the greater glider (DAWE 2020q). No Threat Abatement Plan has been identified as being relevant for this species.

14.3.9.5.2 Koala

NC Act – V, EPBC Act – V

Habitat

Koala habitat has been broadly defined as any forest or woodland containing species that are known koala food trees, or shrubland with emergent food trees (DAWE 2020r). This can include remnant and non-remnant vegetation in natural, agricultural, urban and peri-urban environments. Movement is not confined to vegetated corridors, as they also move across cleared rural land and through suburbs (Martin et al. 2008). In areas of suitable habitat, koalas also show strong preferences for individual trees. Their diet is restricted mainly to leaves of *Eucalyptus* spp. and related genera (including *Corymbia* spp., *Angophora* spp. and *Lophostemon* spp.) and is usually limited to one or a few of the species present at a site.

Distribution and Population

Koalas occur throughout northeast, central and southeast Queensland, extending south through Victoria into South Australia and Kangaroo Island. The population in 2010 in Queensland was estimated to be 167,000 – a 43% decline from the 1990 estimate which was 295,000 (DAWE 2020r).

Occurrence in the Project Site and Surrounds

Koalas are known to occur within the Project Site and have been recorded during most survey events (Figure 14-25). Following the 2019 survey event suitable habitat for the koala was re-mapped based on the presence of REs which are known to support suitable the species. It should be noted that favoured, breeding and / or foraging habitat for koalas are typically the same and may only be potentially discernible as a result of long-term site-specific studies. As a result, favoured, breeding and / or foraging habitat for koalas have not been separately mapped. The majority of the mapped koala habitat is remnant vegetation, though also includes small areas of non-remnant habitat where known food tree species occur and evidence of koala occurrence was recorded. Figure 14-26 also shows known or potentially suitable koala habitat within 10 km of the Project Site.

Threats

Current key threats to koalas include ongoing habitat loss and fragmentation, mortality due to dog attacks and vehicle strikes and disease (DAWE 2020r). Significant koala mortality is also known to be caused by drought and extreme heat, with post-drought recovery likely to be substantially impaired by other threatening factors. Climate change, including increased fire risk, is also a potential threat to the koala. There is no Commonwealth or State recovery plan for the Koala (DAWE 2020r). No Threat Abatement Plan has been identified as being relevant for this species (DAWE 2020r).

14.3.9.5.3 Ornamental Snake

NC Act – V, EPBC Act – V

Habitat

Ornamental snake is likely to be found in woodlands and open forests in Brigalow, gidgee (*Acacia cambagei*), blackwood (*Acacia argyrodendron*) or coolibah (*Eucalyptus coolabah*) dominated vegetation communities, associated with moist areas, particularly gilgaied landscapes that are associated with habitat for its preferred prey, frogs. It also occurs in modified grassland associated with gilgais, and lake margins and wetlands (Melzer 2012). 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. Common REs in which the species has been recorded are: RE 11.4.3, 11.4.6, 11.4.8 and 11.4.9 (DAWE 2020e). It has also been recorded in RE 11.3.3 and 11.5.16 (DAWE 2020e).

The ornamental snake requires microhabitat shelter sites such as soil cracks, rocks, human debris (e.g. corrugated iron sheeting) and fallen timber and ground litter. Gilgais are a known important habitat feature for the species and the presence of remnant vegetation is not required for the species to occur (DSEWPaC 2011a).

Distribution and Population

Ornamental snake is sparsely distributed across its range and is only known only from the Brigalow Belt North and parts of the Brigalow Belt South bioregions (DAWE 2020e). 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). Whilst the population size is unknown, the species is not thought to have experienced range declines.

Occurrence in the Project Site and Surrounds

Despite targeted surveys for the species within the Project Site (trapping, habitat searches and spotlighting) in February 2012 and February, July and November 2017, no individuals were recorded within potentially suitable habitat located within the ML. As illustrated in Figure 14-22, the only records from survey events are three records from 2011 located 3.5 km west and 5.8 km north west of the northern Project Site boundary.

Suitable non-remnant habitat for this species may occur where alluvial cracking clays and gilgai depressions occur to the north of the Bruce Highway (Figure 14-27). This habitat has been heavily impacted by clearing but there are substantial areas of patchy to sparse Brigalow regrowth. However, surveys in these regrowth areas adjacent to the tributaries of Deep Creek in May 2020 by CO2 Australia indicated much of the gilgai communities support a sandy, clay, loam surface rather than deep cracking clays the species is typically associated with. Consequently, any cracks in the clays were observed as being filled by surface sand, affording little foraging or shelter habitat potential for ornamental snake. A degraded strip of riparian remnant vegetation along a creek line that passes through this area (RE 11.3.25) may also provide shelter and foraging habitat (Figure 14-27). No habitat for ornamental snake was identified within ML 700022.

Threats

The key threat to the ornamental snake is broadscale land clearing and habitat degradation (DE 2014b). Threats also include 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.

14.3.9.5.4 Squatter Pigeon

NC Act – V, EPBC Act – V

Habitat

Information provided by DAWE to CQC via email aimed to clarify the habitat description framework for the assessment of the squatter pigeon (southern) (DEE 2019a). In regard to Breeding Habitat:

- Land Zones 5 and 7, and Land Zone 3 when embedded in Land Zones 5 and/or 7.
- Remnant or regrowth open-forest to sparse, open-woodland or low-woodland dominated by *Eucalyptus*, *Corymbia*, *Acacia* or *Callitris* species within one kilometre of a suitable, permanent or seasonal waterbody. It is distinguished by ground-layer vegetation that:
  - consists of patchy, native, perennial tussock grasses, or a mix of perennial tussock grasses and low shrubs or forbs and
  - does not cover more than 33% of the ground.
- These preferred ground-layer vegetation conditions tend to occur on well-draining, sandy or gravelly soils low, gently sloping, flat to undulating plains and foothills, lateritic (duplex) soils on low 'jump-ups' and escarpments.

In regard to Foraging Habitat:

- Land Zones 5 and 7, and Land Zone 3 when embedded in Land Zones 5 and/or 7.
- Remnant or regrowth open-forest to sparse, open-woodland or low-woodland dominated by Eucalyptus, Corymbia, Acacia or Callitris species within three kilometres of a suitable, permanent or seasonal waterbody. It is distinguished by ground-layer vegetation that:
  - consists of patchy, native, perennial tussock grasses, or a mix of perennial tussock grasses and low shrubs or forbs and
  - does not cover more than 33% of the ground.
- These preferred ground-layer vegetation conditions tend to occur on well-draining, sandy or gravelly soils low, gently sloping, flat to undulating plains and foothills, lateritic (duplex) soils on low 'jump-ups' and escarpments.

In regard to Dispersal Habitat:

- Dispersal habitat is any forest or woodland occurring between patches of foraging or breeding habitat which facilitates movement between patches of foraging habitat, breeding habitat and/or waterbodies.
- Dispersal habitat includes vegetation where the groundcover layer has been thinned through current land-use practices in a way that suits the species (e.g. light cattle grazing). The species does disperse into highly modified or degraded habitats, including cleared areas which are within 100 metres of remnant trees or patches of habitat.

Whilst this information has been considered in the context of the habitat assessment for the species it is important to note that unpublished data from a variety of biologists does not entirely concur with the information provided (Austecology 2020b). For example, there is evidence from current unpublished data which shows that the squatter pigeon (southern) has been recorded within a

variety of land zones, i.e. land zones 3, 4, 5, 7, 8, 9, 10, 11, including some not mentioned in DEE (2019a), including within the Project Site.

Distribution and Population

The squatter pigeon (southern) remains common in much of central Queensland. North of the Carnarvon Ranges where the Project is located the species remains common and is considered to be distributed as a single, continuous sub-population (DAWE 202r). As the southern boundary of the known distribution of the squatter pigeon (southern) is contracting northwards, important sub-populations of the species have been identified as those isolated and sparsely distributed sub-populations that occur south of the Carnarvon Ranges in central Queensland including, but not limited to:

- 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.

In 2000, the total population size was estimated at 40,000 breeding birds, however, this estimate is not considered reliable (DAWE 2020s).

Occurrence in the Project Site and Surrounds

The squatter pigeon is known to occur within the Project Site and was recorded during most survey events. The majority of those records are from the central southern part of ML 80187, either side of the Bruce Highway (Figure 14-28). Squatter pigeons have also been recorded within remnant vegetation throughout the Project Site, including RE 11.3.35, RE 11.4.2, RE 11.5.8a, and RE 11.11.15a. In areas of remnant vegetation adjacent to the Project Site, squatter pigeons have been recorded in RE 11.5.8 / 11.7.2 and RE 11.11.15a.

Following supplementary fauna surveys in 2019 suitable habitat for the squatter pigeon (southern) was re-mapped as shown in Figure 14-28. The majority of the mapped habitat is remnant vegetation, though cleared areas are mapped where conditions and resources are thought to suitable habitat. In addition to habitat within the Project Site, squatter pigeon (southern) habitat within 10 km of the Project Site was also mapped as shown in Figure 14-29.

Threats

Despite being common in much of central Queensland, Squatter pigeon continues to be under threat from vegetation clearing, overgrazing of habitat by livestock and feral herbivores such as rabbits, invasion of weeds and pasture grasses, inappropriate fire regimes, thickening of understorey vegetation, predation by feral cats and foxes, trampling of nests by domestic livestock and illegal shooting (TSSC 2015b). There is no Commonwealth or State recovery plan for the squatter pigeon (southern).

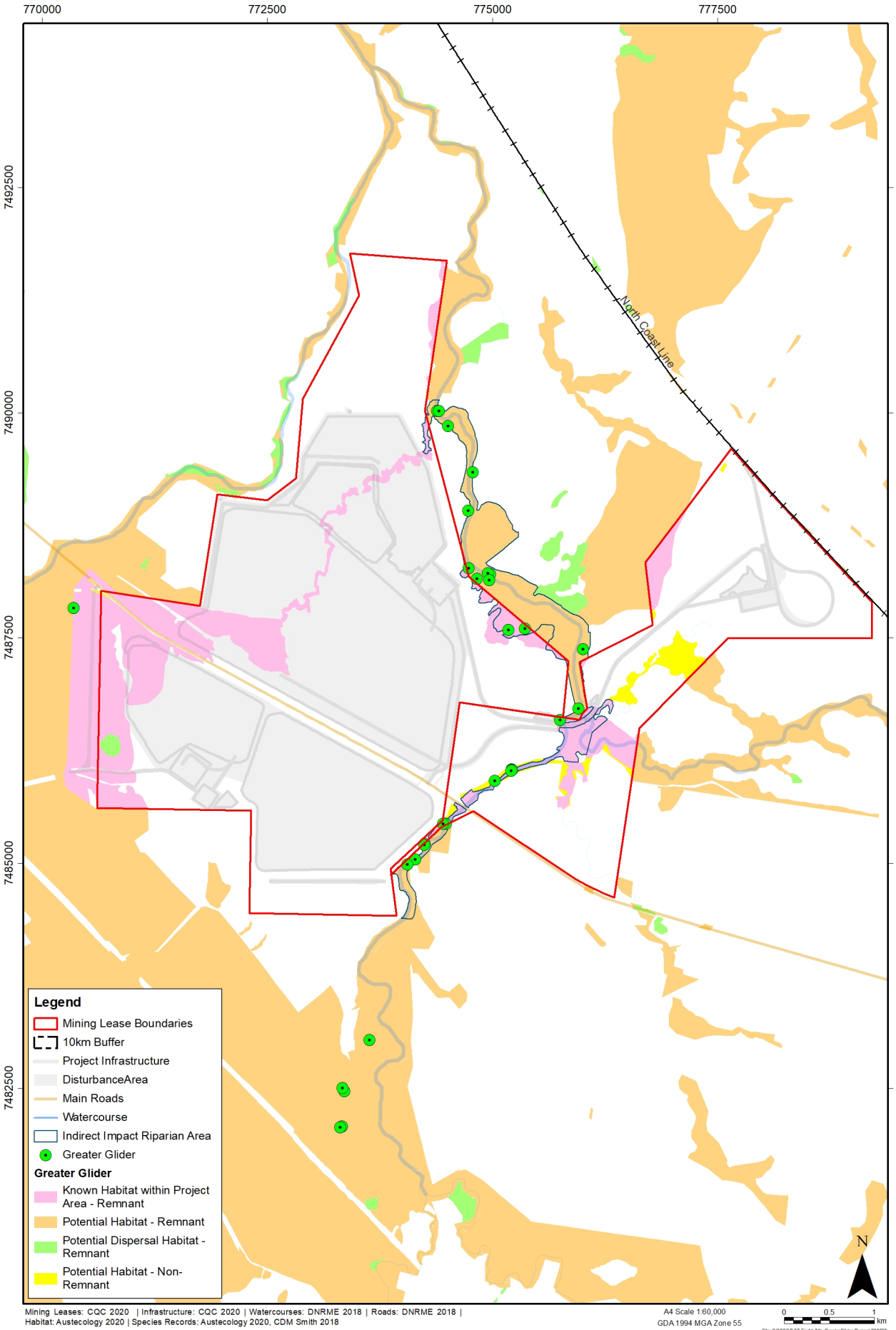


Figure 14-23: Greater glider habitat within the Project Site

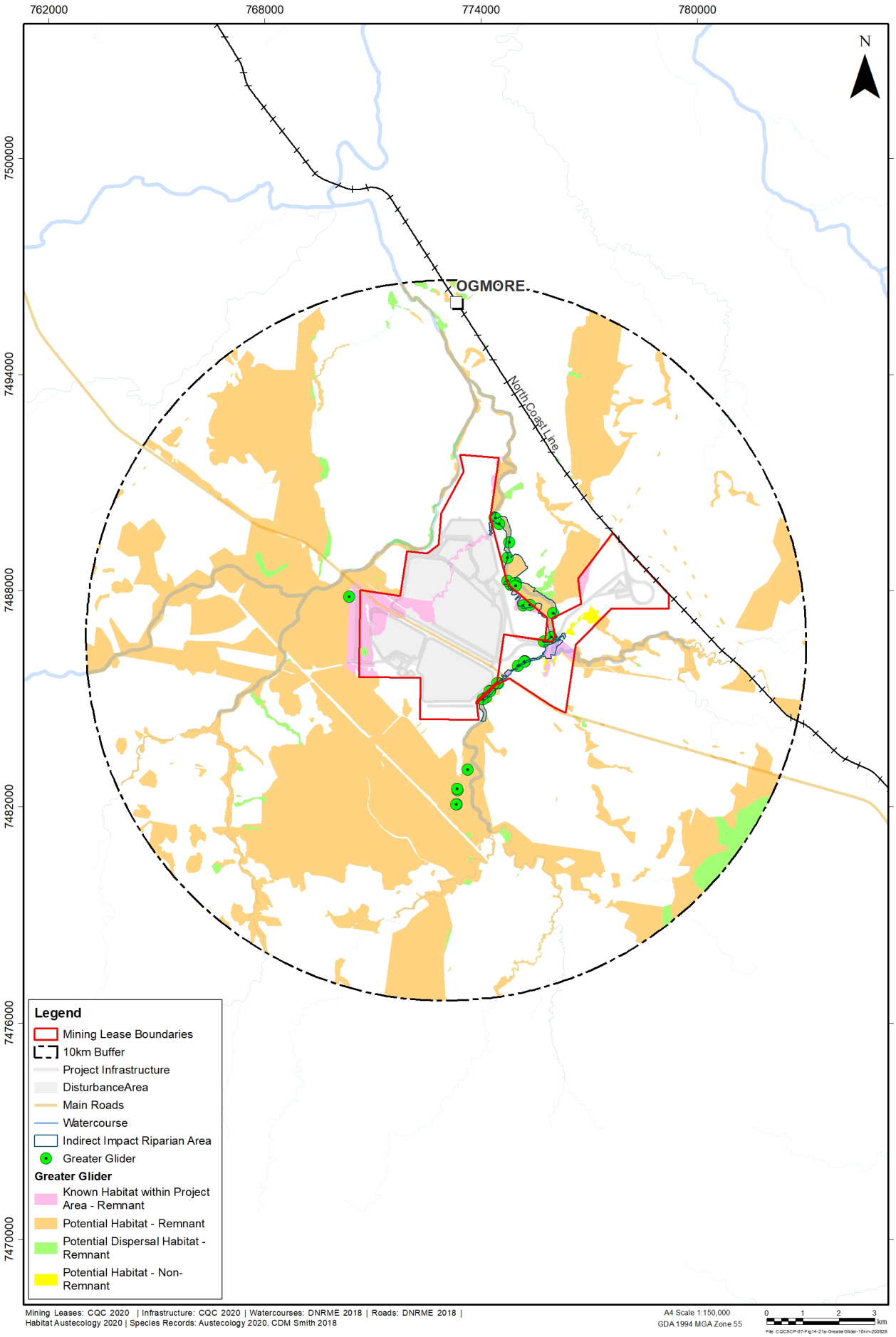


Figure 14-24: Greater glider habitat within 10 km of the Project Site

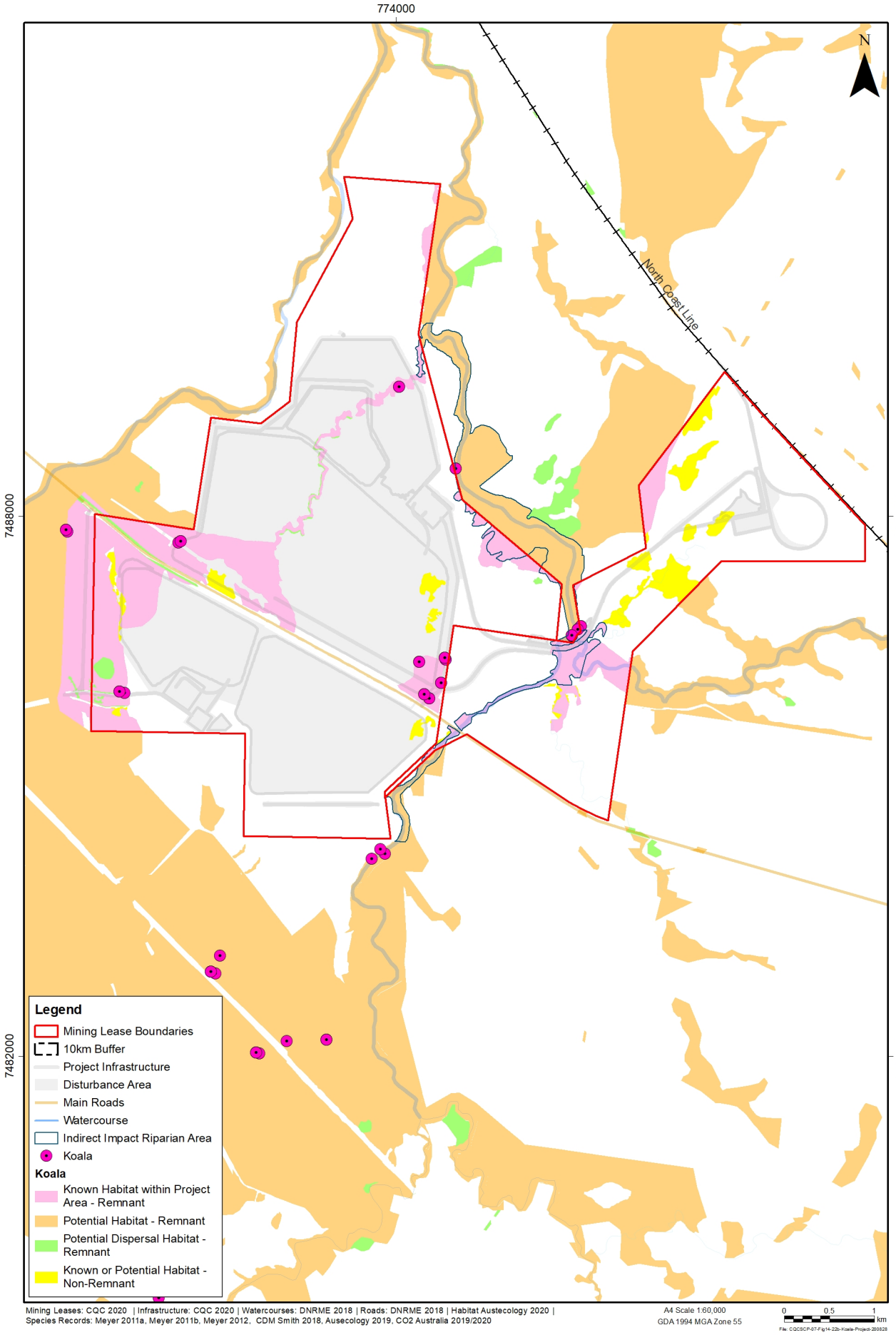


Figure 14-25: Koala habitat within the Project Site

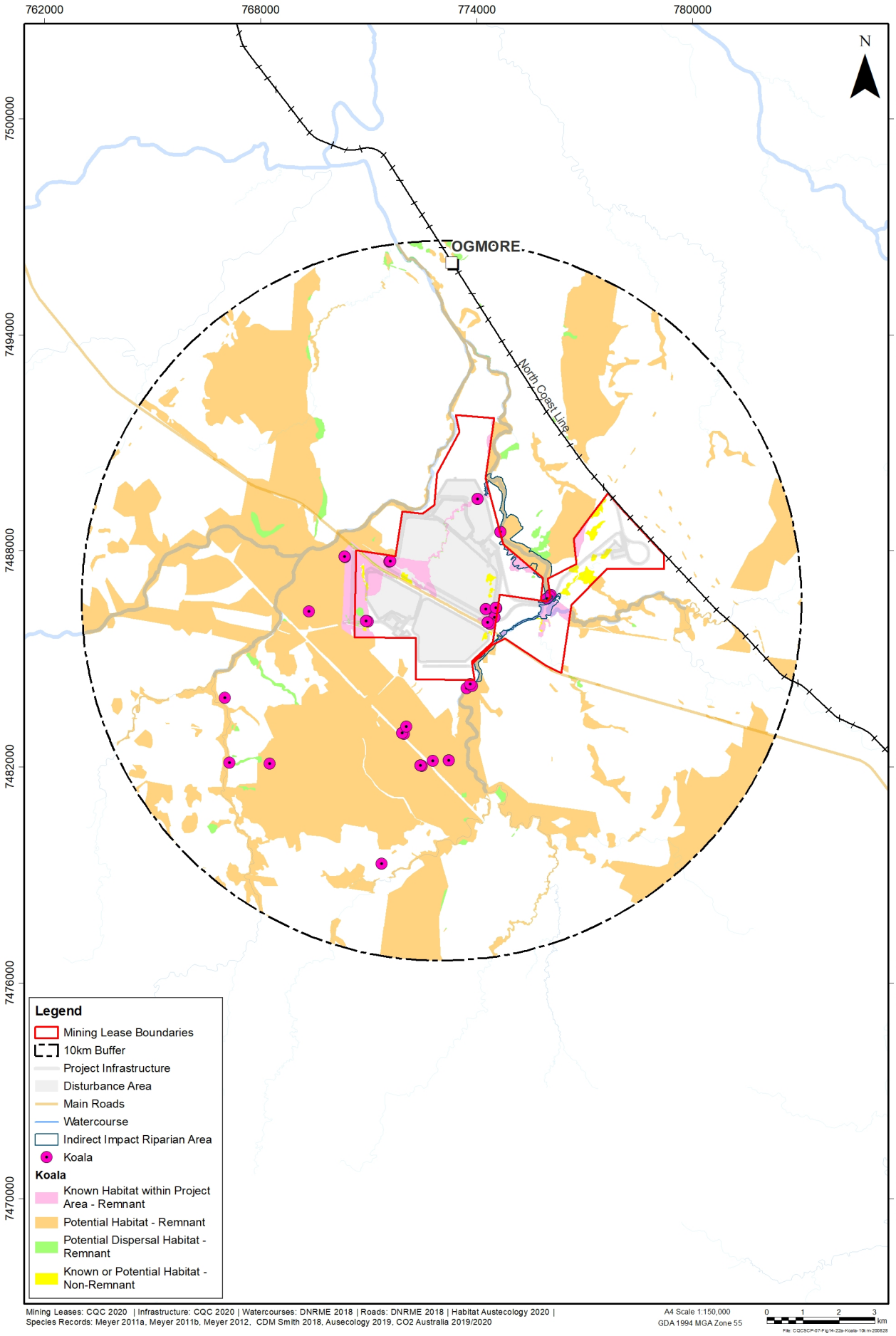


Figure 14-26: Koala habitat within 10 km of the Project Site

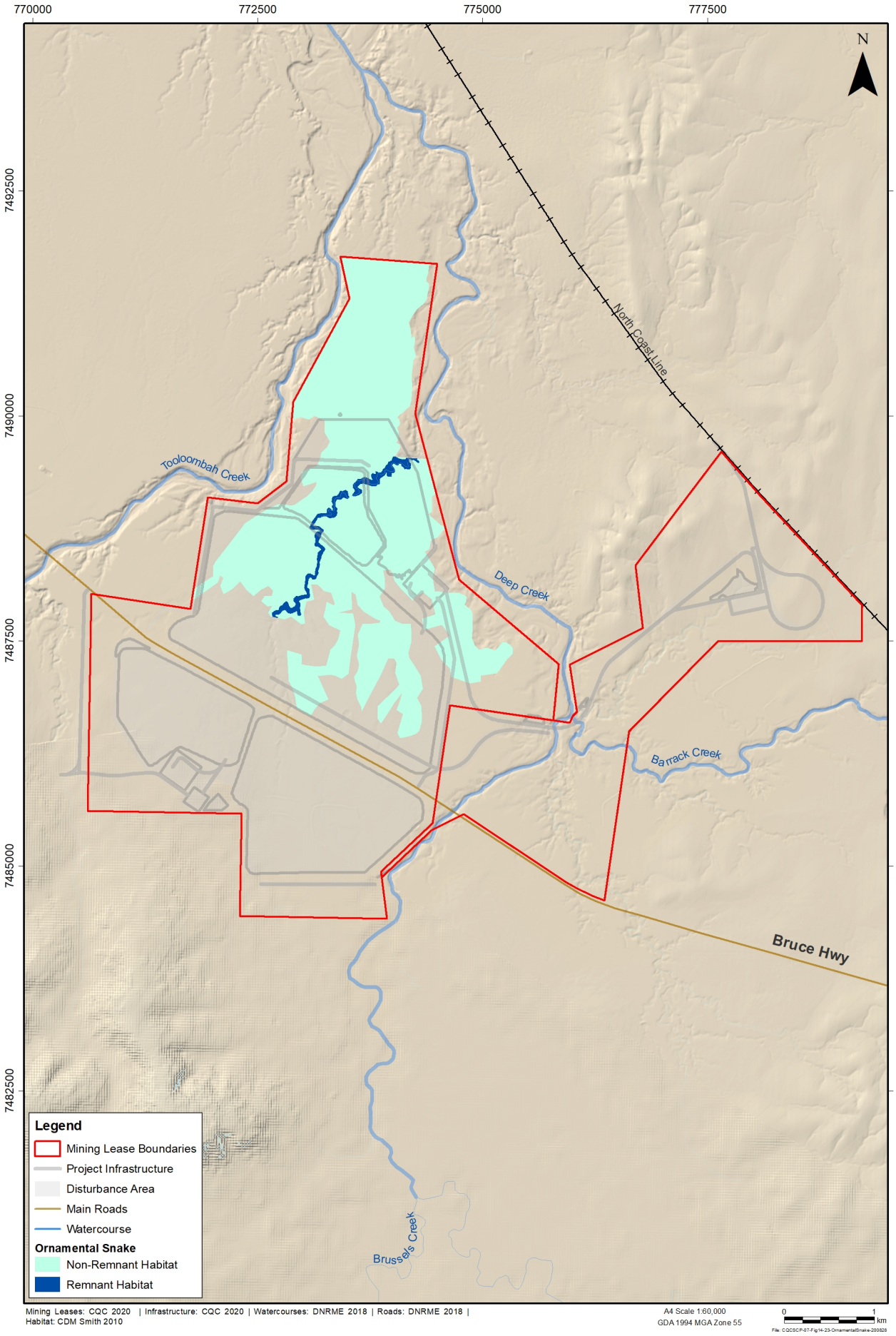


Figure 14-27: Ornamental snake habitat within the Project Site

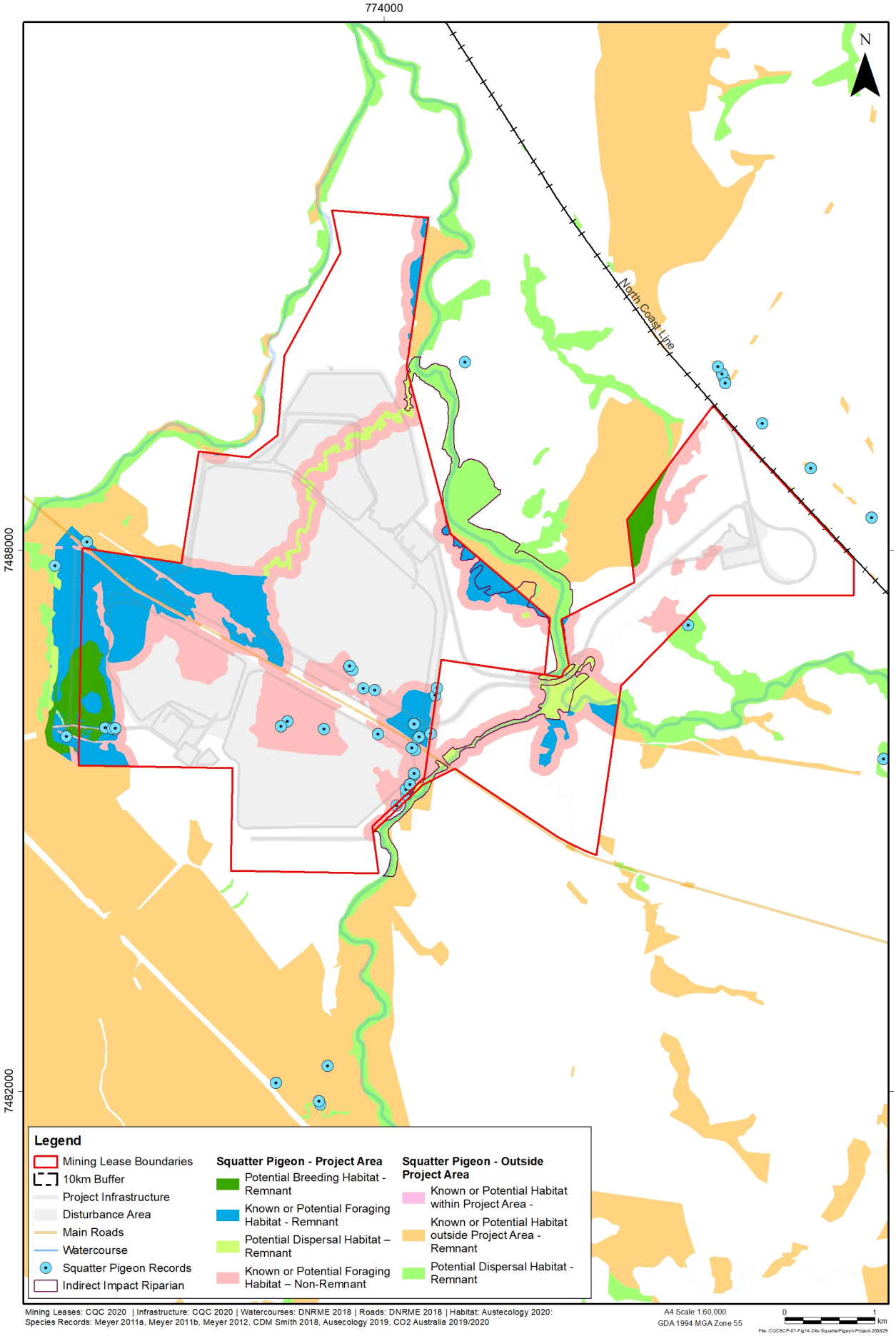


Figure 14-28: Squatter pigeon (southern) habitat within the Project Site

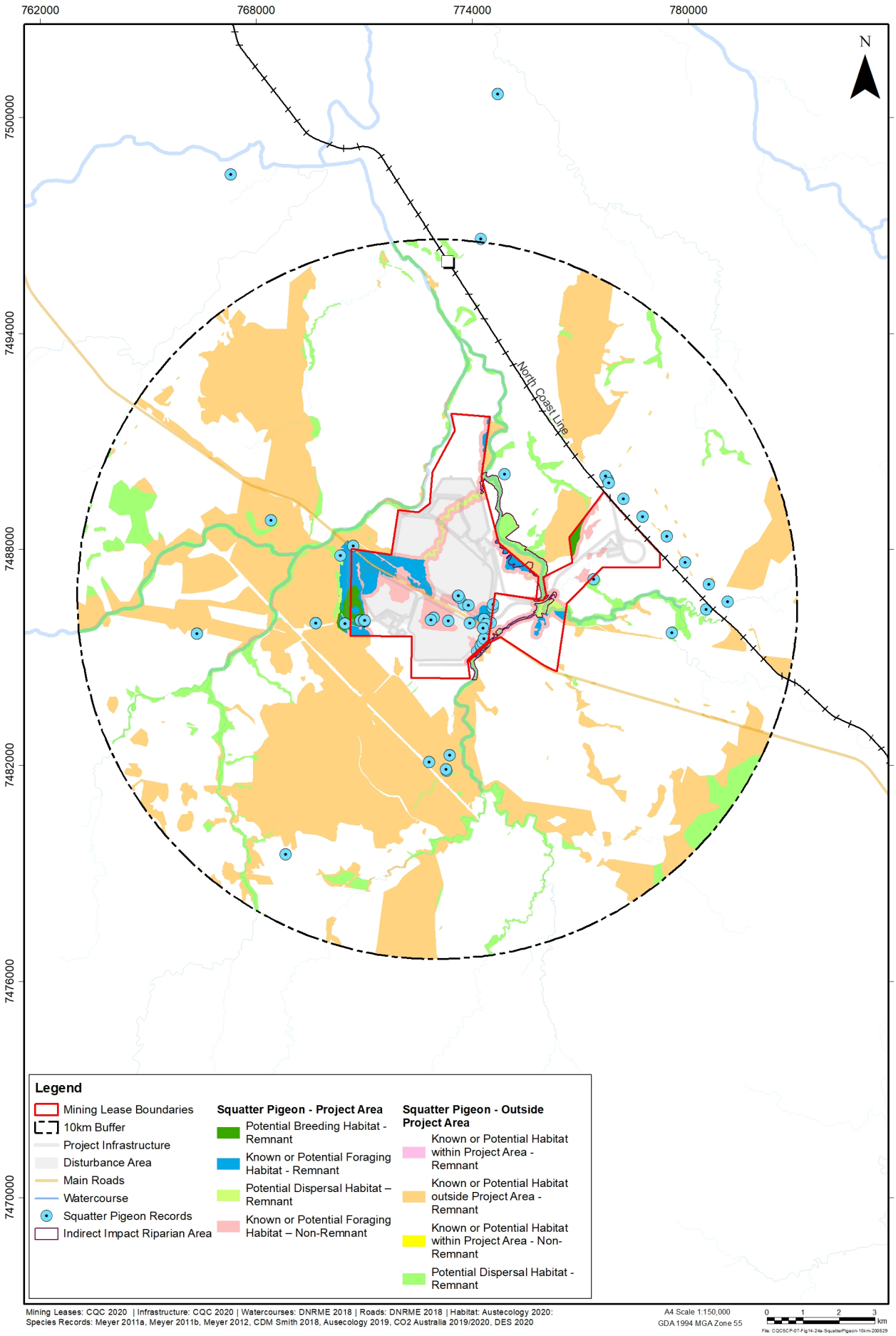


Figure 14-29: Squatter pigeon (southern) habitat within 10 km of the Project Site

14.3.9.5.5 Short-beaked Echidna

NC Act – SL

The short-beaked echidna is Australia's most widespread native mammal, occurring in almost all terrestrial habitats except for intensively managed farms (Augee and Gooden 1993 and Augee 2008). Areas which are known to have high densities of echidnas are all areas with abundant fallen and dead trees (decaying tree stumps and hollow logs provide sources of termites). Scats and diggings attributable to this species were encountered on most survey events. Several individuals were recorded on remote cameras south of the Project Site from September to December 2017. The species is likely to occur within eucalypt and acacia woodlands throughout the wider area. Short-beaked echidnas are killed by cats, dingoes, dogs and motor vehicles. In Queensland, there is no conservation plan prepared for the short-beaked echidna.

14.3.9.5.6 Fork-tailed Swift

NC Act – SL, EPBC Act – M

The fork-tailed swift occurs throughout most of Australia. The fork-tailed swift occupies a broad range of habitat types. In Australia they predominantly occur over dry or open habitats and inland plains, but also above foothills or in coastal areas, over settled areas, treeless grasslands, sandplains with spinifex, open farmland, sand dunes, rainforests, wet sclerophyll forest or open forest or plantations of pines (DAWE 2020c).

DE (2015b) regard 'important habitat' as '*Non-breeding habitat only: Found across a range of habitats, from inland open plains to wooded areas, where it is exclusively aerial.*' There are large wooded areas of habitat which are consistent with the description of important habitat located to the west of the Project Site description. There is no habitat within the Project Site consistent with the with the definition of important habitat.

Fork-tailed swift was recorded within EPC 1029 during survey events in March 2011 and February 2012, although location is unknown. As a wide-ranging aerial species, the fork-tailed swift could occur over any part of the Project Area during the non-breeding season. Meyer (2011) identified that there was suitable foraging habitat for this species over much of EPC 1029.

There are no significant threats to the fork-tailed swift in Australia (DAWE 2020c). Due to the wide range of the species the potential impacts are thought to be negligible.

14.3.9.5.7 Glossy Ibis

NC Act – SL, EPBC Act – M

Foraging and breeding habitat for the glossy ibis includes freshwater marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (DAWE 2020t). It is also occasionally observed in coastal locations including estuaries, deltas, saltmarshes and coastal lagoons. It breeds in dense colonies, from mid-spring to the end of summer, often with other species of ibis and waterbirds (Marchant and Higgins 1990).

The glossy ibis is a migratory and nomadic species occurring throughout the northern hemisphere and over much of Australia. 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 (DAWE 2020t). The species is known to move north in autumn and return to the main breeding areas in spring and summer.

The glossy ibis was recorded to the north-east of the Project Site on a brackish swamp during the September 2011 survey (to the north-east of EPC 1029). The Project Site and Near Surrounds are likely to provide suitable foraging habitat for the species, particularly following heavy rainfall.

The main threat to glossy ibis is wetland destruction or degradation through water diversion, drainage, irrigation and hydroelectric power production (DAWE 2020t). Other threats include modification of habitat through clearing, grazing, burning, increased salinity, groundwater extraction and invasion by exotic plants and fish. There is no adopted or made Recovery Plan for this species, and no Threat Abatement Plan has been identified as being relevant for this species (DAWE 2020t).

14.3.9.5.8 Lathams Snipe

NC Act – SL, EPBC Act – M and Migratory Shorebird

Latham's snipe typically inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies, though can also occur on wetland habitat with saline or brackish water, in modified or artificial habitats (e.g. farm dams), and in habitats located close to humans or human activity (Frith et al. 1977 and Higgins and Davies 1996).

Latham's snipe has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia (Geering et al. 2008). Most birds spend the non-breeding period at sites located south of the Richmond River in New South Wales, with few (if any) remaining in northern Australia over the austral summer (Frith et al. 1977; Higgins & Davies 1996).

Latham's snipe was recorded at a single farm dam within the Project Site in February 2017 (Figure 14-22). Several visits to the site were made to ascertain the number of individuals present and up to 15 individuals were recorded. A single individual was also observed at a large dam to the south of Project in September 2017. Individuals were also recorded on farm dams in the wider area in September 2017 and January 2018. Suitable habitat may be abundant (as both natural or man-made wetlands (farm dams) within and around the Project Site following heavy rains.

Broad Sound encompasses the Broad Sound Important Bird Area (IBA), an area of approximately 119,420 ha of marine, estuarine and freshwater wetlands, and including extensive areas of suitable habitat for Latham's snipe, e.g. the Torilla Plain (BirdLife International 2020). BirdLife International (2020) estimates the population of Latham's snipe in Broad Sound to be between 206-500, and as a result, is regarded as one of six species populations of IBA trigger species. Further to the east, are the Shoalwater Bay IBA, and Shoalwater and Corio Bays Area Ramsar Site (wetland of international importance). Both the IBAs and the Ramsar wetland site are known to support Latham's snipe, though have not been comprehensively surveyed to develop population estimates (BMT WBM 2010).

The ongoing key threat to Latham's snipe in Australia is the loss of habitat caused by drainage and modifications to wetlands (DAWE 2020a). There are currently no other known major threats to the species in Australia.

14.3.9.5.9 Oriental Cuckoo

NC Act – SL, EPBC Act – M

The oriental cuckoo has broad habitat requirements and occurs in a range of environments including rainforest, vine thickets, wet sclerophyll forest and open forest and woodland (Higgins 1999). The species may also occur in relatively cleared areas such as leafy trees in paddocks (Pizzey and Knight 2012). DE (2015b) regard 'important habitat' as '*Non-breeding habitat only: monsoonal rainforest,*

vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands. Frequently at edges or ecotones between habitat types. Riparian forest is favoured habitat in the Kimberley region.'

In Australia the oriental cuckoo is known to occur throughout northern and eastern Australia. It is widespread but sparsely recorded across eastern Queensland in the summer months (September to May).

A single record of this species was recorded 1.3 km east of the Project Site during the March 2011 survey (Figure 14-22). Oriental cuckoo may be an occasional visitor to denser woodlands in the area, such as riverine and adjacent woodland. Potentially suitable habitat occurs in denser and wider sections of riparian vegetation along Deep Creek. Potentially this species could occur within such habitat, though unlikely to be resident. There is potentially suitable habitat along Tooloombah Creek and within the Tooloombah Creek Conservation Park. Given the extent of potentially suitable habitat within Tooloombah Creek Conservation Park, the species may be resident there. There is a higher likelihood for occurrence within potentially suitable habitats during passage migration periods.

There are no threats listed for this species. There is no adopted or made Recovery Plan for this species, and no Threat Abatement Plan has been identified as being relevant for this species. DEE (2017a) does not list any invasive species harmful to oriental cuckoos.

14.3.9.5.10 Rufous Fantail

NC Act – SL, EPBC Act – M

The rufous fantail occurs in coastal and near coastal districts of northern and eastern Australia (Higgins et al. 2006). 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). In the northern part of its distribution, rufous fantails often occur in tropical rainforest and monsoon rainforests, including semi-evergreen mesophyll vine forests, semi-deciduous vine thickets or thickets of Paperbarks (*Melaleuca* spp.) (Higgins et al. 2006).

DE (2015b) regard 'important habitat' as '*Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands*'.

The rufous fantail occurs in coastal and near coastal districts of northern and eastern Australia (Higgins et al. 2006). Globally they are considered a common and secure species (DAWE 2020d).

A single record of this species was recorded during the March 2011 survey of the broader area, although the location is unknown. There are no other records of the species for any of the other survey events. Within the Project Site and Near Surrounds, potentially suitable habitat occurs in denser and wider sections of riparian vegetation along Deep Creek. Potentially this species could occur within such habitat, though unlikely to be resident. There is also potentially suitable habitat along Tooloombah Creek. There is a higher likelihood for occurrence within potentially suitable habitats during passage migration periods.

The key threat to rufous fantail is land clearing and urbanisation which results in the fragmentation and loss of core moist forest breeding habitat particularly remnant vegetation along migration routes (DAWE 2020d). DEE (2017a) regards the black rat (*Rattus rattus*) and invasive vines of riparian habitat (e.g. rubber vine) as invasive species' harmful to the rufous fantail. There is no adopted or

made Recovery Plan for this species, and no Threat Abatement Plan has been identified as being relevant for this species (DAWE 2020d).

14.3.9.5.11 White-throated Needletail

NC Act – V[25], EPBC Act – V[25],M

The white-throated needletail is a large swift, almost exclusively aerial. Whilst the species has been recorded over most types of habitat (remnant, non-remnant, urban, pastures, etc.), they are thought to be more regularly recorded above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy (Higgins 1999).

DE (2015b) regard 'important habitat' as *'Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites*'.

The white-throated needletail is widespread over eastern and south-eastern Australia during the warmer months. The global population of the white-throated needletail is unknown, however, it is not considered to be globally threatened (DAWE 2020b).

White-throated needletail was recorded approximately 3.5 km south of the Project Site in November 2017 (Figure 14-22). Habitat consistent with the description for the species is located to the west of the Project Site.

In 2019 the white-throated needletail was listed as Vulnerable under the EPBC Act and NC Act. The Conservation Advice for the species lists threats as collision with wind turbines, overhead wires, windows and lighthouses (TSSC 2019), but the scale of these impacts at the population level is unknown. Other threats listed include the use of insecticides which may decrease the abundance of invertebrates, or from secondary poisoning from ingestion of prey. The loss of roosting sites in Australia may also contribute to the decline of the species (TSSC 2019).

14.3.9.6 Species Known or Likely to Occur (Downstream)

Based on the likelihood assessment and as listed in Table 14-15, a total of 24 bird species listed under the NC Act and/or EPBC Act have been identified as known or likely to occur in the downstream environment. Of these, 16 are migratory shorebirds.

Table 14-15: Summary of listed species known or likely to occur (downstream)

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act	EPBC Act					
Australian painted snipe	E	E		x	x		
Bar-tailed godwit (baueri)	V	V,M	x	x	x	x	x
Beach stone-curlew	V			x		x	
Caspian tern	SL	M		x		x	x
Common greenshank	SL	M	x	x		x	
Crested tern	SL	M		x		x	
Curlew sandpiper	E	CE,M	x	x	x	x	
Eastern curlew	E	CE,M	x	x	x	x	x

[25] In 2019 the white-throated needletail was listed as Vulnerable under the EPBC Act and NC Act, adding to its existing listing as Migratory under the EPBC Act.

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act	EPBC Act					
Eastern osprey	SL	M			x	x	
Great knot	E	CE,M	x	x	x	x	
Greater sand plover	V	V,M	x	x		x	
Grey plover	SL	M	x	x		x	
Grey-tailed tattler	SL	M	x	x		x	
Gull-billed tern	SL	M		x		x	x
Latham's snipe	SL	M	x	x	x	x	x
Lesser sand plover	E	E,M	x	x		x	
Little tern	SL	M		x	x	x	
Marsh sandpiper	SL	M	x	x		x	
Red knot	E	E,M	x	x			
Red-necked stint	SL	M	x	x		x	
Sharp-tailed sandpiper	SL	M	x	x	x[11]	x	
Terek sandpiper	SL	M	x	x		x	
Whimbrel	SL	M	x	x	x	x	x
Yellow chat	E	CE		x	x		

14.3.9.7 Species for which Further Information was Requested

14.3.9.7.1 Red Goshawk

The DAWE (formerly DEE) submitted a request for further information regarding the potential occurrence of red goshawk, or suitable habitat for the species, in the Project Site or Surrounds. The following information addresses this request.

Habitat

The red goshawk occurs in a variety of woodland or forest types, most frequently in riverine forests. They generally do not occur in dense forests such as rainforest or wet sclerophyll forests. Red goshawk prefer areas with a patchwork or mosaic of woodland / forest types and the presence of water considered to be an important factor (Debus and Czechura 1988).

Species Occurrence in the Wider Area

As illustrated in Figure 14-30, the closest red goshawk record to the Project Site is from 1999 and is located 17 km to the north-west of the Project (ALA 2018). Figure 14-30 also depicts other records from the Project Area (post 1950 records only). There are no records within the Project Area since 2001. The nearest recent records to the Project Site are located 440 km south-east at Hervey Bay (2005 record). The closest recent records to the north are several records from the Mission Beach area (640 km north-west of the Project) (eBird 2018).

Project Survey Intensity

CDM Smith undertook bird surveys and nest searches throughout 2017 and January 2018 as part of targeted ecology surveys along Deep Creek and Tooloombah Creek. The Commonwealth's Survey guidelines for Australia's threatened birds (DEWHA 2010a) recommends 80 hours of area searches

over ten days to locate nest sites (including by use of vehicle). CDM Smith's overall survey effort is considered to have exceeded the guideline survey effort comprising the following:

- Timed bird surveys (20 min) comprising 115 surveys (approximately 38.5 hours) carried out over the Project Site and surrounding areas including dams, wetland areas and creek lines.
- Opportunistic vehicle-based surveys undertaken throughout the Project Site and surrounds (up to a 10 km radius of the Project Site). Based on two hours per day travelling between survey sites (fauna, flora and water quality sampling) over 30 days (approximately 60 hours in total).
- Raptor nest searches were carried out in riparian and adjacent habitat in conjunction with, locations for habitat suitability assessments, water quality sampling along Deep Creek and Tooloombah Creek, and opportunistically during driving across the wider area throughout the surveys.

The species was not observed despite the overall survey effort. The only active raptor nest observed was that of a brown falcon (*Falco berigora*) located in open grazing lands north of the Bruce Highway. No raptor nest sites were observed in the vicinity of the major creek lines in the area.

Habitat Availability

The Project Site is predominantly cleared. Suitable nesting habitat is likely to be restricted to forest red gum communities (RE 11.3.25 and RE 11.3.4) which comprises emergent tall eucalypts along, or adjacent to creek lines (refer Figure 14-31). However, much of this habitat, particularly north of the Bruce Highway which bisects the mine area, occurs as narrow lines of riparian vegetation surrounded by cleared habitat. Given the species prefers continuous forest it is considered unlikely the species would utilise these areas for nesting.

More suitable habitat occurs to the south of the Project Site where foraging habitat, which may be considered as virtually all woodlands, and open forest containing forest birds in the area, is contiguous with riparian vegetation. The species has large home range requirements. The patchy nature of the remnant vegetation in the area immediately surrounding the Project (Figure 14-31) appears less suitable for the occurrence of the species compared to the continuous forests located in the ranges to the west.

Species Potential to Occur

Given the lack of any recent records of the species in the region, the lack of any record of the species in the area despite abundant survey effort for the Project over a substantial period of time, and the limited habitat availability with the Project Site, as per the classification categories described in Section 14.2.3, whilst there is potential for this species to occur, it is not considered likely. Significant impact assessments have been restricted to species which are known or likely to occur and as such no further assessment has been carried out for red goshawk.

14.3.9.7.2 Collared Delma

The DAWE (formerly DEE) submitted a request for further information regarding the potential occurrence of collared delma, and the suitability of habitat for the species, in the Project Site or surrounds. The following information addresses this request and includes information from the 2020 MNES and MSES Fauna Supplementary Impact Assessments (see Appendix 9d).

Habitat

The collared delma is endemic to Queensland, with highly restricted, disjunct populations extending from the outer Brisbane western suburbs north to near Blackwater (Blackdown Tablelands National

Park) and west to Roma, central Queensland. The collared delma is regarded as a cryptic reptile, typically associated with rocky sloped or ridge-top areas, often westerly-facing, in eucalypt and acacia dominated woodland with ground cover comprising native grasses, thick leaf litter, and an abundance of loose surface rocks. The Draft referral guidelines (DSEWPaC 2011a) describes 'suitable habitat' for collared delma as: 'Open-forests, woodlands and adjacent exposed rocky areas on Land Zones 3, 9 and 10.'

Species Occurrence in the Wider Area

The nearest known ALA database records for the collared delma are 145 km to the south-east of the Project Site at Ulam (1974) (south of Rockhampton) and 130 km south-west from the Blackdown Tableland National Park (1997). Figure 14-32 shows these records in relation to the Project Site. There are no records to the west of the Project. Mapping of the species potential occurrence by ALA and DAWE (2020u) indicates the Project Site is at the northern edge of its potential range. As illustrated on Figure 14-32, the south-western extent of the Project Site is within the 'species or species habitat may occur' modelled distribution (DAWE 2020u). The closest area mapped as 'species or species habitat likely to occur' is the Blackdown Tableland National Park.

Project Survey Intensity

The overall Project survey effort for collared delma included the following:

- Diurnal active habitat searches – including searches for burrows, under leaf litter and logs, rocks, cave and crevices. Approximately 42 hours of searches over approximately 42 ha were conducted over a total of 20 days.
- Pitfall / funnel trapping - no pitfall trapping was possible in March 2011 due to wet conditions. Trapping carried out at eight sites comprising 32 trap nights (four sites each in September 2011 and February 2017).

Survey Results and Habitat Availability

The collared delma has not been recorded within the Project Site or Near Surrounds. Target surveys were implemented in what was considered to be potentially suitable habitat within the elevated areas of Mamelon Station. Habitat suitability assessments across the Project Site demonstrate that land zone 3 habitats do not support suitable conditions or resources for collared delma (L. Agnew & E. Meyer, December 2019, unpub. data). There is no habitat which occurs on land zone 9 within the Project Site. Since the submission of SEIS v2, the southern boundary of ML 80187 has been contracted north to avoid impacts on vegetation in the southern areas, and as such there is no longer any habitat which occurs on land zone 10 within the Project Site. Consequently, there is no suitable habitat for the species within the Project Site.

Figure 14-33 describes the extent of potentially suitable habitat for the collared delma near the Project Site. The nearest potentially suitable habitat occurs approximately 1 km to the south and south-west of the Project Site in RE 11.10.7.

Species Potential to Occur

Table 14-13 there is considered potential for the collared delma to occur within habitat to the south of the Project Site, however, it is considered unlikely that the species would occur within the Project Site itself given there is no suitable habitat present. Significant impact assessments have been restricted to species which are known or likely to occur and as such no further assessment has been carried out for collared delma.

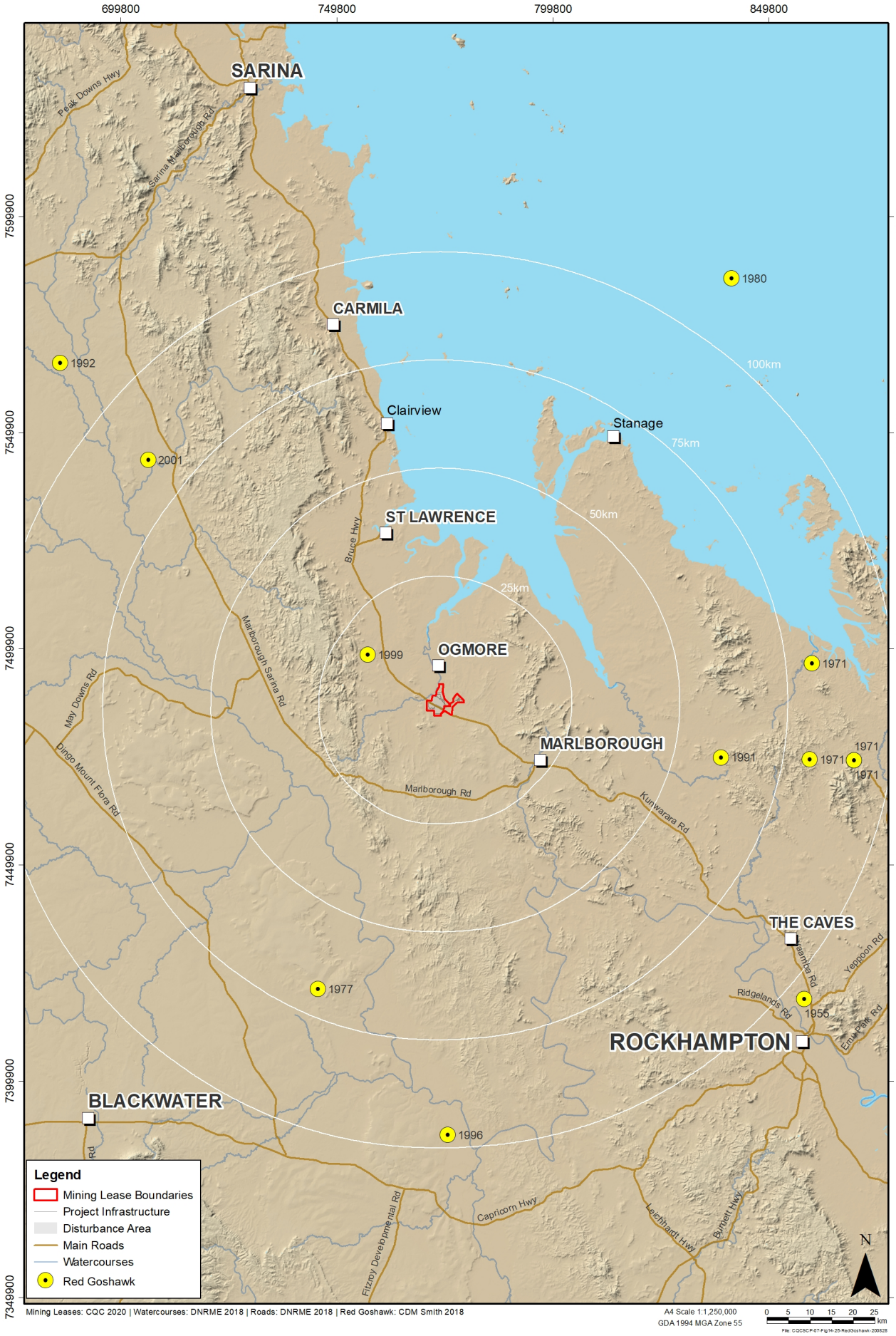


Figure 14-30: Red goshawk database records from the wider area

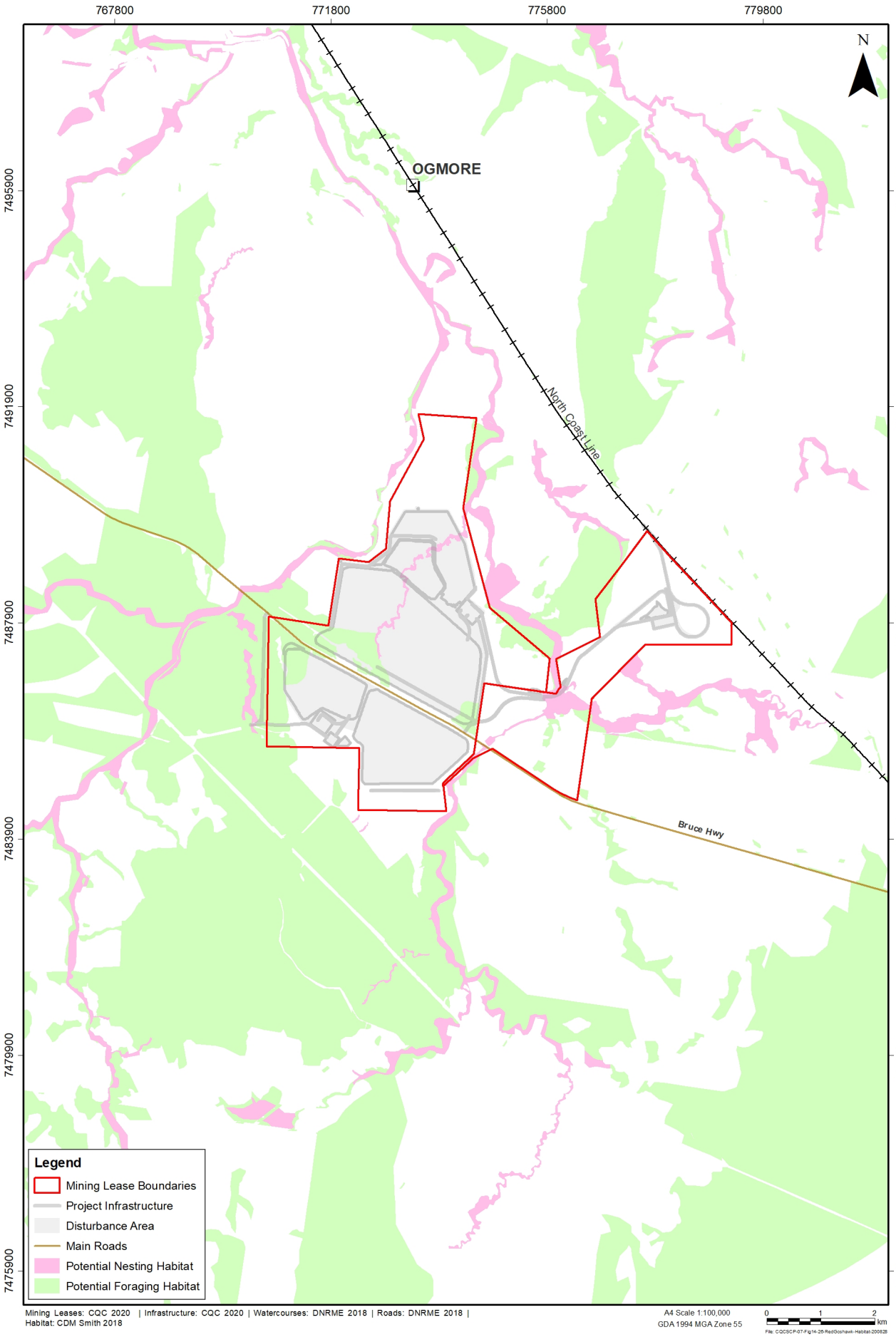


Figure 14-31: Red goshawk potential foraging and nesting habitat

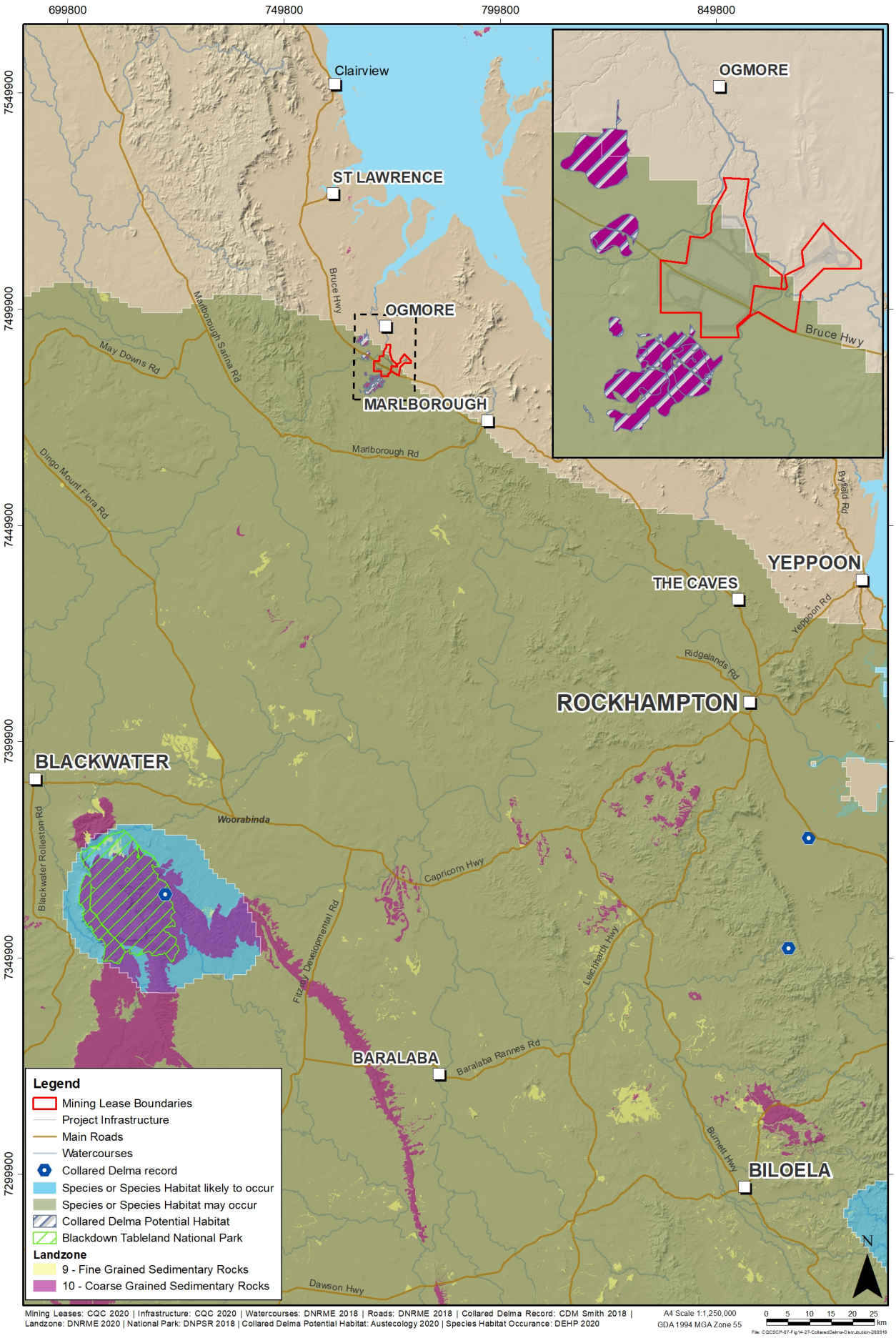


Figure 14-32: Collared delma modelled distribution and species records

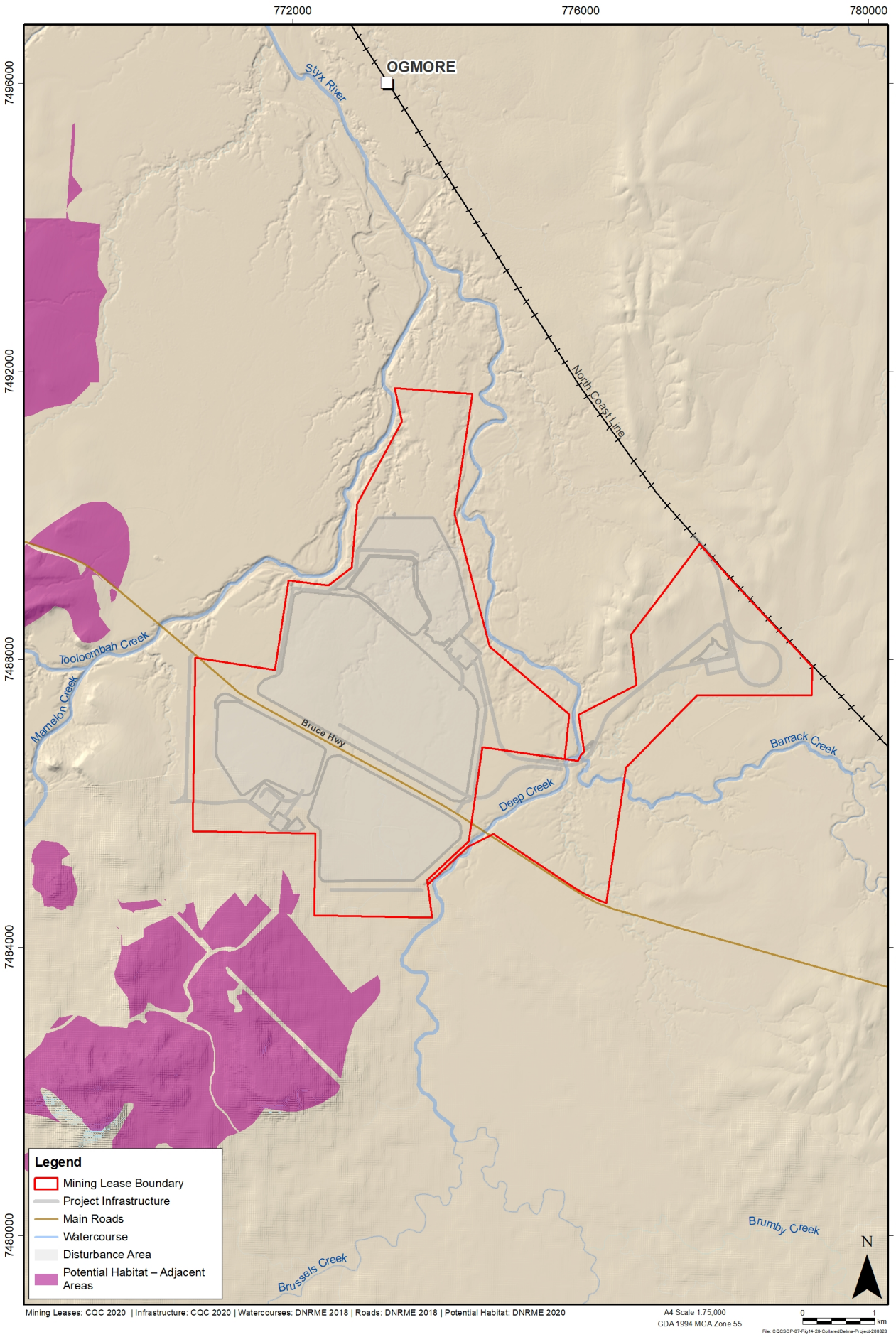


Figure 14-33: Collared delma potential habitat near the Project Site

14.3.10 Pest Animals

Database searches identified 15 introduced fauna species known to occur, or with the potential to occur within the search area (DSITIA 2020, DEE 2020). Five of these species are also listed as Restricted Matters under the Biosecurity Act (Table 14-16). Field surveys since 2011 have regularly recorded a variety of introduced fauna including cats, dogs, pigs, house mouse, rabbits, cane toad, and common myna (Meyer 2011a 2011b, 2012; CDM Smith 2018; Austecology 2020a).

Table 14-16: Introduced fauna species

Species Name	Common Name	WO	PMST	Biosecurity Act Category
Acridotheres tristis	Common myna	x[26]	x	
Bos taurus	Domestic Cattle	x	x	
Canis lupus familiaris	Dog	x		Category 3, 4, 6
Cervus timorensis	Rusa deer	x[26]		Category 3, 4, 6
Columbia livia	Rock pigeon		x	
Felis catus	Cat	x	x	Category 3, 4, 6
Lepus europaeus	European brown hare	x[26]		
Lonchura punctulata	Nutmeg mannikin		x	
Mus musculus	House mouse		x	
Oryctolagus cuniculus	Rabbit	x	x	Category 3, 4, 5, 6
Passer domesticus	House sparrow	x	x	
Rhinella marina	Cane toad	x	x	
Streptopelia chinensis	Spotted turtle-dove	x	x	
Sus scrofa	Pig	x		Category 3, 4, 6
Vulpes vulpes	Red fox		x	

14.3.11 MNES and MSES

Based on the analyses provided in the preceding sections, a summary of all terrestrial MNES and MSES applicable to the Project is presented in Table 14-17.

Table 14-17: Summary of terrestrial MNES and MSES and applicability to the Project

Description	Project Applicability
MNES	
Listed threatened species under the EPBC Act	As described in Section 14.3.9.5 the Project Site and Near Surrounds are known or likely to contain habitat for five species listed as vulnerable under the EPBC Act. As described in Section 14.3.9.6 the downstream environment is known or likely to contain habitat for nine species listed as critically endangered, endangered or vulnerable under the EPBC Act.
Threatened ecological communities under the EPBC Act	Two endangered TEC are located within the Project Site and Near Surrounds - Brigalow TEC and SEVT TEC.

[26] Not identified in the 2016 wildlife online search, however, was identified in the 2020 search

Description	Project Applicability
Listed migratory species under the EPBC Act	As described in Section 14.3.9.5 the Project Site and Near Surrounds are known or likely to contain habitat for six species listed as migratory under the EPBC Act. As described in Section 14.3.9.6 the downstream environment is known or likely to contain habitat for 21 species listed as migratory under the EPBC Act.
MSES	
RE that are endangered or of concern	As illustrated in Figure 14-34, the Project Site and Near Surrounds includes the following four RE which are endangered or of concern: Of Concern RE 11.3.4, Of Concern RE 11.4.2, Endangered RE 11.3.11 and Endangered RE 11.4.9.
RE that intersect with an area shown as a wetland on the vegetation management wetlands map	As illustrated in Figure 14-35, the Project Site and Near Surrounds includes the following RE which intersect a wetland on the vegetation management wetlands map: Least Concern RE 11.3.27 and Least Concern RE 11.3.12.
RE that is an area of essential habitat for endangered or vulnerable plants or animals	As illustrated in Figure 14-20, the Project Site and Near Surrounds includes RE which are essential habitat for vulnerable animals including greater glider, koala, ornamental Snake and squatter pigeon.
RE located within a defined distance of a relevant watercourse	As illustrated in Figure 14-36, the Project Site and Near Surrounds includes the following RE located within a defined distance of a watercourse: RE 11.3.25, RE 11.3.4, RE 11.4.2 and RE 11.3.35.
RE that contains a connectivity area	The layout of the Project and its potential impact on connectivity were assessed using DES' 'Landscape Fragmentation and Connectivity' tool. The results of the assessment indicate no significant impact to connectivity is expected.
Designated precinct, in a strategic environmental area	The Project Site and Near Surrounds are not located within a strategic environmental area. The nearest strategic environmental area is located approximately 435 km to the south-east of the Project (Fraser Island).
Plants that are endangered or vulnerable under the NC Act	The Project Site does not intersect any area considered to be 'high risk' under the flora survey trigger mapping (Figure 14-16). An area mapped as 'high risk' occurs approximately 1 km directly north of the Project. No currently threatened flora species were recorded within the Study Area during field surveys.
A koala habitat area as defined under the Nature Conservation (Koala) Conservation Plan 2017, section 7B(1)	The Project will not result in a significant residual impact on koala habitat as defined under the Nature Conservation (Koala) Conservation Plan 2017, section 7B(1).
Habitat for an animal that is listed as endangered, vulnerable or special least concern as per the NC Act	As described in Section 14.3.9.5 the Project Site and Near Surrounds are known or likely to contain habitat for 11 species listed as either vulnerable or special least concern under the NC Act. As described in Section 14.3.9.6 the downstream environment is known or likely to contain habitat for 24 species listed as endangered, vulnerable or special least concern under the NC Act.
Any protected area under the NC Act	The nearest protected area to the Project Site is Tooloombah Creek Conservation Park located approximately 1 km to the east.
Any legally secured offset area	There are no legally secured offset areas located within the Project Site and Near Surrounds.

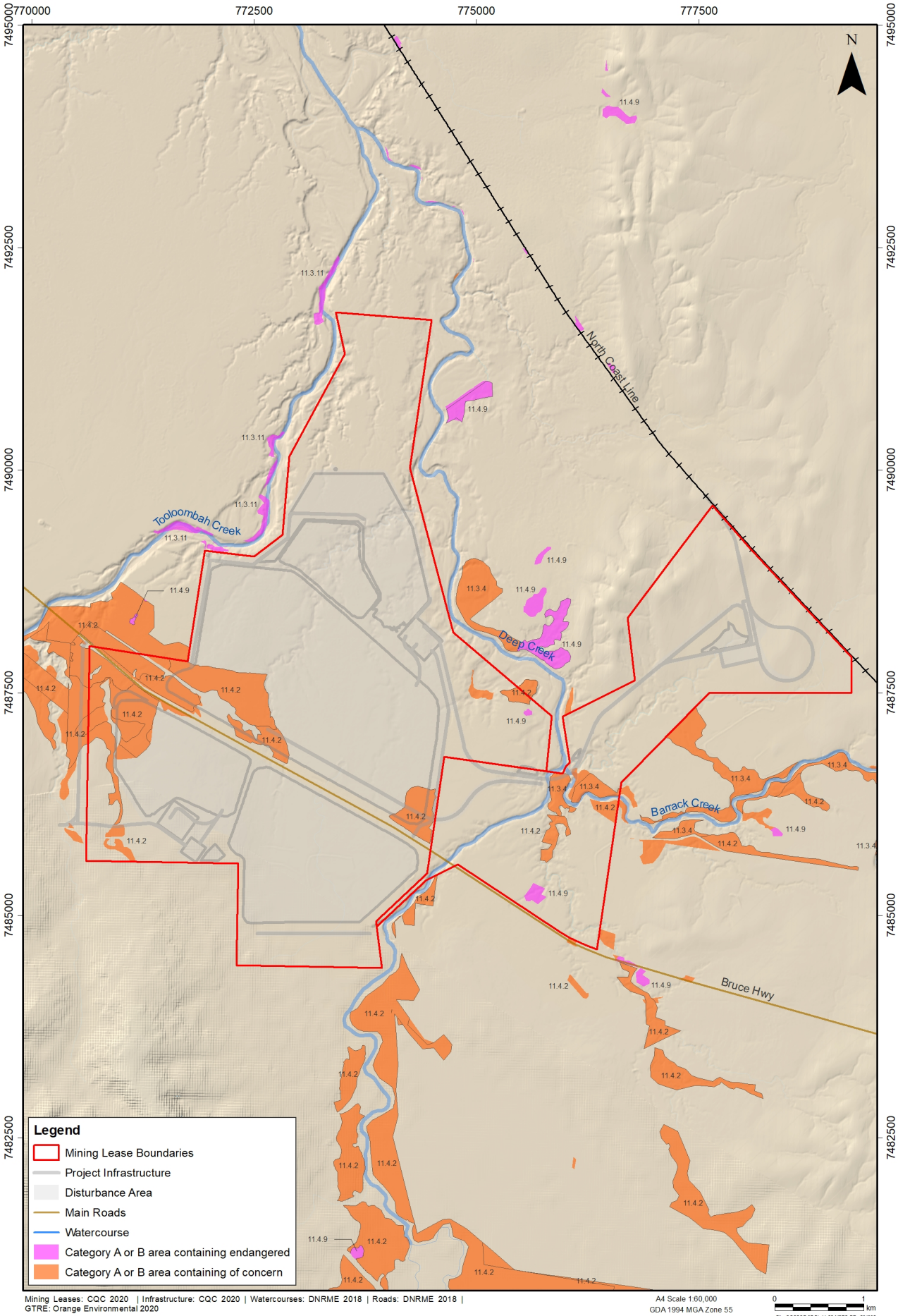


Figure 14-34: MSES - Endangered or of concern RE

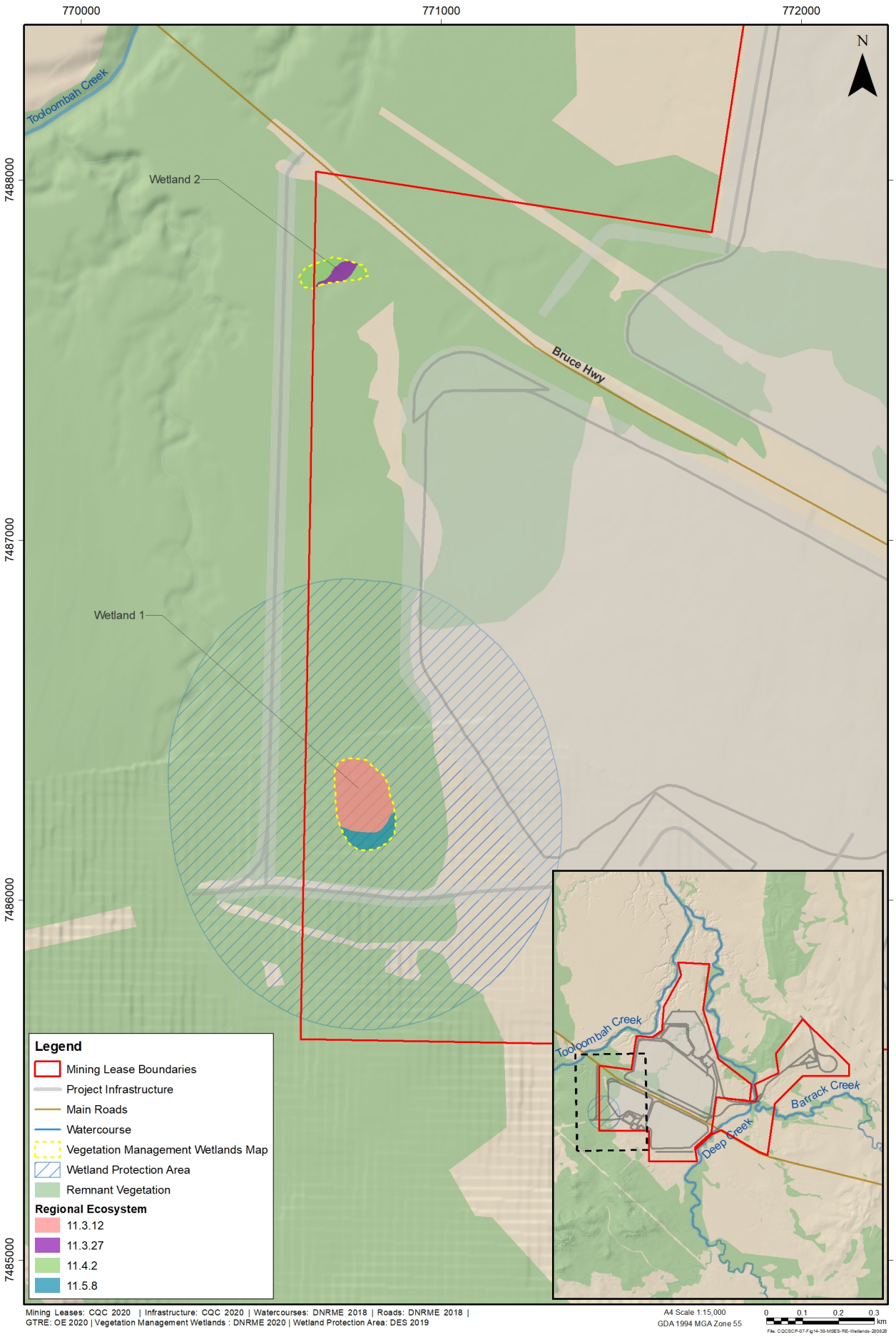


Figure 14-35: MSES – RE intersecting a wetland on the vegetation management wetlands map

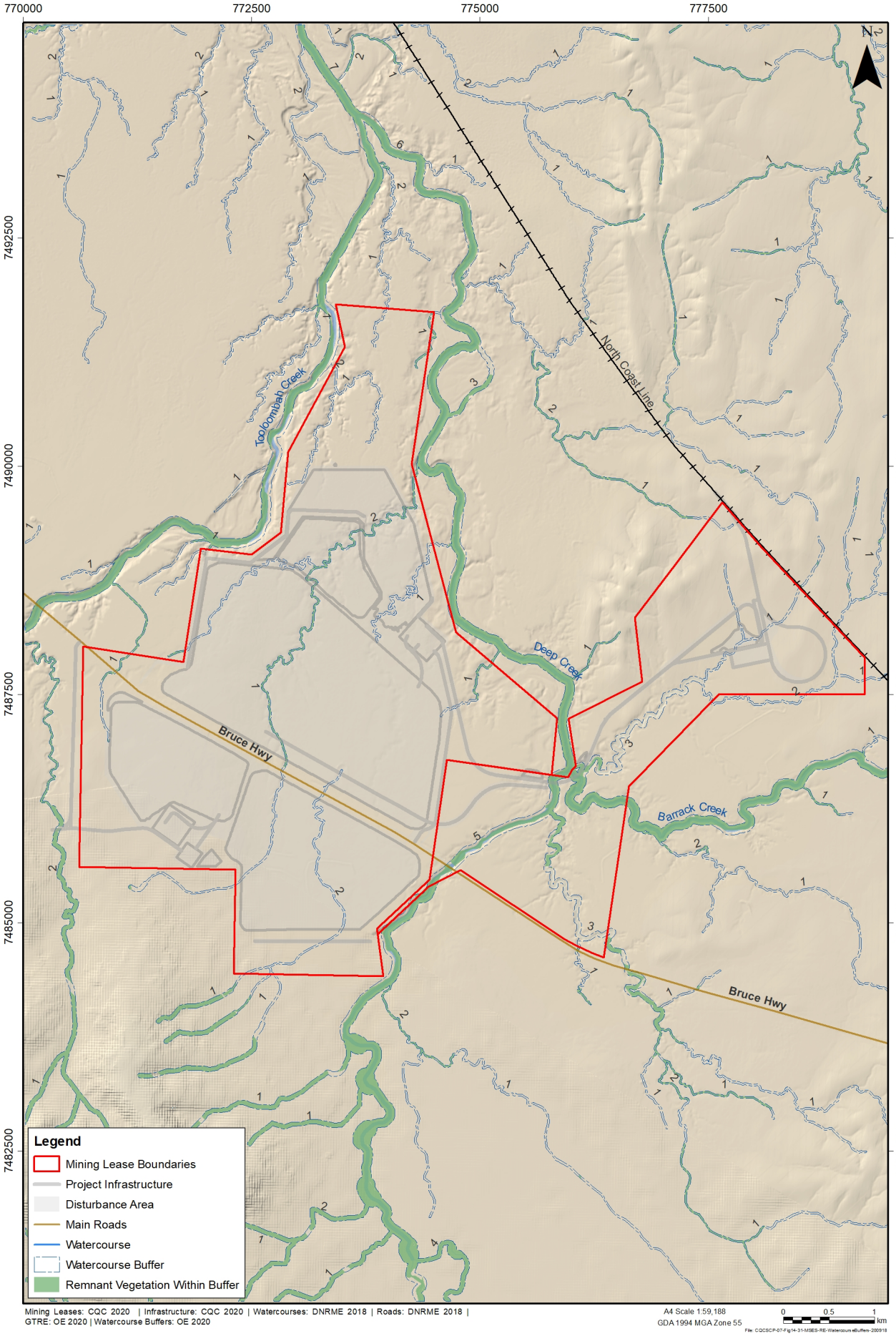


Figure 14-36: MSES – RE located within a defined distance of a watercourse

14.4 Potential Impacts of the Project

The Project has the potential to result in direct and indirect impacts on terrestrial vegetation, flora and fauna values described in the preceding sections as a result of:

- direct clearing of vegetation
- loss of connectivity due to Project infrastructure
- groundwater drawdown
- surface water changes
- erosion of stream banks
- increased dust, noise and lighting
- increased traffic and transport
- increased abundance or diversity of pests and weeds and
- increased fire risk.

The following sections provide a discussion of these potential impacts, how they can impact terrestrial ecological values and the potential for these impacts to arise as a result of the Project.

14.4.1 Vegetation Clearing

The Project has been designed to avoid the clearing of remnant vegetation to the greatest extent possible. The total Disturbance Area, over the period 2021 to 2031 is 1,372.50 ha with the majority of the area mapped as non-remnant vegetation (1,231.13 ha) which has previously been cleared for grazing. Despite all efforts to avoid the clearing of remnant vegetation, the loss of some vegetation within the Project Site is unavoidable during the construction phase of the Project. The total area of remnant vegetation to be cleared comprises 141.37 ha.

Vegetation clearing activities will be staged and will occur on an as needed basis to coincide with construction requirements, and to minimise the extent and duration of cleared areas at any one time. The clearing for the initial Open Cut 2 pit and construction of the initial Coal Handling and Preparation Plant (CHPP), the haul road and Train Loadout Facility (TLF) and associated mine infrastructure located on the east of the Bruce Highway is planned to commence simultaneously in 2021 and will continue into 2022. Clearing for the initial Open Cut 1 pit and associated infrastructure construction will commence in approximately 2029 and will continue into 2031.

14.4.2 Loss of 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. As illustrated in Figure 14-37, the mine area presently consists of a mosaic of predominantly cleared grazing land, areas of regrowth vegetation 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. Lands to the immediate east of the Project Site are largely cleared. A relatively continuous tract of vegetation extending in a north-south orientation, and which includes Tooloombah Creek Conservation Park, is located to the immediate west of the Project Site and is not impacted by the Project.

The haul road has the potential to reduce north-south remnant habitat connectivity along Deep Creek. 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 with 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. As such, impacts to habitat connectivity because of the Project are considered to be minor.

In addition, the layout of the Project and its potential impact on connectivity were assessed using DES 'Landscape Fragmentation and Connectivity' tool. The results of the assessment indicate that there will be no significant impact to connectivity.

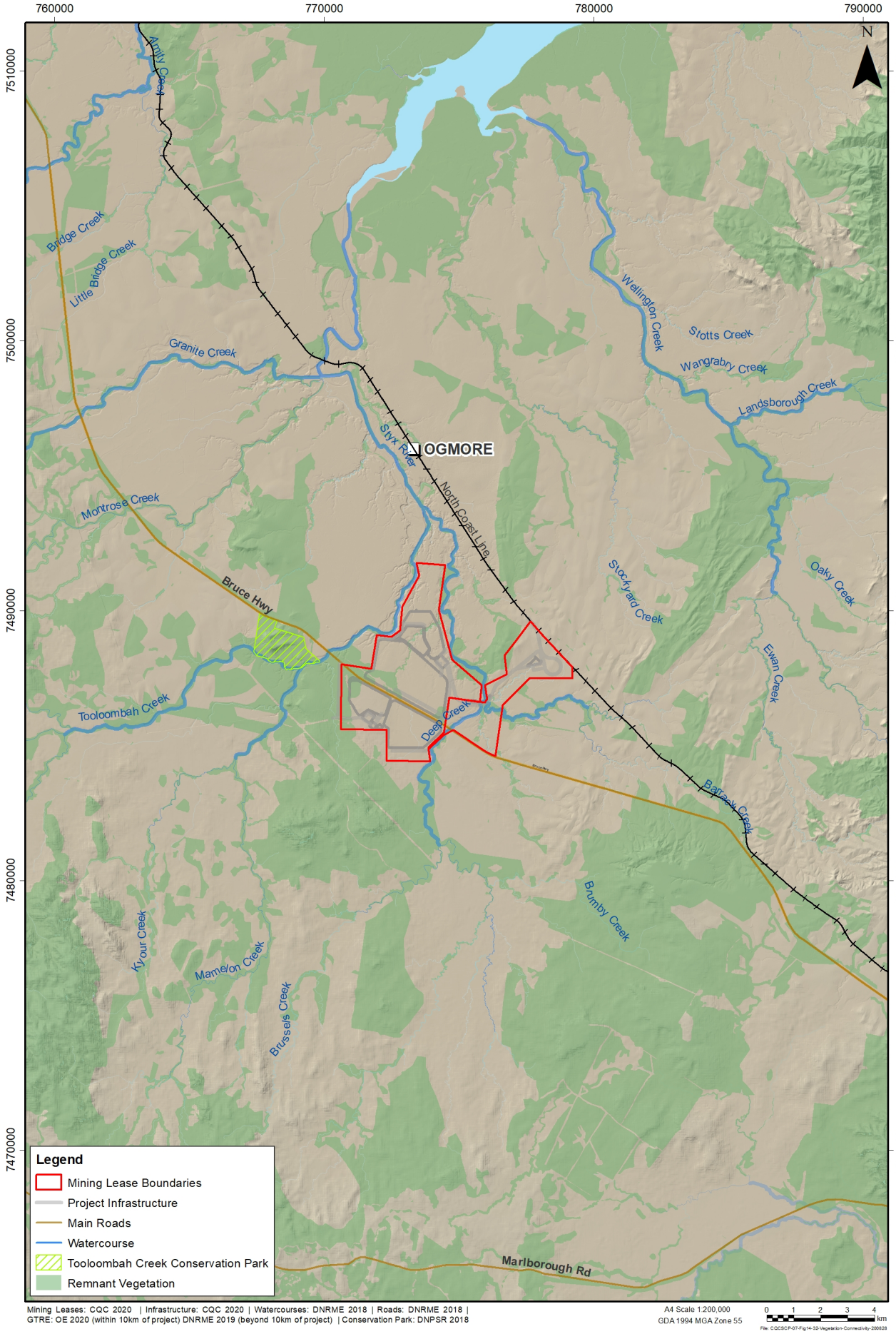


Figure 14-37: Vegetation connectivity within the Project Site and surrounds

14.4.3 Groundwater Drawdown

Mine dewatering and depressurisation will result in groundwater drawdown near the mine and extending below parts of Deep, Tooloombah, Barrack and Mamelon Creeks. Pit progression and associated groundwater drawdown will move in a south-easterly direction, and drawdown will extend to beneath Tooloombah Creek within the first three years of operation. Drawdown will not extend below Deep Creek until three to five years after Project commencement. Within the water table aquifer the model predicts water levels will fall by a maximum of approximately 60 m beneath Deep Creek, and 4.7 m below Tooloombah Creek and Barrack Creek. Groundwater drawdown is not predicted to occur beneath the Styx River and therefore loss of potential baseflow in downstream areas is not considered to be a potential impact of the Project.

Groundwater drawdown can potentially impact terrestrial values through reduction in water availability and alterations to water quality. Groundwater drawdown has the potential to reduce connectivity along waterways, causing streams to dry up faster during dry periods than occurs under baseline conditions.

There is the potential for loss of baseflow / enhanced leakage from reduced groundwater inflows into pools (Aquatic GDEs) which may be important water resources for terrestrial fauna in dry periods. This could pose a threat to koalas during heatwaves and / or periods of drought, when animals require access to free-standing water in order to maintain water balance (Mella et al. 2019).

A reduction in surface water availability could force koalas to travel more widely in search of drinking water, potentially increasing their exposure to predators, especially if animals are forced to travel over land in search of water (as is likely in areas with sparse and / or patchy tree cover). With less available drinking water, predators may also be concentrated around sources of drinking water used by koalas, potentially increasing the risk of predation (Mella et al. 2019). As a granivore, squatter pigeons drink daily (Frith 1982), thus surface water represents a key component of habitat critical to the survival of the squatter pigeon.

Drawdown of groundwater may affect a Terrestrial GDEs ability to access groundwater causing water stress (Andersen et al. 2016). The resulting water deficit / stress could lead to increased leaf abscission and, under extreme conditions, tree mortality as well due to cavitation or air bubble formation in the xylem of trees, carbon starvation, and increased susceptibility of trees to insect / pathogen attack (Matusick et al. 2013; Low 2011 and references therein). Canopy thinning (due to leaf abscission) and / or the death of habitat trees, may limit available shade leaving for fauna leaving them more vulnerable to heat stress during warm / hot weather.

Changes in groundwater quality, which could have follow on effects on GDEs could occur in a number of ways. These have been assessed in Chapter 10 – Groundwater which concludes that no appreciable change in groundwater quality is likely as a result of the Project, with appropriate control of both in pit and out of pit waste storages. Therefore it is considered unlikely that the project would result in changes to groundwater quality that would have follow on effects to terrestrial ecological values.

14.4.4 Surface Water Changes

Control of erosion on and off-site will largely be managed under the site Erosion and Sediment Control Plan (see Appendix 15a). Water will be managed on site via a number of dams, catchment diversion drains, levees and pipes, with water captured on the site used to supply site water

demands through the Mine Site Water Management Plan (WMP). The full details of the mine site water management system are given in Chapter 9 – Surface Water.

The general potential impacts to surface water systems as a result of the Project are discussed below and can be summarised as follows:

- Point source discharges to waterways – from controlled dam releases, uncontrolled dam releases, localised erosion and sedimentation, and spills and leaks, including from waste rock storages or groundwater affected by mining operations.
- Area sources – altered loads from larger catchment areas as a result of land use change, including increases in erosion and sedimentation of waterways, broad based leakage from groundwater and waste rock storages.
- Changes to flow patterns from concentration of flows due to constrictions in flow passages, alterations of floodplain areas, and the like, resulting in changes to erosion, sedimentation and bed load.

These impacts have the potential to affect habitat and / or resources for a range of terrestrial values reliant on the availability of surface water resources. The potential impacts to surface water are addressed in Chapter 9 – Surface Water.

14.4.4.1 Controlled and Uncontrolled Releases

During wet climatic conditions, controlled releases from Dam 1 to Deep Creek may be required to prevent excessive accumulation of water within the site storages and minimise the risk of uncontrolled discharges to the receiving environment. The controlled release point will be located on the northern boundary of Dam 1 and water directed along an existing drainage line into Deep Creek. The release point will be armoured and fitted with energy dissipation structures to prevent erosion and scour.

Flow based controlled release rules have been developed using the water balance model for the Project (provided in Appendix 5b - Flood Study and Water Balance), requiring release only during flow in Deep Creek, with the flow rate and maximum EC and sulfate levels determining when and how releases can occur. The predicted annual controlled release volumes from Dam 1 for median, wet and very wet climatic conditions are given in Chapter 9 – Surface Water. No controlled releases are projected to occur in dry and very dry climatic conditions.

In addition to controlled releases, mine-affected water could potentially overflow directly to the receiving environment through uncontrolled overflows if rainfall exceeds the storage design criteria. The water balance model (Appendix 5b) was used to assess the risk of uncontrolled offsite spills from the proposed water management system. Across all storages the annual risk of overflow is considered to be low (between 1 – 10%) and would only occur under wet conditions. The predicted annual overflows from these dams are given in Chapter 9 – Surface Water.

14.4.4.1.1 Water Quality Impact Assessment

To assess the water quality impacts of controlled releases and uncontrolled overflows six parameters, including EC, Arsenic (As), Molybdenum (Mo), Selenium (Se), Vanadium (V) and Sulphate (SO_4^{2-}), were modelled within the water management system and consequent discharges from the site. These parameters were chosen on the basis of geochemistry analysis for the site, which indicates that they are among the key parameters most likely to be present in high concentrations.

Modelling realisations representative of 1%ile (very wet), 10%ile (wet), and 50%ile (median) climatic conditions were undertaken. For each of these three realisations, the modelled water quality of the receiving waters (Tooloombah Creek, Deep Creek and downstream of the Tooloombah/Deep Creek confluence) on each day that a controlled release or uncontrolled overflow occurred was statistically analysed. For each of the six parameters analysed, the predicted concentrations in the downstream waterways was compared against the known historic concentrations. For each of the parameters analysed the predicted concentrations were well within the range of the typical historical receiving water concentrations. The highest predicted concentrations for all heavy metals that were modelled are also an order of magnitude lower than thresholds set out in model mining EA conditions for water releases.

This assessment indicates that the risks to downstream environments from high concentrations of water quality parameters contained in controlled or uncontrolled releases from the mine are low. Downstream water quality is expected to be within the range of natural variability under all release scenarios. The full details regarding the assessment are in Chapter 9 - Surface Water.

14.4.4.2 Accidental Release of Pollutants

The release of pollutants into the surrounding environment and waterways has the potential to degrade stream habitat quality and water quality near the site. 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. However, standard containment facilities for the storage of fuel, oils and other chemicals will ensure that leaks and spills of these contaminants does not occur. Runoff from Project facilities such as the CHPP/Mine Infrastructure Area (MIA) and waste rock stockpiles will also be captured in a number of environmental dams (and Dam 1 for Waste Rock Stockpile 2) for re-use or treatment, and therefore will not flow directly to nearby waterways. As such the risk of accidental releases of pollutants into surfaces waters is considered to be low.

14.4.4.3 Flooding and Hydrology

A flood impact assessment found that the impacts of the Project on flood extents are generally minor with flooding patterns predicted to remain largely unchanged, and the majority of the flood extent continuing to be confined within the banks of Tooloombah and Deep Creeks. Small increases in flood level, up to about 0.20 m, are caused by the proposed haul road crossing, the diversion of local catchment runoff by the Northern Drain and overflows from Dam 1. The study also found that impacts of the Project on flow velocities in the creeks are very small. The full details of the flood impact assessment are provided in Chapter 9 – Surface Water.

The Project is not expected to result in any major changes to the natural hydrological conditions of Tooloombah and Deep Creeks, and therefore to the Styx River. While some runoff within the creek catchments will be captured and retained on site within the mine footprint, the amount of water involved is minimal compared with that entering the creeks as runoff from the broader catchment during rain events. Surface water modelling shows that there will be no substantial change to the number of no flow days in the system under a mining scenario. Flow currently occurs approximately 24% of the time and this will not be affected by the Project. As such, the ephemeral nature of the creeks and the current flow regime will remain unchanged, and connectivity along the creek systems and into the downstream environments will not be affected. Downstream areas will continue to be

primarily influenced by the tidal regime of the Styx River estuary and Broad Sound marine environment.

14.4.4.4 Changes to the Freshwater – Saltwater Interface

The tidally influenced portion of the Styx River is located up to approximately the Ogmore Road Bridge crossing with a transitional zone extending during peak tides (i.e. tidal bore) to the Tooloombah and Deep Creek confluence. Surface water modelling for the Project indicates that this will not change as result of the Project. This, combined with the negligible changes to the hydrological regime, suggests there will be no change in the location of the freshwater – saltwater interface within surface waters of the Styx River.

14.4.4.5 Erosion and Sedimentation

Vegetation clearing, mining operations and earthworks required during both construction and operation will expose the land to varying levels of erosion based on a number of factors including soil type, surface slopes and extent of ground coverage, runoff potential and rainfall intensity. Sediment can be mobilised and transported by surface water during rainfall events ultimately discharging into drainage lines which can result in negative impacts on water quality and downstream environments.

A conceptual Erosion and Sediment Control Plan (ESCP) (see Appendix 15a) has been prepared for the Project to manage the risk of erosion from the Project Site. It describes the proposed strategies and controls for management of erosion and sedimentation based on the site conditions, proposed mine features, seasonal influences, management controls and mitigation measures. Risks associated with the erosion of stream banks will also be managed through the engineering design of diversion channels, drains and spillways, and through minimising the disturbance to riparian vegetation.

The risk of erosion and consequent loss of sediment has been calculated for the Project for both the existing pre-mine condition (baseline) and operationally which accounts for waste rock material, mine water management and the layout of the proposed mine. Based on average climatic conditions the assessment shows that the Project will result in a reduction in the estimated baseline sediment generation rate of 5,037 t/year to approximately 2,297 t/year, due to the proposed water management system, destocking of the undisturbed Project Site and Mamelon offset areas and the subsequent managed regeneration of native vegetation on the majority of the Mamelon property. Based on this assessment the Project will reduce the sediment load to the downstream environment by approximately 2,740 t/year. This equates to a reduction in the total Styx Basin sediment load of 2.74 % and a reduction in the total Fitzroy Basin sediment load of 0.15%. The assessment also considered non-average, very wet, climatic conditions when sediment might be expected to mobilise more readily and found that, even under non-average wet and very wet conditions, the sediment load from the Project will be less than that of current baseline conditions. An assessment against the Reef 2050 Water Quality Targets also indicates that the Project will result in a positive contribution through the expected reduction in sediment load reporting to the Styx River.

14.4.5 Erosion of Stream Banks

Tooloombah and Deep Creek are highly incised waterways that are likely to be partially reliant on the retention of riparian vegetation for streambank stability. The loss of riparian vegetation in some areas, either through direct clearing or indirect impacts associated with changes in hydrology, has the potential to compromise the stability of the banks and lead to collapse. Controlled and

uncontrolled releases also have the potential to cause local erosion of stream beds and banks, if not managed appropriately.

A description of the geomorphological values of the Project Area is provided by Gippel (2020) in Appendix A5d - Fluvial Geomorphology. The geomorphology assessment concluded that while there could be isolated areas subject to somewhat higher risk of scour compared with baseline conditions, the overall risk of rapid and significant geomorphic change in Tooloombah and Deep creeks and the Styx River due to the proposed mining activity is low. Impacts from the Project on hydraulic variables will be small enough that a rapid geomorphic response would not be expected. Rather, the channel will slowly adjust over the life of the mine to the altered hydraulic conditions through minor changes in bed and floodplain levels, or channel widths.

14.4.6 Dust

Increased dust resulting from excavations, topsoil stripping, vehicle movement, open cut mining activities, construction of infrastructure and roads, coal transport and from coal stockpiles has the potential to impact flora and fauna values within the Project Site and Near Surrounds.

Trees in urban and industrial areas significantly help to limit the amount of particulate matter (PM) suspended in the air, but PM can have a negative impact on their life (Lukowski et al. 2019). Dust can result in negative impacts on plant photosynthesis and productivity (Chaston & Doley 2006; Naidoo & Chirkoot 2004; Saadullah et al. 2014)), and changes in soil properties which can ultimately impact plant species assemblages' (Farmer 1993; Spencer and Tinnin 1997; Creuzer et al. 2016). The actual impacts on vegetation from coal dust deposition, as opposed to increased atmospheric dust and road dust, has not be widely researched, nor has the impact of dust to fauna, be it from any source, been well studied.

There are no current government or other widely accepted guidelines in regard to dust levels or thresholds of relevance to terrestrial fauna. There are no air quality objectives for the deposition of dust for the protection of the health and biodiversity of ecosystems in the Environmental Protection Policy (EPP) (Air), or any other statutory limit regarding vegetation, creeks or wetland protection. In the absence of readily available information or assessment criteria for dust deposition on vegetation, criteria for this Project have been adopted from the Cumulative Impact Assessment (CIA) for air quality for Abbot Point (Katestone 2012), for which the former Queensland Department of Environmental and Heritage Protection (now DES) provided design guidance for dust deposition for the avoidance of dust nuisance. This study investigated, in part, the effects of coal dust on vegetation, with particular emphasis on assessment for vegetation in marshes and wetland, at Abbot Point (Katestone 2012). The operational goal of a 120-day rolling average deposition rate of 200 $mg/m^2/day$ was recommended as a result of the CIA air quality assessment. This goal is adopted here for the assessment of dust deposition impacts on vegetation.

The impact assessment assessed the deposition rates on a number of sensitive receptors including Tooloombah Creek, Deep Creek, Wetland 1 and Wetland 2. The maximum predicted dust deposition rates for each of these sensitive receptors and a comparison against the adopted goal are presented in Table 14-18. As shown, the model predictions are all below the criteria. As a result, there is not expected to be any impact on vegetation as a result of dust deposition.

Table 14-18: Maximum predicted dust deposition rates

Receptor	UTM Coordinates (km)		120-day rolling average deposition rate ($mg/m^2/day$)		Criteria
	Easting	Northing	Isolation	Cumulative	
Tooloombah Creek	769.689	7488.548	20.28	79.28	200 $mg/m^2/day$
Deep Creek	775.226	7486.022	3.11	62.11	
Western Boundary Wetland 1	770.787	7486.254	17.41	76.41	
Western Boundary Wetland 2	770.743	7487.605	26.49	85.49	

Aquatic and marine values associated with Broad Sound and the GBR include extensive areas of mudflats, saltmarsh flats and mangroves, which provide habitat for a range of migratory birds. Given the distance these habitats are away from the Project Site, the implementation of the erosion and sediment control plan and the relatively minor extent of the modelled impacts as described above, it is considered that coal dust deposition from Project activities will not impact downstream habitats, including those associated with the GBR and Broad Sound.

14.4.7 Noise

Construction, operation, and closure of the Project will result in increased noise from traffic, machinery, blasting, piling, and the presence of personnel, primarily in the MIA, open cut mine pits haul road and TLF.

The potential effects of noise on terrestrial fauna has been described as including physiological stress responses, physical damage to hearing organs, increased energy expenditure or physical injury while responding to noise, interference with normal animal activities, and impaired communication (Workman & Bunch 1991, Patricelli & Bickley 2006, Dooling & Popper 2007, Parris & Schneider 2009, and Ortega 2012). The ongoing impacts of these effects can include habitat avoidance, reduced reproductive success and increased mortality. Reactions to noise depend on the type of noise produced, including frequency, loudness, consistency, and duration, with a species' susceptibility to disturbance likely to vary considerably with factors such as age, season, weather, and degree of previous exposure. Many fauna species, particularly birds, are likely to become habituated to constant background noise due to routine mining and processing operations. In addition, most noise will attenuate relatively quickly with increasing distance, while the local hilly topography will act as a barrier to noise generated by the mine and associated facilities.

In Australia, there is no current government or other widely accepted guidelines in regard to noise levels or thresholds of relevance to terrestrial fauna. The US Department of Transportation (2004) summarises sensitivities of various groups of wildlife as follows:

- mammals (< 10 Hz to 150 kHz; sensitivity at 0-20 dB)
- birds (more uniform than mammals; 100 Hz to 8-10 kHz; sensitivity at 0-10 dB)
- reptiles (poorer than birds; 50 Hz to 2 kHz; sensitivity at 40-50 dB) and
- amphibians (100 Hz to 2 kHz; sensitivity from 10-60 dB).

Collectively, research findings reviewed for this assessment indicate that intentional noise disturbance below 65.5 dB(A) was less likely to elicit strong behavioural responses (Austecology 2020b). In the absence of national guidelines, and based on the findings of the applied research

literature, a threshold level of LAeq of 65 db(A) be considered as a screening tool for ecological noise impacts.

Noise modelling undertaken for the Project, indicates that operational noise levels are approximately 60 dB(A) at the boundary of the Project Site, and thus, are not expected to cause adverse responses in fauna (noise modelling results are provided in Chapter 13 – Noise and Vibration). The relatively low level of impulsive or low frequency noise at a distance from operations is also not likely to impact fauna.

14.4.8 Lighting

Artificial lighting from infrastructure and machinery may impact fauna within the Project Site and Near Surrounds during construction and operation. Artificial lighting may have a range of impacts across different groups of taxa and between species within these groups.

There is increasing evidence that artificial light affects a number of biological processes (IDSA 1996; Longcore et al. 2017; DEE 2019b). Whilst there is evidence that artificial light at night can result in changes in behaviours and habitat usage in a variety of wildlife (Rich & Longcore 2006), there are few studies for Australian fauna, and little information overall on potential thresholds that may initiate behavioural responses or the extent that habituation might change those thresholds.

Francis et al. (2015) found that light pollution from urban sources had a negative influence on the frequency of use of trees by squirrel gliders (*Petaurus norfolcensis*). Generally, trees with higher activity were located in dark areas (within both urban and rural areas). Barber-Meyer (2007) found that captive sugar gliders (*Petaurus breviceps*) decreased activity and foraging time under two artificial light treatments, designed to be similar to street lighting. That work found decreases in the time spent foraging and overall activity levels under the low luminosity treatment (7 Lux), and a substantial decrease in the amount of time spent foraging and cessation of other activities under the high luminosity treatment (>7 Lux to <12 Lux). Known impacts on birds include disruption of migratory patterns and choice of nest sites (Longcore and Rich 2004).

Through the implementation of the mitigation measures described in Section 14.7, the risk of lighting impact to fauna within the Project Site and Near Surrounds is expected to be minor and in the downstream environment is considered to be negligible.

14.4.9 Direct Fauna Mortality

Direct fauna mortality may occur during vegetation clearing activities and through collision with vehicles during all Project phases. A hot spot for potential collisions may be the haul road crossing of Deep Creek and the new Mount Bison access road. Increased traffic in the wider region resulting from workers accessing the Project may pose an increased risk to the regional population of koalas, although the additional traffic generated by the Project would be negligible relative to existing traffic movements on the Bruce Highway which bisects the Project Site. Fauna may also become exposed to mortality risk if using the operational site as shelter, although the CHPP / MIA areas are located well away from vegetated habitat. The TLF is also located entirely within cleared habitat.

14.4.10 Weeds

The movement of earthmoving machinery and other plant and construction materials increases the risk of weed introduction. In addition, the use of that machinery on site can contribute to the spread of existing weeds within the site. Where the soil seed bank on site already has a weedy component,

further movement of those seeds within the site by earthmoving equipment can be impossible to avoid.

As described in Section 14.3.8, weed species are abundant within the Project Site and Near Surrounds. Lantana is regarded as major threat to a variety of conservation significant species within the Fitzroy NRM region (DERM 2010). Buffel grass is regarded as the most threatening invasive plant within the Brigalow Belt Bioregion (Ponce Reyes et al. 2016). Buffel grass invasion is associated with a loss of diversity and abundance of native ground vegetation, especially where the grass forms dense swards - and a decrease in the abundance of invertebrate prey has been linked with buffel grass density. Research also suggests that buffel grass invasion may also lead to major changes in vegetation structure and composition as a result of altered fire regimes, i.e. a significant increase in the intensity and frequency of fires because of the increased fuel load created by buffel grass and through outcompeting and displacing native grasses (of lower fuel load).

Whilst there is potential for introduction and spread of weed species as a result of the Project, it is considered unlikely that the Project would contribute to a significant further change to existing threats. The Project will involve the implementation of weed controls and monitoring through the Environmental Management Plan (EMP), both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed control is likely to relieve the pressure of introduced flora on terrestrial ecological values, improving the quality of vegetation and habitats within and adjacent to the Project Site.

14.4.11 Pest Animals

As described in Section 14.3.10, introduced fauna have been regularly recorded within the Project Site and Near Surrounds, and the current predominant land use is cattle grazing. These species, to varying extents, can present additional pressures to the maintenance of local biodiversity. They have been widely acknowledged as implicit in the degradation of habitat values, and national threat abatement plans have been produced in regard to feral cats (DE 2015b), cane toads (DSEWPaC 2011b), feral pigs (DEE 2017c), rabbits (DEE 2016b) and foxes (DEWHA 2008b). The impact of cattle grazing to native fauna and their habitat is well documented. Currently, about 90% of the northern part of the Brigalow Belt Bioregion is grazed (Ponce Reyes et al. 2016). Feral pigs generate impacts to a variety of threatened species within the surrounding Fitzroy NRM region, particularly through rooting and wallowing that degrades habitat (DERM 2010).

The Project has limited potential to increase pest animal numbers and/or introduce new invasive animal species through construction and operational activities. The greatest risk of increases in pest animals is through poor mine site waste management practices which may attract pests through the supply of artificial food sources. However, it is considered highly unlikely that the Project would contribute to a significant further change to existing threats given the current prevalence of introduced fauna in the area. The Project will involve the implementation of pest animal control and monitoring through the EMP, including measures within the Project Site and in adjacent areas of the Mamelon Station. In addition, the Project will involve the reduction of grazing within the Project Site and surrounds, relieving the pressure of grazing on terrestrial ecological values and improving the quality of vegetation and habitats within and adjacent to the Project Site.

14.4.12 Fire

In the absence of appropriate mitigation and management measures, the spontaneous combustion of product coal or waste rock material has the potential to impact air quality and ignite bushfires in adjacent vegetation.

14.4.12.1 Spontaneous Combustion of Product Coal

Coal is a combustible material that will naturally oxidise when exposed to air by exothermic reaction processes (Busfield 2012). When sufficient heat from the oxidation is generated to ignite the coal, then coal will burn (Busfield 2012). This spontaneous combustion can occur in thermal coal waste areas, coal pillars or coal stockpiles. During the operations phase, coal stockpiles may combust spontaneously resulting in fire and smoke. Coal dust explosions can also occur in the open pits from a build-up of coal dust which is ignited from exhausts or lighting strikes.

The off-site risk from spontaneous combustion of a coal stockpile includes impacts to air quality and ignition of a bushfire, which in turn has the potential to impact terrestrial ecological values within the Project Site and surrounds. CQC will develop a management system to minimise the risk of spontaneous combustion occurring and to manage the risks should spontaneous combustion occur. These procedures would include routine monitoring of the coal stockpiles, stockpile compaction and minimising the stockpile stagnancy.

14.4.12.2 Spontaneous Combustion of Waste Rock Material

In pit emplacement areas are more susceptible to spontaneous combustion due to the inherent mixing that occurs through the mining process of the various waste materials removed. Consequently, managing spontaneous combustion in active spoil areas can prove to be difficult at times, dependent upon the location of outbreaks. If outbreaks occur in inaccessible areas, management of these areas involves visual monitoring prior to developing accesses into the areas for remediation works to be undertaken. If outbreaks occur in readily accessible areas, these access problems are not encountered, and remediation can be planned and undertaken with minimal changes to operations at the time.

14.5 Avoidance and Mitigation through Project Design

An options analysis was undertaken to evaluate the relative social, economic and environmental advantages and disadvantages of different Project scenarios, and to identify opportunities for avoidance of environmental impacts. The analysis included consideration of a range of environmental factors such as:

- the location of protected or declared environmental areas
- mapped areas of biodiversity significance
- the presence of MNES and MSES including, but not limited to, remnant vegetation, wetlands and fauna habitat
- the location of surface water features and
- maximising the use of existing infrastructure such as power supply, telecommunications infrastructure and transportation options, including proximity of mine site to existing ports.

The outcomes of this analysis were used to select the final Project location in the context of the location of coal deposits within EPC 1029, Mineral Development Licence (MDL) 468 and later ML 80187. The final Project Site is located in close proximity to both the Bruce Highway and the North

Coast Rail Line, which the Project will utilise to transport coal to the existing Dalrymple Bay Coal Terminal at the Port of Hay Point. It also has direct access to a 22kV powerline and telecommunications cabling located within the Bruce Highway road corridor.

At the site level, Project infrastructure has been preferentially sited to avoid impacts on TECs ESA, wildlife corridors and mapped wetlands, and to minimise impacts to regulated and riparian vegetation. Existing disturbed areas (such as farm access tracks or clearings) have been used to site infrastructure and reduce impacts to MNES and MSES to the greatest extent possible. Of the total Disturbance Area (1,372.50 ha) approximately 90% is located within non-remnant vegetation which has been previously cleared for cattle grazing (1,231.13 ha).

Through the EIS and SEIS process, refinement of Project design has sought to further avoid and minimise impacts on environmental values. Since the finalisation of SEIS v2, additional changes made to avoid impacts on environmental values include:

- excising 349 ha from the southern extent of ML 80187 to reduce the overall size of the Project Site
- complete removal of Dam 2 to avoid impacts on least concern RE 11.3.27 (freshwater wetlands) and of concern RE 11.4.2
- relocating Environmental Dam 2D from within an area of concern RE 11.3.4 into non-remnant areas adjacent to the Haul Road
- retracting the Open Cut 2 pit northern end wall by 40 m to the south to increase the buffer between the mine and endangered RE 11.3.11
- redesigning, reconfiguring or removing the Waste Rock Stockpiles in order to reduce the stockpile slopes and locating them out of the flood zone to the greatest extent possible and
- consolidating water storages and increasing the size of Dam 1 within areas of non-remnant vegetation to increase storage capacity and reduce the potential for controlled and uncontrolled releases to the receiving environment.

In addition to the location and design of Project infrastructure, the technology used in mining processes can greatly influence the level of environmental impact of an activity and ensure operations are conducted as efficiently as possible. This efficiency can translate to a smaller footprint (the amount of surface area disturbed), less waste generated and cleaner and safer operations. Technologies that have been factored in to the Project design to reduce impacts on the environment include:

- designing and constructing the final rehabilitated landform to integrate with the surrounding environment, with no final void to remain
- the avoidance of tailings storages through the implementation of paste thickeners and filter pressing technology, allowing process water to be recycled (approximately 60%), reducing water losses, process chemical losses, seepage and reducing processing plant water demand, as well as eliminating the risk of potential leaks or releases to the receiving environment from tailings storages and
- installing an overhead bin and train loading facility from the start of the operations to minimise coal dust and the potential loss of coal during train transit.

14.6 Impact Assessment

An impact assessment has been completed for each of the terrestrial ecological values which are known or likely to occur in the Project Site and Near Surrounds, and the downstream environment. For values which are MNES and MSES a significant impact assessment has been completed in accordance with the relevant guidelines as described in 14.2.4.

14.6.1 Groundwater Dependent Ecosystems

14.6.1.1 Aquatic GDEs

As outlined in Section 14.3.5.3, Aquatic GDEs present within the Project Site and Near Surrounds include groundwater fed pools of Tooloombah and, to a lesser extent, Deep Creek. *Melaleuca leucadendra* occurring along the riparian fringe of Tooloombah and Deep Creek, and near groundwater-fed pools, are also consistent with the definition of an Aquatic GDE.

The key potential impact relevant to Aquatic GDEs as a result of the Project is groundwater drawdown through mine dewatering and depressurisation. A reduction or elimination of groundwater inputs to the creek systems during dry periods may have the resultant effect of reducing the time over which some of the pools persist, which could reduce availability of water for fauna as described in Section 14.4.3. However, the impact assessment for Aquatic GDEs as presented in detail in Chapter 15 – Aquatic and Marine Ecology concludes that the impacts of groundwater drawdown on Aquatic GDEs is expected to be relatively minor because:

- Drawdown at Tooloombah Creek is relatively small (<4 m) and the sediments in these locations have a low permeability (reducing the potential for enhanced leakage).
- Bank storage at Tooloombah Creek is unlikely to be significantly affected by groundwater drawdown. This is because any downward movement of water held in bank storage is restricted, to some extent, by the impermeable layer of weathered clay underlying the alluvium of Tooloombah Creek. In addition, because drawdown of the water table aquifer at Tooloombah Creek is relatively small and sediments at these locations have a low permeability, the potential for enhanced leakage is reduced.
- The persistence of bank storage and associated return flows to Tooloombah Creek are likely to provide safeguards to mitigate impacts on pool persistence from drawdown of the water table underneath the creek. Flows from bank storage were predicted to reach the creek for a period of approximately 150 days.
- Permanent pools are likely to still persist throughout most of the dry season, even under the worst-case scenario, with improvements in water quality (less variation in salinity).
- Most pools at Deep Creek are ephemeral. Whilst ephemeral pools are likely to dry up more quickly and for longer than under existing conditions, especially in the middle reaches of Deep Creek, these pools experience a natural cycle of drying under existing baseline conditions, and the aquatic ecosystem is adapted to these cycles.
- Recolonisation of pools will occur naturally as it currently does under existing conditions following rainfall, once the creeks begin flowing again. Flow currently occurs approximately 24% of the time and will not be affected by the Project.
- Groundwater drawdown is not predicted to occur beneath the Styx River and therefore loss of potential baseflow from Aquatic GDEs in downstream areas is not considered to be a potential impact of the Project.

In addition, there will be minimal physical impact to Aquatic GDEs as a result of the Project.

14.6.1.2 Terrestrial GDEs

As presented in Section 14.3.5.4, Terrestrial GDEs across the Project Site and Near Surrounds include Wetland 1 and vegetation communities existing along the riparian corridors of Tooloombah and Deep Creek comprising REs 11.3.4, RE 11.3.25, RE 11.3.12, RE 11.3.27 and RE 11.3.35, where they are accessing groundwater located less than 15 mbgl and that has an EC below the conservative tolerance of 10,000 µS/cm.

For Terrestrial GDEs, prolonged dry periods are when access to groundwater is important. Water requirements for Terrestrial GDEs that cannot be met by rainfall and stream flooding during these periods may be met by groundwater to avoid water stress. During the dry season there are two key pathways to impact on Terrestrial GDEs due to groundwater drawdown:

1. If the water table aquifer is at an accessible depth to vegetation, and of a suitable quality for use, the drawdown of the aquifer through mine dewatering and depressurisation has the potential to directly reduce water availability for Terrestrial GDEs.
2. Lowering of the water table may affect perched aquifers or bank storage through enhanced leakage. This effect is likely to be particularly pronounced where sediments have higher permeability, such as in Deep Creek. The loss of hydraulic support from a drawn down water table aquifer can be expected to reduce the volumes and persistence of groundwater in the unsaturated zone when compared with pre-mining conditions.

In addition, riparian vegetation which does not technically meet the definition of a Terrestrial GDE (see Section 14.3.5.4), but is still reliant to some extent on access to water held in the unsaturated zone, including bank storage or perched aquifers, can also be affected by groundwater drawdown. Drawdown of the water table aquifer may have indirect effects on soil moisture levels in the overlying unsaturated zone through the loss of hydraulic support for this water, resulting in less water available for vegetation. Despite these water sources not meeting the definition of groundwater in the context of GDEs, the potential for such impacts requires assessment.

14.6.1.2.1 Predicted Drawdown of Water Table Aquifer

The timing and extent of drawdown of the water table aquifer varies across the site. In relation to riparian vegetation the following timeframes and drawdown extents are relevant:

- Drawdown occurs first at Tooloombah Creek around three years after Project commencement.
- The magnitude of drawdown at Tooloombah Creek is approximately 0 to 4.7 m, with areas approximately 2 km north of the Bruce Highway subject to the largest amount of drawdown on this creek.
- Drawdown at Deep Creek occurs around 10 years after Project commencement, and ranges from approximately 0 to 60 m, depending on location. Areas adjacent to the northern and southern bounds of the Project Site are subject to minimal drawdown and are the least affected, while those areas adjacent to the central part of the Project Site are predicted to experience drawdown of between 20 and 40 m.
- A strong gradient of increasing drawdown with distance towards the mine pits is evident on the eastern side of Tooloombah Creek and the western side of Deep Creek.

Post-mining head gradient changes in the water table aquifer reduce considerably at the period 100 years post-mining and are consistent with other areas in the region outside of the area of drawdown after 500 years following the completion of mining.

14.6.1.2.2 Groundwater Drawdown Impacts on Wetland 1

There is a low risk of impact from groundwater drawdown on groundwater dependent vegetation at Wetland 1. Field studies have identified that *Melaleuca viridiflora* at Wetland 1 is accessing water in a perched aquifer located at 8 mbgl, well above the underlying water table aquifer located at 13.5 m. Maximum groundwater drawdown of 2.7 m at bore WMP25 near Wetland 1 is considered unlikely to affect the groundwater held in the perched aquifer and it is expected that access to this groundwater source will persist throughout the life of the Project.

14.6.1.2.3 Groundwater Drawdown Impacts on Riparian Vegetation

Assessment of the likely impacts of groundwater drawdown on riparian vegetation (including Terrestrial GDEs and riparian vegetation) considered a range of factors:

- Existing groundwater level and quality (from nearby aquifer bores), and therefore the suitability of groundwater for use by vegetation.
- Predicted drawdown of the water table aquifer in metres in localities where riparian vegetation occurs.
- The results of TEM studies which examined the distribution of various water and geological layers throughout the soil profile of riparian areas and provided some insight into the permeability of sediments underlying the riparian zone.
- The tolerance of tree species within the riparian zone to various natural and Project-induced stressors.
- Predicted changes to surface water flows and the frequency and duration of flood events, which may recharge bank storage for riparian vegetation.
- The results of boreholes drilled in transects across sections of the Tooloombah Creek and Deep Creek riparian zone, which describe the geological features of the alluvial zone and provide the results of laboratory analysis of the physical properties of alluvial sediments.

Tooloombah and Deep Creek were divided into several stream sections based on similar environmental characteristics and predicted exposure to drawdown, to facilitate a risk assessment for each stream reach (Figure 14-10). A series of technical workshops were convened involving specialists in the fields of groundwater, GDEs, impact assessment, geology and botany. Potential impacts of the Project were discussed and agreed, based on the collated Project information of ecological, geological and hydrogeological features.

A qualitative risk assessment was completed for each stream reach, taking into account all of the available information. As the effects of groundwater drawdown on vegetation can vary in scale, the likelihood of several scales of impact was considered for each stream reach, ranging from an 'Insignificant' impact on vegetation through to the 'Extreme' loss of structural integrity and ecological function of the vegetation community. The impact ratings considered are presented in Table 14-19.

Table 14-19: Impact rating for five categories of impact on riparian vegetation

Impact Rating	Impact Description
Insignificant	10% decline in the BioCondition Scores against baseline or pre-impact scores. The regional ecosystem is retained as a functional ecosystem. There are reduced numbers of microhabitat features available for fauna.
Minor	50% decline in BioCondition Scores against baseline or pre-impact scores. Canopy cover < 50% of baseline or pre-impact condition, or canopy height <70% of baseline or pre-impact condition. Vegetation no longer meets the Regional Ecosystem description. Vegetation provides ecosystem services, including minimising erosion and some fauna habitat, but with elevated weed cover. There are limited microhabitat features for fauna, such as hollows.
Moderate	90% decline in the BioCondition Scores against baseline or pre-impact scores. Vegetation no longer meets the Regional Ecosystem description. Vegetation community still existing and provides some ecosystem services in limiting erosion, but significant change in structure and composition (increased weed cover) is evident, with reduced habitat values. Limited microhabitat features for fauna.
Major	Widespread vegetation loss. Vegetation no longer meets the Regional Ecosystem description. Regional Ecosystem only remains in patches, with grasses and shrubs elsewhere. There is a high abundance of weeds. Ecosystem services in limiting erosion are reduced by up to 50%, with some under cutting of banks resulting at times.
Extreme	Widespread vegetation loss. Vegetation no longer meets the Regional Ecosystem description. Grasses and shrubs dominate the riparian zone. Ecosystem services in limiting erosion are reduced by more than 50%, resulting in periodic bank collapse

The likelihood of each impact rating occurring as a result of drawdown of the water table aquifer was assessed for each of the eight stream reaches. The likelihood of the impact occurring was classified as 'Rare', 'Unlikely', 'Possible', 'Likely' and 'Almost Certain'.

If there was a 'Possible' (or above) likelihood of there being a 'Minor' impact on vegetation within the stream reach, then there was concluded to be an impact on vegetation within that stream reach. Results of the impact assessment are summarised in Table 14-20 and discussed for each stream reach in the sections below.

Of the eight stream reaches assessed along Tooloombah and Deep Creek, it was concluded that it was 'Possible' that groundwater drawdown would result in at least 'Minor' impact on vegetation within three of the stream reaches along Deep Creek – reaches 5, 6 and 7. These impacts are considered likely to manifest through a gradual reduction in the condition of structural elements of the vegetation communities, such as forest red gums and melaleuca species. In these areas BioCondition scores, canopy cover and canopy height could be expected to decline over time and the vegetation may no longer meet the RE description. These impacts can be expected to commence over timeframes of 10 to 20 years after commencement of the Project.

Based on the results of this analysis the area predicted to be affected consists of 165.23 ha of riparian vegetation, comprising RE 11.3.25, RE 11.3.27, RE 11.3.35, and RE 11.3.4. It should be noted that this prediction is based on conservative assumptions (see Section 14.3.5.4) and a worst-case scenario impact assessment and so it is possible that the area to be affected may be substantially less than 165.23 ha. Vegetation subject to an impact is shown in Figure 14-38.

Stream Reach 1 - Tooloombah Creek Downstream

For Section 1, the assessment team identified an 'Unlikely' likelihood of 'Insignificant' impact to riparian vegetation, with a 'Rare' likelihood of any impact exceeding the 'Insignificant' criterion. This assessment was based on the relatively small drawdown of 1.5 m in this stream reach, and the low

permeability of alluvial sediments and Styx Formation. While there may be some decline in BioCondition scores for vegetation in this section during prolonged dry periods, the magnitude of change is expected to be small, and similar to that occurring naturally during existing climatic cycles.

Stream Reach 2 - Tooloombah Creek Mid-Section

For Section 2, the assessment team identified a 'Possible' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Rare' likelihood of any impact exceeding the 'Insignificant' criterion. This assessment was based on the presence of saline groundwater being unsuitable for riparian vegetation at this location, and the bores in the area logging clay within the alluvial sediments, with associated low permeability. Fresh groundwater held in bank storage is likely to mitigate the potential for impacts from drawdown in this location. While there is likely to be some decline in BioCondition scores for vegetation in this section during prolonged dry periods, the magnitude of change is expected to be small, and similar to that occurring naturally during existing climatic cycles.

Stream Reach 3 - Tooloombah Creek Upstream

For Section 3, the assessment team identified a 'Rare' likelihood of any impacts to riparian vegetation. This was based on the stream section being located upstream from the Project and further away from the steep drawdown gradient located further downstream adjacent to the mine pits. Impacts to riparian vegetation arising from the Project in this area are expected to be within the bounds of natural variability.

Stream Reach 4 – Deep Creek Far Downstream

For Section 4, the assessment team identified an 'Unlikely' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Rare' likelihood of any impact exceeding the 'Insignificant' criterion. This was based on the low permeability of clay sediments and extensive supply of freshwater, as shown in TEM survey results. While there may be some decline in BioCondition scores for vegetation in this section during prolonged dry periods, the magnitude of change is expected to be small, and similar to that of natural variation.

Stream Reach 5 - Deep Creek Downstream

For Section 5, the assessment team identified a 'Likely' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Possible' likelihood of 'Minor' impacts, and an 'Unlikely' likelihood of 'Moderate' impacts to riparian vegetation. 'Major' and 'Extreme' impacts were assessed to be a 'Rare' likelihood. This assessment was based on the large drawdown depth of approximately 40 m predicted in the water table aquifer, which is expected to provide some hydraulic support to fresh water currently utilised by vegetation. As a result of groundwater drawdown, the vegetation community is expected to no longer meet the RE description after a period of approximately 15 years. This outcome is assessed to be an impact on groundwater dependent vegetation.

Stream Reach 6 - Deep Creek Mid-Section

For Section 6, the assessment team identified a 'Likely' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Possible' likelihood of 'Minor' impacts, and an 'Unlikely' likelihood of 'Moderate' impacts. 'Major' and Extreme impacts were assessed to have a 'Rare' likelihood. This assessment was based on the large drawdown depth of 30 m predicted in the water table aquifer, which is expected to provide some hydraulic support to fresh water utilised by vegetation. As a result of groundwater drawdown, the vegetation community is expected to no longer meet the RE description after a period of approximately 15 years. This outcome is assessed to be an impact on groundwater dependent vegetation.

Stream Reach 7 - Deep Creek Upstream

For Section 7, the assessment team identified an 'Almost Certain' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Likely' likelihood of 'Minor' impacts, and a 'Possible' likelihood of 'Moderate' and 'Major' impacts. 'Extreme' impacts were assessed to have a 'Unlikely' likelihood of occurring. This was based on the very large drawdown depth of approximately 60 m predicted in the water table aquifer, high proportion of sand and silt in sediments and the strong hydraulic gradient associated with drawdown into the adjacent mine pit. As a result of groundwater drawdown, the vegetation community is expected to no longer meet the RE description after a period of approximately 15 years. This outcome is assessed to be an impact on groundwater dependent vegetation. Some increase in erosion can be expected as a result of vegetation loss, unless mitigated through revegetation with species tolerant of the predicted changes in stream bank conditions.

Stream Reach 8 - Deep Creek Far Upstream

For Section 8, the assessment team identified an 'Unlikely' likelihood of 'Insignificant' impacts to riparian vegetation, with a 'Rare' likelihood of any impact exceeding the 'Insignificant' criterion. This assessment was based on the stream section being upstream of the Project, with a relatively smaller groundwater draw down magnitude of 4.5 m predicted. The shallow aquifer at this location has a median EC of 27,000 µS/cm and is unsuitable for use by vegetation. While there may be some decline in BioCondition scores for vegetation in this section, as a result of enhanced leakage of freshwater into deeper layers during dry periods, the magnitude of change is expected to be small, and similar to that occurring naturally during existing climatic cycles.

14.6.1.3 Application of the IESC Risk matrix

Results of the impact assessment and associated risk assessments for Aquatic and Terrestrial GDEs are consistent with the outcomes of applying the risk matrix presented in Appendix G of the IESC Guidelines (Doody et al. 2019). The Project and its associated potential impacts on GDEs is consistent with a Moderate (Environmental) Value and Moderate Risk to GDEs, corresponding to Risk Matrix Box E in Doody et al. (2019). For Projects in this category, the following management actions are recommended (Doody et al. 2019):

- protection of biodiversity hotspots supporting endangered and threatened species
- baseline risk monitoring and mitigation actions
- monitoring and annual assessment of mitigation actions and
- adaptive management with continuous monitoring.

CQC will implement the Project in a manner consistent with these recommendations, with key practices being the avoidance and minimisation of direct and indirect impacts to key values where possible (e.g. Wetland 1 and creeks adjoining the Project Site), and the implementation of a detailed adaptive management and monitoring framework, which will be established and implemented through the Groundwater Dependent Ecosystem Monitoring and Management Plan (GDEMMP).

14.6.1.4 Terrestrial GDE Impact Assessment Summary

Terrestrial GDEs across the Project Site and Near Surrounds are considered to include Wetland 1 and vegetation communities existing along the riparian corridors of Tooloombah and Deep Creek comprising REs 11.3.4, RE 11.3.25, RE 11.3.12, RE 11.3.27 and RE 11.3.35, where they are accessing groundwater located less than 15 mbgl and that has an EC below the conservative tolerance of 10,000 µS/cm.

Eight stream reaches along Tooloombah and Deep Creek meeting the above criteria were assessed in terms of potential for impact as a result of groundwater drawdown. It was concluded that it was 'Possible' that groundwater drawdown would result in at least 'Minor' impact on vegetation within three of the stream reaches along Deep Creek – reaches 5, 6 and 7. These impacts are considered likely to manifest through a gradual reduction in the condition of structural elements of the vegetation communities, such as forest red gums and melaleuca species. In these areas BioCondition scores, canopy cover and canopy height could be expected to decline over time and the vegetation may no longer meet the RE description. These impacts can be expected to commence over timeframes of 10 to 20 years after commencement of the Project.

Based on the results of this analysis the area predicted to be affected consists of 165.23 ha of riparian vegetation, comprising RE 11.3.25, RE 11.3.27, RE 11.3.35, and RE 11.3.4. It should be noted that this prediction is based on conservative assumptions (see Section 14.3.5.4) and a worst-case scenario impact assessment and so it is possible that the area to be affected may be affected may be substantially less than 165.23 ha. Vegetation subject to an impact is shown in Figure 14-38.

Table 14-20: Summary of groundwater drawdown impact assessment for Terrestrial GDEs and riparian vegetation

Stream Section	Scale of Impact					Maximum Drawdown (m)	Timing of Maximum Drawdown (years)	Impact Predicted?
	Insignificant	Minor	Moderate	Major	Extreme			
1: Tooloombah Creek Downstream	Unlikely	Rare	Rare	Rare	Rare	1.5	10	No
2: Tooloombah Creek Mid-Section	Possible	Rare	Rare	Rare	Rare	4.7	5	No
3: Tooloombah Creek Upstream	Rare	Rare	Rare	Rare	Rare	3	5	No
4: Deep Creek Far Downstream	Unlikely	Rare	Rare	Rare	Rare	6	10	No
5: Deep Creek Downstream	Likely	Possible	Unlikely	Rare	Rare	40	15	Yes
6: Deep Creek Mid-Section	Likely	Possible	Unlikely	Rare	Rare	30	10	Yes
7: Deep Creek Upstream	Almost Certain	Likely	Possible	Possible	Unlikely	60	15	Yes
8: Deep Creek Far Upstream	Unlikely	Rare	Rare	Rare	Rare	4.5	10	No

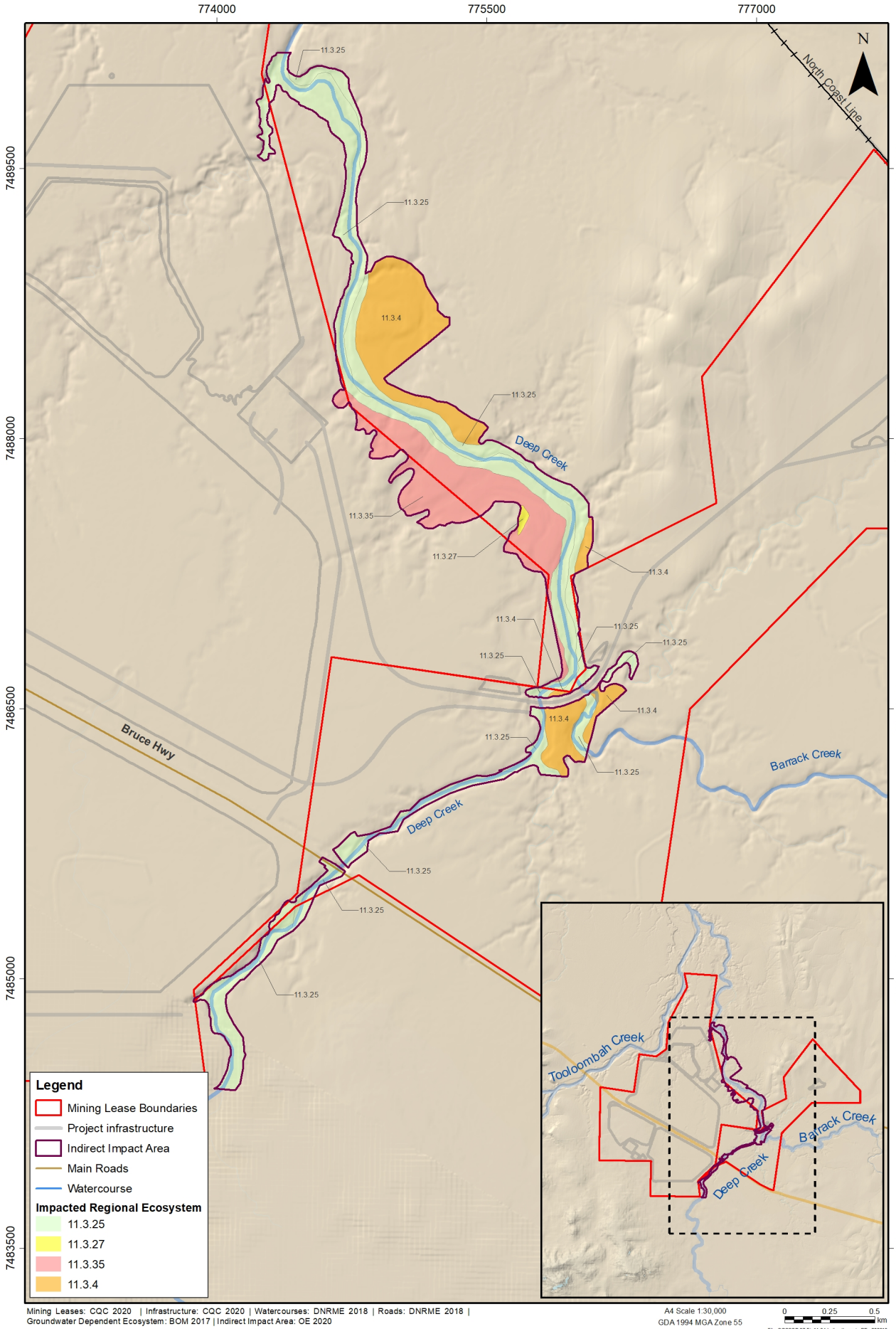


Figure 14-38: Terrestrial GDEs expected to be affected by groundwater drawdown

14.6.2 Regional Ecosystems

The main risks of impact from the Project to RE are vegetation clearing and groundwater drawdown. Changes to surface water catchments also has the potential to impact RE associated with ephemeral freshwater wetlands which are recharged by surface waters. There is a very low risk of impact as a result of increases in dust, weeds, pests and fire as described in Section 14.4.

14.6.2.1 Vegetation Clearing

The total Disturbance Area over the period 2021 to 2031 is 1,372.50 ha. As presented in Table 14-21, the majority of the Disturbance Area is mapped as non-remnant vegetation (1,231.13 ha) which has been previously cleared for cattle grazing. The remaining area to be cleared comprises 141.37 ha of remnant vegetation as shown in Figure 14-39. Of the 11 RE present within the Project Site, four will be directly impacted by vegetation clearing. As outlined in Table 14-21:

- For RE 11.3.25 the clearing extent of 23.59 ha represents 1.59 % of this RE within 10 km of the Project Site and 0.20 % within the subregions of Marlborough Plains and Nebo Connors Ranges.
- A total of 1.39 ha of RE 11.3.4 will be cleared representing 0.14 % of this RE within 10 km of the Project Site and 0.01 % within the subregions.
- The clearing of 192.36 ha of RE 11.4.2 represents 4.41 % of this RE within 10 km of the Project Site and 1.42 % within the subregions.
- For RE 11.5.8, 5.61 ha will be cleared representing 0.56 % of this RE within 10 km of the Project Site and 0.02 % within the subregions.

Table 14-21: RE impacted by direct vegetation clearing

Regional Ecosystem	VM Status	Ground-truthed RE (ha)		DNRME V 11 RE (ha)[27]			
		Project Site	Impact Area (ha)	10 km of Project Site	% 10 km	Sub-regions	% Sub-regions
11.3.25	Least concern	46.02	23.59	1,484.28	1.59	12,008.61	0.20
11.3.4	Of concern	18.92	1.39	978.91	0.14	15,255.10	0.01
11.4.2	Of concern	192.36	110.78	2,510.83	4.41	7,820.40	1.42
11.5.8	Least concern	33.51	5.61	994.31	0.56	25,368.90	0.02
Non-remnant	-	2,322.51	1,231.13	-	-	-	-
Total	-	2,661.16	1,372.50	-	-	-	-

14.6.2.2 Surface Water Changes

As described in Section 14.4.4, surface water changes as a result of the Project present a low risk to environmental values reliant on these resources, including RE. However, there will be some changes to catchment areas which has the potential to impact RE located within wetlands. During mining operations, the mine water management system will capture runoff from areas that would have previously flowed to a number of natural ephemeral freshwater wetland REs, including RE 11.3.12 (Wetland 1) and RE 11.3.27 (Wetland 2). A daily water balance was undertaken to assess the impact of these changes on the wetland catchments. The complete detail of the assessment is available in Appendix A5b - Flood Study and Water Balance. The impacts on wetland catchment areas are summarised as follows:

[27] Conservative assessment because areas presented do not include heterogenous polygons of the RE or HVR.

- The Wetland 1, Wetland 2 and Wetland 5 catchment areas will not be affected by mining operations.
- The Wetland 3 catchment area will be reduced by up to 41% due to mining operations.
- The Wetland 4 catchment area will be reduced by up to 39% due to mining operations.

Water level duration curves were developed for each of the five wetlands to determine the impact of the wetland catchment excision on wetland water levels. The results of this assessment show that the wetland catchment excision due to mining operations will have a negligible impact on water level behaviour in the wetlands. As such there is not expected to be any impact on RE 11.3.27 or RE 11.3.12 as a result of catchment excisions.

14.6.2.3 Groundwater Drawdown

Groundwater drawdown is predicted to impact 165.23 ha of riparian vegetation, comprising RE 11.3.25, RE 11.3.27, RE 11.3.35, and RE 11.3.4. This prediction is based on conservative assumptions (see Section 14.3.5.4) and a worst-case scenario impact assessment and so it is possible that the area to be affected may be substantially less than 165.23 ha. The area of each RE predicted to be impacted is presented in Table 14-22 and illustrated in Figure 14-38. One RE expected to be impacted is listed as Of Concern under the VM Act (RE 11.3.4) and the remaining are Least Concern.

As previously described, decline in vegetation condition is expected to occur gradually and will not commence until at least 10 years after Project commencement. Impacts are considered likely to manifest through a gradual reduction in the condition of structural elements of the vegetation communities. In these areas BioCondition scores, canopy cover and canopy height could be expected to decline over time and the vegetation may no longer meet the RE description.

A draft GDEMMP has been prepared with the aim of minimising and managing the environmental impacts of the Project on GDEs. As part of the draft GDEMMP a monitoring program has been developed, to determine whether mitigation and management measures are adequate and successfully implemented. This work will build upon the baseline studies completed during the EIS and SEIS.

In addition, a revegetation program will be implemented in areas within the riparian corridor expected to be affected by groundwater drawdown with the aim of building ecological resilience. Revegetation will include expansion of the existing riparian corridor by a width of 10 m. A revegetation program will be designed to ensure the planting of drought tolerant, non-groundwater dependent species of similar ecological function as those with the potential to be impacted. Further details of the revegetation program are presented in Section 14.7.

Table 14-22: Regional ecosystems impacted by groundwater drawdown

Regional Ecosystem	VM Act Status	Area Impacted (ha)
RE 11.3.25	Least Concern	87.51
RE 11.3.27	Least Concern	0.59
RE 11.3.35	Least Concern	37.81
RE 11.3.4	Of Concern	39.31

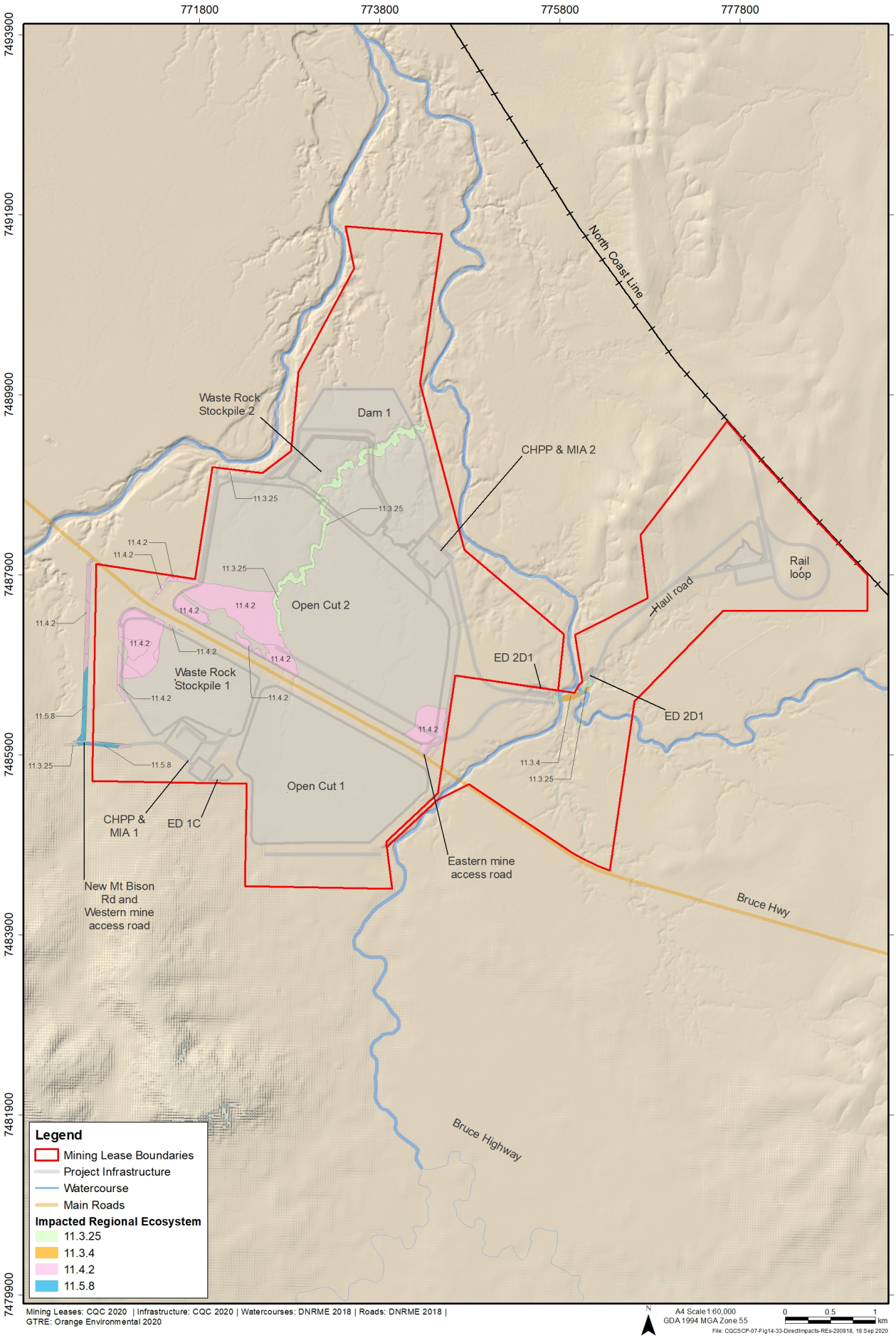


Figure 14-39: Direct impacts of the Project on RE

14.6.2.4 Significant Impact Assessment for MSES

Schedule 2 of the EO Regulations lists the prescribed RE which are MSES. Based on the results of the impact assessment presented above direct and indirect impacts on RE that are MSES have been assessed and are summarised in Table 14-23. In accordance with the EO Act, significant impact assessments for any direct or indirect impacts on MSES are required to be undertaken in accordance with the QEOP Significant Residual Impact Guideline (DEHP 2014). The results of the significant impact assessment is presented in Table 14-23.

Table 14-23: RE MSES Impacts

MSES (structural category)	Impact (ha) Direct	Indirect	Total	Significant Impact Assessment	Significant impact?
Of Concern RE					
RE 11.3.4 (Sparse)	1.39	39.31	40.70	The direct clearing is for linear infrastructure and is greater than 20 m. The indirect impact associated with groundwater drawdown is greater than 20 m wide and greater than 2 ha.	Yes
RE 11.4.2 (Sparse)	110.78	0.00	110.78	The direct clearing is generally for non-linear infrastructure and is greater than 2 ha.	Yes
RE located within a defined distance of a relevant watercourse					
Watercourse RE 11.3.4 (Sparse)	0.52	3.78	4.30	The direct clearing is for linear infrastructure, is greater than 20 m and is within 5 m of the defining bank. The indirect impact associated with groundwater drawdown is greater than 20 m wide, greater than 2 ha and is within 5 m of the defining bank.	Yes
Watercourse RE 11.3.25 (Sparse)	10.74	68.06	78.80	The direct clearing is generally for non-linear infrastructure and is greater than 2 ha and is within 5 m of the defining bank. The indirect impact associated with groundwater drawdown is greater than 20 m wide, greater than 2 ha and is within 5 m of the defining bank.	Yes
Watercourse RE 11.4.2	1.10	0.00	1.10	The direct clearing is generally for non-linear infrastructure and is less than 2 ha and is within 5 m of the defining bank. There is no indirect impact.	No
Watercourse RE 11.3.35 (Sparse)	0.00	1.84	1.84	There is no direct impact. The indirect impact associated with groundwater drawdown is greater than 20 m wide, however, is less than 2 ha and is not within 5 m of the defining bank.	No
RE that is an area of essential habitat for vulnerable animals					
Greater glider	0.00	15.00	15.0	See Section 14.6.5.1.1	Yes
Koala	96.10	14.34	110.4	See Section 14.6.5.1.2	Yes
Ornamental snake	0.00	6.73	6.73	See Section 14.6.5.1.3	Yes
Squatter pigeon	14.64	14.27	28.91	See Section 14.6.5.1.4	No

14.6.3 Threatened Ecological Communities

The Project has been designed to avoid direct and indirect impacts on Brigalow TEC and SEVT TEC. There will be no clearing within areas of Brigalow TEC and SEVT TEC. Retained TEC within and adjacent to the Project Site will be protected and managed through the implementation of the Project's EMP. The SEVT TEC is not a Terrestrial GDE, as the key vegetation species comprising the community are not groundwater dependent (3D Environmental 2020). The GDE Assessment (ELA 2020a) also concludes that Brigalow TEC (RE 11.4.9) is not a Terrestrial GDE. Therefore, SEVT TEC and Brigalow TEC will not be impacted by groundwater drawdown associated with the Project. There is only a very low risk of impact on TECs associated with dust, weeds, pests and fire as described in Section 14.4.

14.6.3.1 Significant Impact Assessment

Impacts to Brigalow TEC and SEVT TEC have been assessed in accordance with the MNES Significant Impact Guidelines 1.1 (DE 2013) as presented in Table 14-24. Based on this assessment, the Project is not expected to result in a significant residual impact to Brigalow TEC or SEVT TEC.

Table 14-24: Significant impact assessment – Brigalow and SEVT TEC

Significant impact criteria	Response	Significant impact?
Reduce the extent of an ecological community	The Project Site has a long history of grazing. This has resulted in clearing of native vegetation such that Brigalow TEC and SEVT TEC are heavily fragmented across the local landscape and only small, very minor and isolated patches of Brigalow TEC and SEVT TEC are present within Project Site as illustrated in Figure 14-11. There will be no direct clearing of these small patches of Brigalow TEC or SEVT TEC as a result of the Project. Occurrences of Brigalow TEC and SEVT TEC within the Project Site will be retained and protected throughout the life of the Project. Prior to construction, boundaries of clearing and 'no-go' areas will be clearly pegged/flagged on the ground prior to clearing commencing. Training for all personnel will include information on identifying these marked areas and characteristics of the TEC. Based on the above, it is considered highly unlikely that the Project would reduce the extent of an ecological community, or fragment or increase fragmentation, of an ecological community.	No
Fragment or increase fragmentation of an ecological community		No
Adversely affect habitat critical to the survival of the community	TSSC (2013) states that areas considered critical to the survival of Brigalow TEC are 'all patches that meet the key diagnostic characteristics and condition thresholds for the ecological community; plus the buffer zones, particularly where these include native vegetation.' The small patches of Brigalow TEC located within the Project Site satisfy these criteria. These patches will not be directly or indirectly impacted by the Project. In addition, they will be protected over the life of the Project through the implementation of actions within the EMP. As such, it is considered highly unlikely that the Project would adversely affect habitat critical to the survival of Brigalow TEC. There is no definition of habitat critical to the survival of SEVT TEC in the National Recovery Plan (McDonald 2010). There is no approved conservation advice for this TEC. This is a widespread community extending from coastal Townsville to the Liverpool Plains region of NSW. Given the wide extent of occurrence, the minor extent of those	No

Significant impact criteria	Response	Significant impact?
	fragments within the Project Site and the avoidance of impacts on SEVT TEC, it is considered highly unlikely the Project will adversely affect habitat critical to the survival of the community.	
Modify or destroy abiotic factors necessary for an ecological community's survival	The Project will not modify or destroy abiotic factors necessary for the survival of Brigalow TEC or SEVT TEC located within the Project Site and Near Surrounds.	No
Cause a substantial change in the species composition of an occurrence of the ecological community	The Project will not cause a substantial change in the species composition of the Brigalow TEC or SEVT TEC located within the Project Site and Near Surrounds.	No
Cause a substantial reduction in the quality or integrity of an occurrence of the ecological community	There is a very low risk of impact on these TECs associated with increased dust, weeds, pests and fire as described in Section 14.4. The EMP will include measures for weed and pest control, dust suppression, and fire prevention and management, as outlined in Section 14.7. These actions will improve the quality of retained vegetation within the Project Site and Near Surrounds, including Brigalow TEC and SEVT TEC. In addition, the Project will lead to the reduction of grazing within the Project Site and Near Surrounds, relieving the pressure of grazing on these TECs. A vegetation monitoring program will also be implemented through the Project's EMP. Should impacts be detected to the TECs that can be attributed to the Project activities, appropriate corrective actions will be implemented. As such the Project is considered highly unlikely to cause a substantial reduction in the quality or integrity of an occurrence of these TEC. Moreover, activities associated with the implementation of the Project's EMP are likely to improve the quality of Brigalow TEC and SEVT TEC within the Project Site and Near Surrounds.	No
Interfere with the recovery of the ecological community	There is no State or Commonwealth approved recovery plan for Brigalow TEC. The draft recovery plan by Butler (2008) identifies the following specific objectives: • Increase the area of the Brigalow TEC and its representation in conservation reserves. • Improve knowledge of the Brigalow TEC and its condition as habitat for native species. • Mitigate key threats to the Brigalow TEC by controlling fire, clearing and fragmentation, weeds and animal pests. The Commonwealth Approved Conservation Advice (TSSC 2013) for the Brigalow TEC lists several priority management actions designed to conserve the community. These include threat control and reduction, land management, management for wildlife and develop and propagate conservation information. The Project will not interfere with these objectives. The Project will support the achievement of these objectives through the implementation of measures to manage key threats to Brigalow TEC. The Project EMP will incorporate pest and weed management, fire	No

Significant impact criteria	Response	Significant impact?
	management and monitoring / management of groundwater and surface water values. The National Recovery Plan for SEVT TEC (McDonald 2010) states the following objectives: • Identify and evaluate the extent, biodiversity value and condition of remnant and regrowth areas of SEVT TEC. • Establish a comprehensive, adequate and representative system of SEVT TEC areas, protected either by reservation or conservation agreements (including MOU's). Ensure 'best-practice" management is applied to sites containing the SEVT TEC. • Encourage involvement of landholders and the community in the conservation and management of the SEVT TEC. • Enhance the ability of government and non-government organisations to recognise and incorporate SEVT TEC conservation issues into all planning processes. The Project will not interfere with these objectives	

14.6.4 Native Flora

As described in Section 14.3.7, no conservation significant flora species are known or likely to occur within the Project Site or Near Surrounds. As such, no direct or indirect impacts as a result of the Project are anticipated.

14.6.5 Native Fauna

14.6.5.1 Species Known or Likely to Occur (Project Site and Near Surrounds)

As listed in Table 14-25, a total of 11 conservation significant fauna species are considered known or likely to occur within the Project Site or Near Surrounds. The impact assessment for each species, including significant impact assessments, is provided in the sections below.

Table 14-25: Summary of listed species known or likely to occur (Project Site and Near Surrounds)

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[28]	EPBC Act[29]					
Greater glider	V	V		x	x	x	x
Koala	V	V		x	x	x	x
Ornamental snake	V	V			x		x
Squatter pigeon (southern subspecies)	V	V		x	x	x	x
Short-beaked echidna	SL			x		x	x
Fork-tailed swift	SL	M		x	x		x
Glossy ibis	SL	M		x			x
Latham's snipe	SL	M	x	x	x	x	x
Oriental cuckoo	SL	M			x		x

[28] Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (LC), Special Least Concern (SL)
[29] Critically Endangered (CE), Endangered (E), Vulnerable (V), Migratory (M)

Species	Status		Migratory Shorebird	Wildlife Online	PMST Report	WildNet Record	Field Survey
	NC Act[28]	EPBC Act[29]					
Rufous fantail	SL	M		x	x	x	x
White-throated needletail	V	V,M		x	x		x

14.6.5.1.1 Greater Glider

The main risks of impact from the Project on greater glider are vegetation clearing and groundwater drawdown. There is a very low risk of impact as a result of increases in weeds, pests, noise, lighting and fire as previously described in Section 14.4.

Vegetation Clearing

The Project Site comprises 415.8 ha of greater glider habitat. As presented in Table 14-26 and Figure 14-23, approximately 115.8 ha of known greater glider habitat is proposed to be cleared for the Project. As presented in Figure 14-24, potentially suitable habitat for greater glider appears widespread in the landscape with approximately 9,575 ha mapped within 10 km of the Project Site. There are large contiguous patches of habitat extending to the north-west, west, and south of the Project Site. The proposed clearing of habitat within the Project Site, represents approximately 1.2 % of the potentially equivalent habitat within 10 km of the Project Site.

The clearing of habitat for the haul road crossing of Deep Creek (25 m wide) has the potential to create a barrier to movement for the greater glider (Austecology 2020b). Clearing will involve an area of habitat 500 m long and 25 m wide. Whilst the species can glide up to 100 m between trees (DELWP 2019), the distance that can be traversed is related to the height of the launch tree. For example, the distance between trees along the Bruce Highway is approximately 45 to 50 m. The tree height required to traverse this gap in a single crossing would be at least 35 m (range 35.6 to 44m) (Austecology 2020b). This is well in excess of the typical canopy height of the vegetation within this area (J. Cousin unpub. data for the site). Thus, the Bruce Highway represents an existing significant challenge for safe greater glider movement between habitats, and it is possible that clearing for the haul road could also create an additional barrier to movement.

To minimise this risk, and to facilitate greater glider movement, dedicated road crossing treatments will be implemented where the proposed haul road transects Deep Creek. Consistent with best-practice approaches, a suite of treatments will include minimising the design width of the road (minimising canopy gap width) and the inclusion of suitably sized and located wooden glide poles at intervals along the length of the riparian habitat edge corresponding with the road crossing.

Groundwater Drawdown

Predicted declines in vegetation characteristics and condition as a result of groundwater drawdown along sections of Deep Creek has the potential to impact habitat for greater gliders. Potential impacts include:

- reduction in the availability of leaf forage, including eucalypt shoot growth, affecting not only nutrition but also water balance, since the species obtain a significant proportion (upwards of 60%) of their daily water needs from the foliage of feed trees
- reduction in leaf (foliar) water content affecting the ability of greater glider to maintain water balance, particularly under hot / dry conditions or in drought affected areas where free water is scarce and
- increased physiological stress due to reduced availability of food / water, and shelter.

Based on a worst case scenario impact assessment, groundwater drawdown is predicted to impact approximately 165 ha of riparian vegetation which is known or potential habitat for the greater glider (Table 14-26). This impact represents approximately 1.7 % of the potentially equivalent habitat within 10 km of the Project Site. As previously described, decline in vegetation condition is expected to occur gradually and will not commence until at least 10 years after Project commencement.

Table 14-26: Greater glider habitat loss

Habitat Type	Vegetation Clearing (ha)	Groundwater Drawdown (ha)	Total (ha)
Remnant			
Known	115.74	40.82	156.56
Potential	0.00	124.39	124.39
Total	115.74	165.21	280.95
Non-remnant			
Potential	0.10	0.00	0.10
Total	0.10	0.00	0.10

Significant Impact Assessment

The direct and indirect impacts on greater glider habitat have been assessed in accordance with the MNES Significant Impact Guidelines 1.1 (DE 2013) for Vulnerable species as presented in Table 14-27. Taking into account a range of mitigation and management measures to reduce the intensity of the potential impacts as described in detail in Section 14.7, it is concluded that Project activities will result in a significant residual impact to 281 ha of greater glider habitat.

The greater glider is also listed as Vulnerable under the NC Act. The MNES Significant Impact Guidelines 1.1 (DE 2013) for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore, an additional assessment for the QEOP guidelines has not been undertaken and it is assumed that the impact to greater glider habitat as a MSES is significant by virtue of being significant under the EPBC Act.

Table 14-27: Significant impact assessment - greater glider

Criteria	Assessment	Significant Impact?
Will the action lead to a long-term decrease in the size of an important population of a species?	DAWE (2020q) does not identify / describe any 'important populations' within the bioregion or broader area surrounding the Project. There are no published estimates of greater glider population size or density for the bioregion or broader area surrounding the Project (TSSC 2016a; DAWE 2020q). As such it is concluded that there is no important population of greater gliders present in the area. Even if there was an important population present the Project would not lead to a long-term decrease in the size of an important population of the species. Evidence indicates that greater gliders occur within the landscape surrounding the Project (L. Agnew. pers obs). Habitat suitability assessments for the area indicate that there is approximately 9,650 ha of remnant vegetation suitable as greater glider habitat within 10 km of the Project. The Project has been designed to avoid disturbance to habitats of potentially higher value to greater gliders - the large contiguous habitat patches to the west and south of the Project Site (see Figure 14-24). Total expected impacts of the Project on greater glider habitat is 281 ha. This impact represents 2.9 % of potential habitat for the species within 10 km of	No
Will the action reduce the area of occupancy of an important population?		No
Will the action fragment an existing important		No

Criteria	Assessment	Significant Impact?
population into two or more populations?	the Project. The quantum of direct habitat loss and the nature / location of habitat proposed to be cleared is not considered to be a significant reduction in the area of occupancy of greater gliders within the wider landscape context. The scale of potential habitat degradation from groundwater drawdown is predicted to occur gradually and over considerable time frames (10-20 years following Project commencement) and is not considered to represent a significant reduction in the area of occupancy of greater gliders within the wider landscape context. A range of mitigation and monitoring measures are proposed to be implemented as part of the SSMP and GDEMMP to reduce the scale of impact from groundwater drawdown on vegetation. This includes the implementation of a revegetation along riparian areas of Deep Creek as described in Section 14.7. The Project does not necessitate any clearing of habitat along Tooloombah Creek which is likely to support greater gliders and habitat important for local movement / dispersal. The Project does require clearing of a section of riparian habitat on Deep Creek for the haul road crossing. This clearing, without mitigation, could create an impediment to movement for greater gliders along Deep Creek, thus fragmenting the local population. Implementation of a suite of road crossing treatments will be incorporated within the clearing for the haul road crossing to support greater glider movements. The Project Site is bisected by the Bruce Highway which would have already significantly diminished movement opportunities between greater glider habitats to the east and west. Whilst the loss of minor watercourse vegetation in the northern part of the Project Site will result in removal of habitat potentially used for dispersal, the primary movement opportunities within the landscape will remain, i.e. riparian habitat along Deep Creek and Tooloombah Creek and within the extensive habitat areas located in the west and the south. There are no large patches of known or potential greater glider habitat associated with Deep Creek downstream of the potential indirect impact area, thus any potential impact on this vegetation through groundwater drawdown would not fragment habitat areas. Habitat of comparatively higher value to greater gliders for foraging and breeding comprise large contiguous habitat patches to the north-west, west, and south of the Project. The Project has been designed to avoid disturbance to these areas. It is highly unlikely that the any potential changes to habitat as a result of the Project would disrupt the breeding cycle of an important population if it were to occur. Given the above, and that there is no important population present (DAWE 2020q), the Project would not: • lead to the long-term decrease in the size of an important population of greater glider • reduce the area of occupancy of an important population of greater glider • fragment an existing an important population of greater glider into two or more populations • disrupt the breeding cycle of an important population of greater glider.	
Will the action disrupt the breeding cycle of an important population?		
Will the action adversely affect habitat	There is no recovery plan for the species which identifies habitat critical for greater glider, and there is no habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. In accordance with the DE	Yes

Criteria	Assessment	Significant Impact?
critical to the survival of a species?	(2013), habitat critical for the survival of a species includes areas that are necessary for foraging, breeding, roosting or dispersal. As the Project will result the loss or degradation of habitat required for foraging, breeding, and / or dispersal, which by definition of the significant impact guidelines (DE 2013) is considered to be habitat critical to the survival of the species, the Project will adversely affect habitat critical to the survival of a species. However, in assessing the quantum of habitat loss and the nature / location of habitat proposed to be cleared in the context of habitat to be retained, and within a wider landscape context, the outcome is not considered to be an adverse impact to the survival of the species.	
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Project will result in the modification, destruction and removal of habitat for greater gliders through direct clearing of vegetation and groundwater drawdown. However, the quantum of habitat loss, and the nature / location of habitat proposed to be cleared, in the context of habitat to be retained, and within a wider landscape context, is not considered to be an adverse impact to the species. The Project will not significantly impact on the ecological functionality of the large contiguous patches of habitat to the north-west, west, and south of the Project. The Project does require clearing of a section of riparian habitat on Deep Creek. This clearing, without mitigation, could create an impediment to movement for greater gliders along Deep Creek, thus fragmenting the local population. Implementation of a suite of road crossing treatments will be incorporated to support movement across the haul road. As such, it is concluded that the action would not isolate habitat or decrease the quality of habitat to the extent that the species is likely to decline. Changes to groundwater also have the potential decrease the quality of habitat within the predicted indirect impact area. However, the limited spatial extent of potentially impacted habitat, in the context of habitat to be retained, and within a wider landscape context, is not considered to be an adverse impact to the species. There are no large patches of known or potential greater glider habitat associated with Deep Creek downstream of the potential indirect impact area, thus any potential impact on this vegetation through groundwater drawdown would not fragment potentially important habitat areas. Implementation of a suite of measures, including revegetation and active habitat management, to respond to potential habitat degradation resulting from hydrological changes will assist in reducing the potential impact. Given the above, it is concluded that the Project would not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Weeds and pests are currently prevalent throughout the Project Area. As described in Section 14.4, there is a very low risk that the Project would introduce a new invasive species to the area, or increase the abundance of existing invasive species. Nonetheless, the Project will involve the implementation of weed and pest animal management strategies through the EMP, both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed and pest control measures within and adjacent to the Project Site is likely to relieve the pressure on terrestrial ecological values including habitat for the species. Given the above, it is concluded that the Project will not result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	No

Criteria	Assessment	Significant Impact?
Will the action introduce disease that may cause the species to decline?	Tree dieback caused by the root-rot fungus *Phytophthora cinnamomi* is a threat to greater glider habitat within parts of the species' distribution, though the status of *P. cinnamomi* within the region is unknown. It is possible that this fungus already occurs in the region, though environmental conditions which prevail do not appear to provide the optimum climate for disease expression. Specific hygiene procedures designed to prevent the introduction / spread of *P. cinnamomic* will be prepared for land management works within remnant vegetation areas retained outside the project area (e.g. vehicle washdown stations, footwear cleaning stations). Given this, it is concluded that the Project is unlikely to introduce disease that may cause the species to decline.	No
Will the action interfere substantially with the recovery of the species?	There is no Commonwealth or State recovery plan for the greater glider (DAWE 2020q). TSSC (2016) recommends that there should be a national recovery plan, and notes that in Queensland, there are no species-specific management actions currently in place for the greater glider. In the absence of a recovery plan, the TSSC (2016) identifies the following primary conservation actions: reduce the frequency and intensity of prescribed burns; identify appropriate levels of patch retention, habitat tree retention, and logging rotation in hardwood production; and protect and retain hollow-bearing trees, suitable habitat and habitat connectivity. The action has been designed to minimise disturbance of habitats of comparatively higher value to greater gliders, and will implement measures and strategies to protect and retain hollow-bearing trees. Through the Project's EMP a variety of measures will be implemented to support the proposed conservation actions including fire management, weed control, revegetation of riparian areas and the protection of hollow-bearing trees. If necessary the installation of refuge / next boxes will augment the suite of measures and strategies to reduce potential impacts to greater gliders. Given the above, the Project is considered unlikely to interfere substantially with the recovery of the species.	No

14.6.5.1.2 Koala

The main risks of impact from the Project on koala are vegetation clearing and groundwater drawdown. There is also the potential for impacts as a result of direct mortality from vehicle strike associated with increased traffic. There is a very low risk of impact as a result of increases in weeds, pests, noise, lighting and fire as previously described in Section 14.4.

Vegetation Clearing

The Project Site comprises 487 ha of koala habitat. As presented in Table 14-28 and Figure 14-25 approximately 159.40 ha of koala habitat is proposed to be cleared for the Project. As presented in Figure 14-26, potentially suitable habitat for koala appears widespread in the landscape with the presence of approximately 8,326 ha of well connected, remnant koala habitat within 10 km of the Project Site. There are large contiguous patches of habitat extending to the north-west, west, and south of the Project Site. The proposed clearing of habitat within the Project Site, represents approximately 1.9 % of the potentially equivalent habitat within 10 km of the Project Site.

Clearing of a linear strip of riparian vegetation for the haul road crossing of Deep Creek has the potential to impact koala movement in this area. It is highly likely that koalas disperse under the Bruce Highway bridge to access Deep Creek riparian habitat on either side, and with suitable design strategies, it is expected that the movement opportunities can be facilitated at the location of the

crossing at Deep Creek. The remaining areas of habitat proposed to be cleared are not well connected from an ecological perspective.

Groundwater Drawdown

Predicted declines in vegetation characteristics and condition as a result of groundwater drawdown has the potential to impact habitat for koala. Potential impacts include:

- Loss of shelter / shade due to canopy thinning and / or mortality of shelter trees.
- Reduction in the availability of leaf forage, including eucalypt shoot growth, affecting not only nutrition but also water balance, since koala obtain a significant proportion (upwards of 60%) of their daily water needs from the foliage of feed trees.
- Reduction in leaf (foliar) water content affecting the ability of the species to maintain water balance, particularly under hot / dry conditions or in drought affected areas.
- Increased physiological stress due to reduced availability of food / water and shelter may potentially increase the susceptibility of koalas to diseases such as Chlamydia, which can lead to reduced fertility, increased blindness and increased mortality.

Based on a worst case scenario impact assessment, groundwater drawdown is predicted to impact approximately 165 ha of riparian vegetation which is known or potential habitat for the koala at Deep Creek (Table 14-26). This impact represents approximately 1.9 % of the potentially equivalent habitat within 10 km of the Project Site. As previously described, decline in vegetation condition is expected to occur gradually and will not commence until at least 10 years after Project commencement.

Table 14-28: Koala habitat loss

Habitat Type	Vegetation Clearing (ha)	Groundwater Drawdown (ha)	Total (ha)
Remnant			
Known	138.94	40.88	179.82
Potential Dispersal	2.40	124.34	126.74
Total	141.34	165.22	306.56
Non-remnant			
Known or Potential	18.06	0.00	18.06
Total	18.06	0.00	18.06

Other Potential Impacts

The Project Site currently presents a high risk of vehicle strike for koalas due to its location adjacent to the Bruce Highway. Melzer & Tucker (2011) report that 'There is a long history of koala mortality due to collision with motor vehicles on the St Lawrence stretch of the Bruce Highway'. Within the Project Site itself, a suite of best practice measures will be implemented to minimise the potential for vehicle strike, e.g. access and internal road speed limits, locating specific treatments such as 'slow zones', and user awareness strategies to alert drivers of the potential to encounter koalas. Furthermore, dedicated road crossing treatments will be implemented where the proposed haul road transects Deep Creek. Consistent with best-practice approaches a suite of treatments will include grade-separated crossings with dedicated fauna movement underpasses (including underpass 'furniture') and specific roadside treatments (e.g. koala directional and exclusion fencing, refuge poles, and vegetation management).

Significant Impact Assessment

The direct and indirect impacts on koala have been assessed in accordance with the MNES Significant Impact Guidelines 1.1[30] (DE 2013) as presented in Table 14-29. Taking into account a range of mitigation and management measures to reduce the intensity of the potential impacts of the Project as described in detail in Section 14.7, it is concluded that Project activities will result in a significant residual impact to koala habitat.

The koala is also listed as Vulnerable under the NC Act. The MNES Significant Impact Guidelines 1.1 (DE 2013) for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore, an additional assessment for the QEOP guidelines has not been undertaken and it is assumed that the impact to koala habitat as a MSES is significant by virtue of being significant under the EPBC Act.

Table 14-29: Significant impact assessment - koala

Criteria	Assessment	Significant Impact?
Will the action lead to a long-term decrease in the size of an important population of a species?	DAWE (2020r) does not identify / describe any 'important populations' within the bioregion or broader area surrounding the Project. There are no published estimates of koala population size or density for the bioregion or broader area (DAWE 2020r). As such it is concluded that there is no important population for the koala present in the area. Even if there was an important population present the Project would not lead to a long-term decrease in the size of an important population of the species. Evidence indicates that koalas appear to be widespread in the areas surrounding the Project (L. Agnew. pers obs.). Habitat suitability assessments conclude that the surrounding area supports approximately 8,326 ha of remnant vegetation suitable as koala habitat. The Project has been designed to minimise disturbance to habitats of potentially higher value to koalas - the large contiguous habitat patches to the north-west, west and south of the Project Site (Figure 14-26). Total expected impacts of the Project on koala habitat are 324.62 ha. This impact represents only 3.9 % of potential habitat for the species within 10 km of the Project. The scale of habitat loss and the nature / location of habitat proposed to be cleared is not considered to represent a significant reduction in the area of occupancy of koalas within the wider landscape context. The Project will not create a significant disconnection or fragmentation of local koala habitats – noting that the Bruce Highway bisects local habitat and represents a potentially significant threat to koalas of the local area. The Project will not significantly impact on the ecological functionality of the large contiguous patches of koala habitat to the west and south of the Project. Ecological connectivity to those habitat areas along Deep Creek from the southern part of the Project will not be altered. Implementation of a suite of design and management strategies will be incorporated within the road crossing of Deep Creek to facilitate safe and on-going koala movements. Habitat of comparatively higher value to koalas for foraging and breeding (and where the majority of koala records exist) comprise a set of large contiguous habitat patches to the north-west, west, and south of the Project Site (Austecology 2020b). It is highly unlikely that any potential changes to habitat	No
Will the action reduce the area of occupancy of an important population?		No
Will the action fragment an existing important population into two or more populations?		No
Will the action disrupt the breeding cycle of an		

[30] The EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) criteria for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore an additional assessment for the QEOP has not been applied.

Criteria	Assessment	Significant Impact?
important population?	within the Project Site would disrupt the breeding cycle of an important population if it were to occur. Given the above, and that there is no important population present (DAWE 2020r), the Project would not: • lead to the long-term decrease in the size of an important population of koala • reduce the area of occupancy of an important population of koala • fragment an existing an important population of koala into two or more populations • disrupt the breeding cycle of an important population of koala.	
Will the action adversely affect habitat critical to the survival of a species?	The EPBC Act Referral Guidelines for koala (DE 2014a) provides a habitat assessment tool for identifying critical habitat for the koala. DE (2014a) state that assessment outcomes with a score ≥5 results in the determination that 'habitat critical to the survival of the koala' occurs on a site. The assessment was completed over all areas of potential habitat on the Project Site and found that 'habitat critical to the survival of the koala' occurs. The Project will result in both direct and indirect impacts on this habitat. As such, it must be determined that the Project will adversely affect habitat critical to the survival of a species.	Yes
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The Project will result in the modification, destruction and removal of habitat for this species. However, the quantum of habitat loss, and the nature / location of habitat proposed to be cleared, in the context of habitat to be retained, is highly unlikely to cause the species to decline. As described above, evidence indicates that koalas appear to be widespread in the landscape of the Project Area (L. Agnew. pers obs.) and habitat suitability assessments conclude that the surrounding area supports approximately 8,326 ha of remnant vegetation suitable as koala habitat. The Project has been designed to minimise disturbance to habitats of potentially higher value to koalas - the large contiguous habitat patches to the north-west, west and south of the Project Site (Figure 14-26). The Project will not impact the ecological functionality of these areas. Ecological connectivity to those habitat areas along Deep Creek to the south of the Project will not be impacted - though noting that the Bruce Highway bisects the Project Site, and its operation is an existing threat to koalas within the landscape. Implementation of a suite of design and management strategies will be incorporated within the road crossing of Deep Creek to facilitate safe and on-going koala movements. Changes to groundwater characteristics has the potential decrease the quality of habitat within the predicted impact area. Potential habitat degradation from groundwater drawdown (resulting in a reduction of available habitat) is predicted to commence over considerable time frames (10-20 years following Project commencement). In the context of available habitat in the landscape, the spatial extent of this impact is considered to be insignificant. A suite of measures, including revegetation and active habitat management of potentially impacted riparian vegetation, will be implemented to respond to potential habitat degradation resulting from hydrological changes. This will assist in reducing the scale of the potential impact. Given the above, it is concluded that the Project would not modify, destroy, remove or isolate, or decrease the availability or quality of habitat, to the extent that the species is likely to decline.	No

Criteria	Assessment	Significant Impact?
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Weeds and pests are currently prevalent throughout the Project Area. As described in Section 14.4, there is a very low risk that the Project would introduce a new invasive species to the area, or increase the abundance of existing invasive species. Nonetheless, the Project will involve the implementation of weed and pest animal management strategies through the EMP, both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed and pest control measures within and adjacent to the Project Site is likely to relieve the pressure on terrestrial ecological values including habitat for the species. Given the above, it is concluded that the Project will not result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	No
Will the action introduce disease that may cause the species to decline?	Koala populations are threatened by at least two diseases: chlamydia and Koala retrovirus (KoRV). KoRV is estimated to infect up to 100% of Koalas in Queensland (DE 2020a). It is possible that both these diseases already occur in the populations found on and around the Project Site (latent or otherwise). The Project does not include activities that would result in the spread of such diseases as to cause the species to decline. Increased physiological stress due to reduced availability of food / water and shelter (as a consequence of indirect impacts from groundwater drawdown) may potentially increase the susceptibility of koalas to diseases such as Chlamydia. Implementation of a suite of measures, including revegetation and active habitat management, to respond to potential habitat degradation resulting from hydrological changes may assist in reducing the potential impact. Tree dieback caused by the root-rot fungus *Phytophthora cinnamomi* is a threat to koala habitat within parts of the species' distribution, though the status of *P. cinnamomi* within the region is unknown. Environmental conditions which prevail within the region do not appear to provide the optimum climate for disease expression. Nonetheless, specific hygiene procedures will be prepared / implemented to prevent the introduction / spread of *P. cinnamomi* will be prepared for land management works within remnant vegetation areas retained outside the project disturbance area. As such, the action is unlikely to introduce disease that may cause the species to decline.	No
Will the action interfere substantially with the recovery of the species?	The interim recovery objectives described by DE (2014) are to protect and conserve large, connected areas of koala habitat and maintain corridors and connective habitat that allow movement of koalas between such habitat. The Project would not significantly impact on the achievement of these recovery objectives. The Project will not significantly impact on the ecological functionality of the large contiguous habitat patches to the south and west of the Project. Habitat connectivity to the southern habitat patch along Deep Creek from the southern part of the Project Site will not be impacted - though noting that the Bruce Highway bisects the project area, and likely causes associated on-going threats / impacts to koalas within the landscape. Implementation of a suite of design and management strategies will need to be incorporated within the access road crossing of Deep Creek to facilitate safe and on-going koala movements to and from habitats downstream of the project area, i.e. downstream habitats to the north-east and east of the project area (outside of the mining leases). Given the above, the action is considered unlikely to interfere substantially with the recovery of the species.	No

14.6.5.1.3 Ornamental Snake

The main risks of impact from the Project on ornamental snake is the loss or fragmentation of habitat through the direct clearing of vegetation. There is a very low risk of impact as a result of increases in weeds, pests or surface water changes as previously described in Section 14.4.

Despite extensive survey effort the ornamental snake has not been recorded within the Project Site or Near Surrounds. The nearest record is from September 2011 approximately 3.5 km west of the northern boundary of ML 80187.

Potential non-remnant habitat for this species may occur where patchy to sparse areas of Brigalow regrowth, heavily impacted by clearing and grazing, occur to the north of the Bruce Highway in ML 80187 (Figure 14-27). A degraded strip of riparian remnant vegetation along a creek line that passes through this regrowth area (RE 11.3.25) has the potential to provide shelter and foraging habitat.

However, surveys in the potentially suitable regrowth areas in May 2020, adjacent to the tributaries of Deep Creek, indicated much of the gilgai communities in this area support a sandy, clay, loam surface rather than deep cracking clays the species is typically associated with (pers. comm. J Cousin). Consequently, any cracks in the clays were observed as being filled by surface sand, affording little foraging or shelter habitat for ornamental snake (pers. comm. J Cousin). Cracking clays with higher sand content, often associated with Brigalow / Belah-dominated communities, have a lower fine clay particle fraction and are likely to have less water retention capacity. Water retention capacity increases with an increase in the fine clay particle fraction of soils. This, in turn, influences certain habitat conditions that are important for the ornamental snake and the frog species it preys upon. Given the structural habitat conditions (deep cracking clay soils) in these areas are poorly developed, the depauperate nature of key resources (fallen timber) and the highly degraded condition of these areas due to clearing and grazing, it is unlikely that this habitat supports a productive set of conditions and resources required for ornamental snake.

However, in the absence of confirmation of species presence, and applying the precautionary principle, the Project has the potential to impact on 18.79 ha of potential shelter and foraging habitat and 444.75 ha of potential non-remnant habitat for the ornamental snake (Figure 14-27).

Significant Impact Assessment

The direct impacts on ornamental snake have been assessed in accordance with the MNES Significant Impact Guidelines 1.1[31] (DE 2013) as presented in Table 14-30. Taking into account a range of mitigation and management measures to reduce the intensity of the potential impacts of the Project, as described in detail in Section 14.7, it is concluded that Project activities will not result in a significant residual impact to ornamental snake. However, it is noted that in CDM Smith (2018), an offset was proposed for impacts on potential remnant ornamental snake habitat, despite the Project not having a significant impact on the species. As such, this commitment continues to be honoured and an offset for ornamental snake is described in Section 14.8.

The ornamental snake is also listed as Vulnerable under the NC Act. The MNES Significant Impact Guidelines 1.1 (DE 2013) for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore, an additional assessment for the QEOP guidelines has not been undertaken and it is assumed that the

[31] The EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) criteria for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore an additional assessment for the QEOP has not been applied.

impact to ornamental snake habitat as a MSES is not significant by virtue of being not significant under the EPBC Act.

Table 14-30: Significant impact assessment - ornamental snake

Criteria	Assessment	Significant Impact?
Will the action lead to a long-term decrease in the size of an important population of a species?	As described in DSEWPaC (2011a), given that ornamental snake is difficult to detect and population information is limited, important habitat for ornamental snake is a surrogate definition for an important population of the species. The guidelines state an occurrence of suitable habitat is considered important for ornamental snake when it is: • habitat where the species has been identified during a survey • near the limit of the species' known range • large patches of contiguous, suitable habitat and viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations) or • a habitat type where the species is identified during a survey, but which was previously thought not to support the species. Ornamental snake has not been identified within the Project Site despite targeted surveys. The Project Site is not near the limit of the species known range. There are substantial areas of patchy to sparse Brigalow regrowth present north of the Bruce Highway. These areas have been heavily impacted by clearing, grazing and introduced pasture grasses which are known threats to ornamental snake and limit the suitability of potential habitat (DE 2014b). Surveys in these regrowth areas adjacent to the tributaries of Deep Creek in May 2020 indicated much of the gilgai communities in this area support a sandy, clay, loam surface rather than deep cracking clays the species is typically associated with (pers. comm J Cousin). Given the structural habitat conditions (deep cracking clay soils) in these areas are poorly developed, the depauperate nature of key resources (fallen timber) and the highly degraded condition of these areas due to clearing and grazing, it is unlikely that this habitat supports a productive set of conditions and resources required for ornamental snake, and no important habitat is considered to be present. Given the limited suitability of this habitat for the species, potential habitat within the Project Site is not considered to represent contiguous, suitable habitat within viable landscape corridors (necessary for the purposes of breeding, dispersal or maintaining the genetic diversity of the species over successive generations). Based on the above, it is concluded that there is no important population or important habitat for the ornamental snake present in the Project Site, and the Project will not: • lead to the long-term decrease in the size of an important population of ornamental snake. • reduce the area of occupancy of an important population of ornamental snake. • fragment an existing important population of the ornamental snake into two or more populations. • disrupt the breeding cycle of an important population.	No
Will the action reduce the area of occupancy of an important population?		No
Will the action fragment an existing important population into two or more populations?		No
Will the action disrupt the breeding cycle of an important population?		No

Criteria	Assessment	Significant Impact?
Will the action adversely affect habitat critical to the survival of a species?	Despite targeted surveys, ornamental snake has not been identified within the Project Site and no habitat critical to the survival of the species has been identified as detailed above. As such, it is concluded that the Project will not: • adversely affect habitat critical to the survival of the species • modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?		No
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Weeds and pests are currently prevalent throughout the Project Area. As described in Section 14.4, there is a very low risk that the Project would introduce a new invasive species to the area, or increase the abundance of existing invasive species. Nonetheless, the Project will involve the implementation of weed and pest animal management strategies through the EMP, both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed and pest control measures within and adjacent to the Project Site is likely to relieve the pressure on terrestrial ecological values including habitat for the species. Given the above, it is concluded that the Project will not result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	No
Will the action introduce disease that may cause the species to decline?	The EMP will incorporate management measures for 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 the species to decline.	No
Will the action interfere substantially with the recovery of the species?	There is no recovery plan for this species. DAWE (2020e) state that no recovery plan is required and that the approved conservation advice for the species provides sufficient direction to implement priority actions and mitigate against key threats. The conservation advice for the species states the following priority recovery and threat abatement actions: • Identify populations of high conservation priority. • Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate inclusion in reserve tenure if possible. • Minimise adverse impacts from land use at known sites. • Control introduced pests such as pigs to manage threats at known sites. • Develop and implement a management plan for the control of cane toads in the region. • Raise awareness of the ornamental snake and other reptiles found in the Brigalow Belt Bioregion within the local community.	No

Criteria	Assessment	Significant Impact?
	The Project will not interfere substantially with these recovery and threat abatement actions, as such, the Project will not interfere substantially with the recovery of the species.	

14.6.5.1.4 Squatter Pigeon

The main risks of impact from the Project on squatter pigeon (southern) are vegetation clearing and groundwater drawdown. There is a very low risk of impact as a result of increases in weeds, pests, noise, lighting and fire as previously described in Section 14.4.

Vegetation Clearing

Based on the habitat categorisation described by DEE (2019a), the Project Site comprises 413.60 ha of remnant habitat and 514.60 ha of non-remnant habitat for the squatter pigeon (southern), including foraging, breeding and dispersal habitat. Table 14-31 summarises Project impacts on this habitat. Vegetation clearing will result in the direct loss of 141.30 ha of remnant habitat for the squatter pigeon (southern). The Project will also impact 276.10 ha of non-remnant habitat. Figure 14-28 illustrates the location of habitat that will be impacted.

As shown in Figure 14-29 potentially suitable habitat for squatter pigeon appears widespread in the landscape with the presence of approximately 19,455 ha of well-connected remnant habitat within 10 km of the Project Site. There are large contiguous patches of habitat extending to the north-west, west, and south of the Project Site. The proposed clearing of 141.30 ha of remnant habitat within the Project Site, represents approximately 0.73 % % of the potentially equivalent habitat within 10 km of the Project Site.

Groundwater Drawdown

Predicted declines in vegetation characteristics and condition as a result of groundwater drawdown has the potential to impact habitat for squatter pigeon. Given the spectrum of habitat conditions and resources that squatter pigeons are known to use, there is a comparatively higher level of uncertainty as to the nature and magnitude of potential impacts of groundwater drawdown, and thus, the significance of the impacts to squatter pigeons, compared to the other species assessed in this chapter. In addition, the areas which may be subject to groundwater drawdown impacts do not support the full suite of 'key habitat requirements' for the species. Potential habitat value is likely limited to the provision of drinking points within the waterway, and these values not expected to be significantly impacted by groundwater drawdown associated with the Project.

Notwithstanding the above, based on a worst case scenario impact assessment, groundwater drawdown is predicted to impact approximately 165 ha of riparian vegetation which is known or potential habitat for the squatter pigeon at Deep Creek (Table 14-31). This impact represents approximately 0.85% of the potentially equivalent habitat within 10 km of the Project Site. As previously described, decline in vegetation condition is expected to occur gradually and will not commence until at least 10 years after Project commencement.

Table 14-31: Squatter pigeon habitat loss

Habitat Type	Vegetation Clearing (ha)	Groundwater Drawdown (ha)	Total (ha)
Remnant			
Known or Potential Foraging	113.40	38.29	151.69
Potential Breeding	5.20	0.00	5.20
Potential Dispersal	22.70	126.92	149.62
Total	141.30	165.21	306.51
Non-remnant			
Known or Potential Foraging	168.80	0.00	168.80
Potential Breeding	0.00	0.00	0.00
Potential Dispersal	107.30	0.00	107.30
Total	276.10	0.00	276.10

Significant Impact Assessment

The direct and indirect impacts on squatter pigeon have been assessed in accordance with the MNES Significant Impact Guidelines 1.1[32] (DE 2013) as presented in Table 14-32. Taking into account a range of mitigation and management measures to reduce the intensity of the potential impacts of the Project as described in detail in Section 14.7, it is concluded that Project activities will result in a significant residual impact to remnant habitat for squatter pigeon as the Project will adversely affect remnant habitat critical to the survival of the species. However, the scale of the impact on non-remnant habitat (grazed pasture), including that depicted on Figure 14-28 as 'potential dispersal habitat', would not result in a significant impact to the squatter pigeon. In the context of the availability of similar non-remnant habitat across the surrounding area, the potential impact of the removal of non-remnant habitat is regarded as negligible.

The squatter pigeon is also listed as Vulnerable under the NC Act. The MNES Significant Impact Guidelines 1.1 (DE 2013) for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore, an additional assessment for the QEOP guidelines has not been undertaken and it is assumed that the impact to squatter pigeon remnant habitat as a MSES is significant by virtue of being significant under the EPBC Act.

Table 14-32: Significant impact assessment - squatter pigeon

Criteria	Assessment	Significant Impact?
Will the action lead to a long-term decrease in the size of an important population of a species?	DAWE (2020s) does not identify / describe any 'important populations' within the region relevant to the Project Site, i.e. north of the Carnarvon Ranges in Central Queensland. DAWE (2020s) concludes that the squatter pigeon (southern) remains common north of the Carnarvon Ranges and is considered to be distributed as a single, continuous (i.e. inter-breeding) sub-population. As such, it is concluded that there is no important population for the squatter pigeon present in the Project Site.	No
Will the action reduce the area of occupancy of an		No

[32] The EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) criteria for Vulnerable species closely aligns with the QEOP Significant Residual Impact Guidelines (DEHP 2014) criteria for Vulnerable species listed under the NC Act. Therefore an additional assessment for the QEOP has not been applied.

Criteria	Assessment	Significant Impact?
important population?	Even if there was an important population present, the Project would not lead to a long-term decrease in the size of an important population of the species. Evidence indicates that squatter pigeons occur throughout the landscape surrounding the Project and that potentially suitable remnant woodland habitat is widespread (L. Agnew. pers obs.), and as illustrated in Figure 14-29. There are numerous records of squatter pigeons within cleared and grazed landscapes throughout the wider area and that type of non-remnant habitat is widespread within the landscape surrounding the Project (L. Agnew. pers obs.). As illustrated in Figure 14-29, approximately 19,455 ha of suitable remnant habitat for the squatter pigeon is present within the 10 km of the Project Site. The Project will impact a total of 306.51 ha of remnant habitat for the species (direct and indirect impact). This impact represents only 1.5 % of potential remnant habitat for the species within 10 km of the Project. The quantum of habitat loss and the nature / location of habitat proposed to be cleared is not considered to be a significant reduction in the area of occupancy of squatter pigeons within the area. The Project will be largely contained within cleared pastoral lands, though will include clearing of areas of remnant woodland. The proposed clearing, whether on cleared pastoral lands or remnant woodland, will not be of the extent or location which will create fragmentation of the squatter pigeon sub-population within the area of known occupancy, or within the landscape surrounding the Project. A large area of remnant woodland habitat, of comparatively higher value as breeding habitat for squatter pigeons, will be retained to the west of the Project (Austecology 2020b). Based on the habitat classification described by DEE (2019a) only 5.20 ha of potential breeding habitat will be impacted by the Project. The scale of the habitat clearing within the Project's disturbance footprint is unlikely to have any impact on the breeding cycles of squatter pigeons within the context of the larger tracts of woodland habitat adjacent to the Project Site. In addition, areas of potential indirect impact do not support breeding habitat and any changes to existing habitat attributes as a result of groundwater drawdown would not have any impact on the breeding cycles of squatter pigeons. Based on the above, it is concluded that there is no important population for the squatter pigeon present in the area, and the Project will not: • Lead to the long-term decrease in the size of an important population of squatter pigeon. • Reduce the area of occupancy of an important population of squatter pigeon. • Fragment an existing an important population of squatter pigeon into two or more populations. • Disrupt the breeding cycle of an important population.	
Will the action fragment an existing important population into two or more populations?		No
Will the action disrupt the breeding cycle of an important population?		
Will the action adversely affect habitat critical to the survival of a species?	There is no Commonwealth or State recovery plan which identifies habitat critical to the survival of squatter pigeon (southern), and there is no habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act. DEE (2019a) provides a habitat categorisation to inform the assessment of 'key habitat requirements' for the species. This includes definitions	Yes – remnant habitat only

Criteria	Assessment	Significant Impact?
	for breeding, foraging and dispersal habitat. Implementing an assessment based on that information it must be determined that the Project will adversely affect habitat for breeding, foraging and dispersal, and as such habitat critical for the survival of the species. Therefore, it must be determined that the Project constitutes a significant impact to squatter pigeon (southern) within the Project Site. However, the significance of the impact is considered to be limited to impacts on remnant habitat (306.51 ha). The impact of removing non-remnant habitat (grazed pasture), including that depicted on Figure 14-28 as 'potential dispersal habitat', would not result in a significant impact to the squatter pigeon. In the context of the availability of similar non-remnant habitat across the surrounding area, the potential impact of the removal of non-remnant habitat is regarded as negligible.	
Will the action modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The scale of the proposed habitat clearing (both remnant and non-remnant vegetation) within the Project's disturbance footprint is unlikely to have an impact to the extent that would result in a decline of the species. Evidence indicates that squatter pigeons occur throughout the landscape surrounding the Project and that potentially suitable remnant habitat is widespread (L. Agnew. pers obs.). There are numerous records of squatter pigeons within cleared and grazed landscapes throughout the wider area and that type non-remnant habitat is widespread within the landscape surrounding the Project (L. Agnew. pers obs.). As illustrated in Figure 14-29, approximately 19,455 ha of suitable remnant habitat for the squatter pigeon is present within the 10 km of the Project Site. The Project will impact a total area of 306.51 ha of remnant habitat for the species. This impact represents only 1.5 % of potential habitat for the species within 10 km of the Project. Various land and habitat management strategies for the Project will be implemented through the EMP and SSMP to result in positive outcomes for squatter pigeons and prevent further degradation of retained and adjacent habitat (e.g. buffering and rehabilitation of retained woodland habitat, control strategies for feral plants and animals, and management of bushfire fuel loads). Based on the above, it is concluded that the action would not modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No
Will the action result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	Weeds and pests are currently prevalent throughout the Project Area. As described in Section 14.4, there is a very low risk that the Project would introduce a new invasive species to the area, or increase the abundance of existing invasive species. Nonetheless, the Project will involve the implementation of weed and pest animal management strategies through the EMP, both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed and pest control measures within and adjacent to the Project Site is likely to relieve the pressure on terrestrial ecological values including habitat for the species. Given the above, it is concluded that the Project will not result in an invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	No

Criteria	Assessment	Significant Impact?
Will the action introduce disease that may cause the species to decline?	There is a negligible potential for the action to introduce disease that may cause the species to decline.	No
Will the action interfere substantially with the recovery of the species?	There is no Commonwealth or State recovery plan for the squatter pigeon. DAWE (2020r) state that no recovery plan is required and that the approved conservation advice for the subspecies provides sufficient direction to implement priority actions and mitigate against key threats. The conservation advice for the species states the following priority recovery and threat abatement actions: • Identify sub-populations of high conservation priority, especially in the southern part of the squatter pigeon's (southern) range. • Protect and rehabilitate areas of vegetation that support important sub-populations. • Protect sub-populations of the listed subspecies through the development of covenants, conservation agreements or inclusion in reserve tenure. • Develop and implement a stock management plan for key sites. • Develop and implement a management plan, or nominate an existing plan to be implemented, for the control and eradication of feral herbivores in areas inhabited by the squatter pigeon (southern). • Raise awareness of the squatter pigeon (southern) within the local community, particularly among land managers. • Monitor selected sub-populations throughout the distribution of the subspecies to identify rates of population change. • Identify preferred food plants, and the responses of these to fire and grazing regimes. • Determine patterns of dispersal or residency, and the factors that may determine these. • Assess reproductive success, and the factors that affect this. • Assess the species' status, and the impacts of mining, in central Queensland. The Project will not interfere with these actions.	No

14.6.5.1.5 Short-beaked Echidna

All remnant vegetation impacted by the Project could be considered potential habitat for the echidna given the species occurs in almost all terrestrial habitats, except for intensively managed farms. However, habitat for the echidna also occurs extensively across the Project Area and the clearing of habitat for the Project is not expected to result in a significant impact to the species.

In addition, there is a very low risk of impact as a result of increased pests (particularly wild dogs) as previously described in Section 14.4. There is also the potential for impacts as a result of direct mortality from vehicle strike associated with increased traffic. Within the Project Site, a suite of best practice measures will be implemented to minimise the potential for vehicle strike, e.g. access and internal road speed limits, locating specific treatments such as 'slow zones', and user awareness strategies to alert drivers of the potential to encounter echidnas.

A significant impact assessment for the echidna has been undertaken in accordance with the QEOP Significant Residual Impact Guidelines (DEHP 2014). As summarised in Table 14-33, the Project will not have a significant residual impact on the echidna.

Table 14-33: Significant impact assessment - echidna

Criteria	Assessment	Significant Impact?
Result in a long-term decrease in the size of a local population, or	Species is known to occur onsite. Species is dispersed across the entire continent and is Australia's most widespread native mammal, occurring in almost all terrestrial habitats No subpopulations noted on mainland Australia. As such, the Project is unlikely to lead to a long-term decrease of a local population.	No
Result in a reduced extent of occurrence of the species, or	Extent of occurrence refers to the area bounded by an imaginary line around all known records of a species (termed minimum convex polygon). Unless a development is near the edge of a species' distribution and the development is likely to contract that minimum convex polygon, then it is very unlikely that a development will reduce the extent of occurrence of a species.	No
Result in fragmentation of an existing population, or	The echidna is widespread throughout Australia and is known to occur from the wider Project Area. There is extensive suitable habitat for the species throughout the Project Area. The Project will not result in fragmentation of an existing population or in genetically distinct populations forming as a result of habitat isolation.	No
Result in genetically distinct populations forming as a result of habitat isolation, or		No
Result in disruption to ecologically significant locations (breeding, feeding or nesting sites) of a species	The echidna has the potential to be encountered at feeding and resting sites during construction clearing as it is known to occur in the Project Area. Mitigation measures during construction will include the presence of qualified fauna spotter / ecologist to ensure that the Project does not disrupt ecologically significant locations for the echidna.	No

14.6.5.1.6 Latham's Snipe

The only migratory shorebird species known to occur within the Project Site and Near Surrounds is Latham's snipe (EPBC Act – MS; NC Act – SL). Potential impacts to Latham's snipe due to Project activities include loss or fragmentation of habitat through direct clearing and establishment of Project infrastructure.

Impacts to Latham's snipe within the Project Site and Near Surrounds have been assessed in accordance with the EPBC Act Policy Statement 3.21 (DEE 2017a) as presented in Table 14-34. Based on this assessment, the Project is not expected to result in a significant residual impact to Latham's snipe. Special least concern species which are also listed as Migratory under the EPBC Act do not require additional assessment against the QEOP Significant Residual Impact Guidelines (DEHP 2014).

Table 14-34: Significant impact assessment – Latham's snipe (Project Site and Near Surrounds)

Criteria	Assessment	Significant impact?
Does the migratory shorebird species habitat within the Project Site and Near Surrounds represent 'important habitat'?	The EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017a) 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 or • areas that support at least 18 individuals of the species. Six important sites have been identified in Australia located in Victoria (five sites) and Tasmania (one site). Latham's snipe was recorded at a single farm dam within the Project Site in February 2017 with up to 15 individuals recorded (Figure 14-22). A single individual was also observed at a large dam to the south of the Project in September 2017. Individuals were also recorded on farm dams in the wider area in September 2017 and January 2018. Although below the threshold described above, 15 individuals is a reasonably 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 Site during the February 2017 survey and no other migratory shorebird / wader species were recorded. Habitat where Latham's snipe was recorded is a highly degraded, ephemeral farm dam (0.6 ha in size). Seasonal wetland (RE 11.3.27) within the Project Site (though outside the Disturbance Footprint) may also support a small area (approximately 2.5 ha) of potentially suitable habitat. Ephemeral farm dams of this type are common and widespread throughout the Study Area outside of the Project Site. Habitat within the Project Site and Near Surrounds is not considered to be important habitat for Latham's snipe as it does not meet the criteria defined within DEE (2017a), it is a relatively small area, and the species readily occupies artificial and ephemeral swamps which are abundant in the broader area.	NA
Loss of important habitat Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site Increased disturbance to important habitat leading to a substantial reduction in migratory shorebirds using important habitat Direct mortality of birds leading to	Habitat within the Project Site and Near Surrounds is not considered to be important habitat for Latham's Snipe. Nonetheless, any impacts arising from the removal of the farm dams would not be expected to significantly impact Latham's snipe particularly given the abundance of similar suitable habitat for the species in the surrounding areas. Potential impacts on this species will be managed through the implementation of the Project's SSMP including the following: • Habitat areas to be cleared will be thoroughly checked by a fauna spotter-catcher prior to clearing. • Fauna-spotter catcher will be present for all clearing activities. The spotter-catcher will be required to hold a Permit to Take or Interfere with Wildlife. • Prior to construction at artificial dams, a qualified ecologist will inspect the area and if required, remove native fauna, which will be relocated to a suitable pre-determined area.	No

Criteria	Assessment	Significant impact?
substantial reduction in migratory shorebird numbers using important habitat	Given that no important habitat for Latham's Snipe has been identified within the Project Site, and the abundance of farm dams in the region, the Project will not result in the: • Loss of important habitat for the species. • Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site. • Increased disturbance to important habitat leading to a substantial reduction in migratory shorebirds using important habitat. • Direct mortality of birds leading to substantial reduction in migratory shorebird numbers using important habitat.	

14.6.5.1.7 Other Migratory Birds

Five migratory birds listed under the EPBC Act are known or likely to occur within the Project Site or Near Surrounds including white-throated needletail (EPBC Act – V/M; NC Act – V)[33], fork-tailed swift (EPBC Act – M; NC Act – SL), glossy ibis (EPBC Act – M; NC Act – SL), oriental cuckoo (EPBC Act – M; NC Act – SL) and rufous fantail (EPBC Act – M; NC Act – SL). Potential impacts to these species due to Project activities include loss or fragmentation of habitat through the direct clearing of vegetation and groundwater drawdown.

Impacts to these species have been assessed in accordance with the EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) as presented in Table 14-35. Based on this assessment, the Project is not expected to result in a significant residual impact to these migratory bird species. Special least concern species which are also listed as Migratory under the EPBC Act do not require additional assessment against the QEOP Significant Residual Impact Guidelines (DEHP 2014).

Table 14-35: Significant impact assessment - migratory birds (Project Site and Near Surrounds)

Criteria	Assessment	Significant impact?
Does the migratory species habitat within the Project Site and Near Surrounds represent 'important habitat'?	Based on the definition of important habitat described in DE (2015b) there is potential for important habitat for these species to occur in the areas surrounding the Project Site, although is not considered to be present within the Project Site itself, as described below. DE (2015b) regard 'important habitat' for the white-throated needletail as 'Large tracts of native vegetation, particularly forest, may be a key habitat requirement for species. Found to roost in tree hollows in tall trees on ridge-tops, on bark or rock faces. Appears to have traditional roost sites'. Habitat consistent with this description may be located in the large contiguous tracts of vegetation to the west of the Project Site. DE (2015b) regard 'important habitat' for the fork-tailed swift as 'Non-breeding habitat only: Found across a range of habitats, from inland open plains to wooded areas, where it is exclusively aerial.' There are large wooded areas of habitat which are consistent with the description of important habitat located to the west of the Project Site description. There is no habitat within the Project Site	NA

[33] In 2019 white-throated needletail was listed as Vulnerable under the EPBC Act and NC Act, adding to its existing listing as Migratory under the EPBC Act. As the Vulnerable listing occurred following submission of the EIS, the significant impact assessment presented in this chapter considers the Migratory criteria only.

Criteria	Assessment	Significant impact?
	consistent with the with the definition of important habitat for the fork-tailed swift. DE (2015b) regard 'important habitat' for oriental cuckoo as 'Non-breeding habitat only: monsoonal rainforest, vine thickets, wet sclerophyll forest or open Casuarina, Acacia or Eucalyptus woodlands. Frequently at edges or ecotones between habitat types. Riparian forest is favoured habitat in the Kimberley region.' Potentially suitable habitat for the species occurs in denser and wider sections of riparian vegetation along Deep Creek. Potentially this species could occur within such habitat, though unlikely to be resident. There is potentially suitable habitat along Tooloombah Creek and within the Tooloombah Creek Conservation Park. Given the extent of potentially suitable habitat within Tooloombah Creek Conservation Park, the species may be resident there. DE (2015b) regard 'important habitat' for rufous fantail as 'Moist, dense habitats, including mangroves, rainforest, riparian forests and thickets, and wet eucalypt forests with a dense understorey. When on passage a wider range of habitats are used including dry eucalypt forests and woodlands and Brigalow shrublands'. Within the Project Site and Near Surrounds, potentially suitable habitat occurs in denser and wider sections of riparian vegetation along Deep Creek. Potentially this species could occur within such habitat, though unlikely to be resident. There is also potentially suitable habitat along Tooloombah Creek. The Project Site and Near Surrounds are likely to provide suitable foraging habitat for glossy ibis, particularly following heavy rainfall. However, there is no definition of important habitat for this species and the largest contiguous areas of prime habitat in Australia is inland and northern floodplains (DAWE 2020t).	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Whilst there is the potential for important habitat for these species to occur within denser vegetation along Deep and Tooloombah Creek, and within large tracts of vegetation located to the west of the Project, none of this habitat will be substantially modified, destroyed or isolated by Project activities. Any impacts on vegetation which may be suitable for these species will be relatively localised and restricted to a small area of riparian vegetation at Deep Creek. Implementation of a suite of measures, including weed control, revegetation and active habitat management, to respond to potential habitat degradation resulting from hydrological changes (groundwater drawdown), will assist in reducing the potential impact. As such it is not expected that the Project would substantially modify, destroy or isolate an area of important habitat for migratory species if it was to occur.	No
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Whilst there is potential for introduction and spread of invasive species as a result of the Project, it is considered unlikely that the Project would contribute to a significant further change to existing threats given the current prevalence of weeds and pests in the area and the land use history for the Project Site and surrounding area. The Project will involve the implementation of a comprehensive suite of best-practice weed and pest animal management strategies through the EMP, both within the Project Site and in adjacent areas of the Mamelon Station. Furthermore, the implementation of weed	No

Criteria	Assessment	Significant impact?
	and pest control measures within and adjacent to the Project Site is likely to relieve the pressure on terrestrial ecological habitat within and surrounding the Project Site.	
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	What constitutes an 'ecologically significant proportion of the population' is ill-defined. Under the significant impact guidelines (DE 2013), factors that should be considered for each species includes the species' population status, genetic distinctiveness specific behavioural patterns including site fidelity and dispersal patterns (DE 2013). There is no evidence that there is an ecologically significant proportion of the population of these migratory birds within the Project Site and Near Surrounds. None of these species were observed in large enough numbers that may represent an ecologically significant proportion of the population of a migratory species. Only one species was recorded on more than a single survey event (fork-tailed swift).	No

14.6.5.2 Species Known or Likely to Occur (Downstream)

As listed in Table 14-15, a total of 23 fauna species listed under the NC Act and/or EPBC Act have been identified as known or likely to occur in the downstream environment. The Project will not result in any impacts on these species. Groundwater drawdown is not predicted to occur beneath the Styx River and therefore loss of potential baseflow in the Styx River estuary and Broad Sound wetlands, which provides habitat for these species, will not occur. As presented in detail in Chapter 9 – Surface Water, there will be no changes to water quality in the downstream environment as a result of the Project, and therefore there are not expected to be any impacts to birds that utilise water or intertidal habitats downstream of the Project.

14.6.5.2.1 Significant Impact Assessment

Migratory Shorebirds

There are 16 migratory shorebirds listed under the EPBC Act considered known or likely to occur in the downstream environment. These species are also listed under the NC Act as either threatened or special least concern (SL). These are bar-tailed godwit (EPBC Act – V/ MS; NC Act - V), common greenshank (EPBC Act – MS; NC Act - SL), curlew sandpiper (EPBC Act – CE/MS; NC Act - E), eastern curlew (EPBC Act – CE/MS; NC Act - E), great knot (EPBC Act – CE/MS; NC Act - E), greater sand plover (EPBC Act – V/ MS; NC Act – V), grey plover (EPBC Act – MS; NC Act - SL), grey-tailed tattler (EPBC Act – MS; NC Act - SL), Latham's snipe (EPBC Act – MS; NC Act - SL) lesser sand plover (EPBC Act – E/MS; NC Act - E), marsh sandpiper (EPBC Act – MS; NC Act - SL), red knot (EPBC Act – E/MS; NC Act - E), red-necked stint (EPBC Act – MS; NC Act - SL), sharp-tailed sandpiper (EPBC Act – MS; NC Act - SL), terek sandpiper (EPBC Act – MS; NC Act - SL) and whimbrel (EPBC Act – MS; NC Act - SL).

Impacts to these species have been assessed in accordance with the EPBC Act Policy Statement 3.21 (DEE 2017a) as presented in Table 14-36. Based on this assessment, the Project is not expected to result in a significant residual impact to migratory shorebirds in the downstream environment. Special least concern species which are also listed as Migratory under the EPBC Act do not require additional assessment against the QEOP Significant Residual Impact Guidelines (DEHP 2014).

Table 14-36: Significant impact assessment - migratory shorebirds (downstream)

Criteria	Assessment	Significant impact?
Loss of important habitat	The Broad Sound wetland is noted as providing important habitat for waterbirds including substantial aggregations of a range of migratory shorebirds listed under the EPBC Act (DEE 2017b). Shoalwater Bay and Broad Sound are noted as sites of international importance for the following migratory shorebirds; bar-tailed godwit, whimbrel, eastern curlew, terek sandpiper, grey-tailed tattler and great knot. As such, important habitat for a number of migratory shorebirds listed above may occur downstream of the Project, both within the Styx River estuary and nearshore/intertidal environments of Broad Sound. These areas are at least 10 km downstream of the Project and therefore will not be subject to any direct impacts as a result of the Project that would cause 'direct mortality of birds leading to substantial reduction in migratory shorebird numbers using important habitat'. As described in Section 14.4.3, 14.4.4 and 14.4.5 potential indirect impacts to downstream habitats as a result of groundwater drawdown, surface water changes and erosion of stream banks or are not anticipated. As such, the Project will not: • Result in a loss of important habitat for migratory shorebirds. • Cause degradation of, or increase disturbance to, important habitat leading to a substantial reduction in migratory shorebirds using the site.	No
Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site		No
Increased disturbance to important habitat leading to a substantial reduction in migratory shorebirds using important habitat		No
Direct mortality of birds leading to substantial reduction in migratory shorebird numbers using important habitat		No

Migratory Birds (Non-Migratory Shorebirds)

There are five migratory and special least concern birds listed under the EPBC Act and NC Act considered known or likely to occur in the downstream environment. These are Caspian tern (EPBC Act – M; NC Act - SL), crested tern EPBC Act – M; NC Act - SL), eastern osprey EPBC Act – M; NC Act - SL), gull-billed tern EPBC Act – M; NC Act - SL) and little tern EPBC Act – M; NC Act - SL). Impacts to these species have been assessed in accordance with the EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) as presented in Table 14-37. Based on this assessment, the Project is not expected to result in a significant residual impact to habitat for these migratory bird species. Special least concern species which are also listed as Migratory under the EPBC Act do not require additional assessment against the QEOP Significant Residual Impact Guidelines (DEHP 2014).

Table 14-37: Significant impact assessment - migratory species (downstream)

Criteria	Assessment	Significant impact?
Does the migratory species habitat within the downstream environment represent 'important habitat'?	Based on the definition of 'important habitat' in DE (2013) there is some uncertainty whether habitat in the downstream environment would constitute important habitat for these species. What constitutes an 'ecologically significant proportion of the population' is ill-defined. Under the significant impact guidelines, factors that should be considered for each species includes the species' population status, genetic distinctiveness and	NA

Criteria	Assessment	Significant impact?
	specific behavioural patterns including site fidelity and dispersal patterns (DE 2013). None of the migratory species recorded were observed in significantly large numbers that may represent an ecologically significant proportion of the population of a migratory species. Caspian tern has been recorded regularly in low numbers at roost sites in western Broad Sound in recent years. Gull-billed tern has been regularly at roost sites, sometimes in large numbers, in western Broad Sound (refer Appendix A9h). There is one Wildlife Online record (DSITIA 2020), one WildNet record from western Broad Sound (DES 2020b) for crested tern. There is one WildNet record of eastern osprey within the Torrilla Plain in the eastern Broad Sound (DES 2020b). Several WildNet records in Broad Sound area on and near Turtle Island for little tern. Whilst there is some uncertainty regarding the importance of the downstream environment for these species, a significant impact assessment has been undertaken as per the below, and the outcome is that there is no pathway to impact for any of these downstream species, therefore it is immaterial whether the downstream environment is important habitat or not.	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Habitat for these species is located at least 10 km downstream of the Project, and as such there will be no direct impact on this habitat from the Project. As described in Section 14.4.3, 14.4.4 and 14.4.5 potential indirect impacts to downstream habitats as a result of groundwater drawdown, surface water changes and erosion of stream banks or are not anticipated. As such, the Project will not: • Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species or • Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species		No
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	The Project is highly unlikely to lead to the introduction or spread of any invasive species detrimental to intertidal areas, or that is a threat to migratory birds that inhabit intertidal environments.	No

Critically Endangered and Endangered Species

There are four Critically Endangered bird species listed under the EPBC Act as known to occur in the downstream environment including curlew sandpiper (EPBC Act – CE/MS; NC Act - E), eastern curlew (EPBC Act – CE/MS; NC Act - E), great knot (EPBC Act – CE/MS; NC Act - E) and yellow chat (EPBC Act – CE; NC Act – E). These species are also listed as Endangered under the NC Act.

There are three Endangered bird species listed under the EPBC Act known to occur in the downstream environment including Australian painted snipe (EPBC Act – E/MS; NC Act - E), lesser sand plover (EPBC Act – E/MS; NC Act - E) and red knot (EPBC Act – E/MS; NC Act - E). These species are also listed as Endangered under the NC Act.

Impacts to these species have been assessed in accordance with the MNES Significant Impact Guidelines 1.1 (DE 2013) and the QEOP Significant Residual Impact Guideline (DEHP 2014). These two sets of guidelines are very similar, so have been presented together in Table 14-38. Based on this assessment, the Project is not expected to result in a significant residual impact to habitat for these threatened bird species.

Table 14-38: Significant impact assessment – critically endangered and endangered species (downstream)

Significant impact criteria	Response	Significant impact?
Lead to a long-term decrease in the size of a population ***(local population)***	Nationally important numbers of great knot, curlew sandpiper, eastern curlew, lesser sand plover and red knot are known to occur in Broad Sound (Jaensch 2009). Habitat critical to the survival of a species refers to, amongst other things, areas that are necessary for activities such as foraging, breeding, roosting, or dispersal. Great knot, curlew sandpiper, eastern curlew, lesser sand plover and red knot are known to roost in Broad Sound (Jaensch 2009). As such, it considered likely that habitat critical to the survival of these species occurs in Broad Sound. For yellow chats, approximately 75% of the known population occurs at the Torilla Plains (Houston and Melzer 2008). Habitat critical to the survival of yellow chat is considered to be present within the Torilla Plains. There are no population estimates for Australian painted snipe in the downstream environment, and there are only three database records for this species from Broad Sound region (including St Lawrence wetlands). TSSC (2013) identifies important areas for this species including the Fitzroy Basin of Central Queensland. The Project is located adjacent to the Fitzroy Basin. Whilst there are known populations of the majority of these species present in the downstream environment, as well as habitat critical to the survival of these species, there will be no direct impact on these habitat areas, or any populations of these species, as the Project is located at least 10 km upstream of any suitable habitat areas and there is no direct impact on the downstream environment. Furthermore, as described in Section 14.4.3, 14.4.4 and 14.4.5 potential indirect impacts to downstream habitats as a result of groundwater drawdown, surface water changes and erosion of stream banks or are not anticipated. As such, the Project will not: • Lead to a long-term decrease in the size of a population *(local population)*.	No
Fragment an existing population into two or more populations ***(result in genetically distinct populations forming as a result of habitat isolation)***		No
Adversely affect habitat critical to the survival of a species ***(cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species)***		No
Disrupt the breeding cycle of a population		No
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline		No

Significant impact criteria	Response	Significant impact?
	• Fragment an existing population into two or more populations *(result in genetically distinct populations forming as a result of habitat isolation)*. • Adversely affect habitat critical to the survival of a species *(cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species)*. • Disrupt the breeding cycle of a population. • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	
Reduce the area of occupancy of the species ***(Reduce the extent of occurrence of the species)***	As described above, the Project will not directly, or indirectly, impact habitat for these species. As such, it will not reduce the area of occupancy of these species. Extent of occurrence refers to the area bounded by an imaginary line around all known records of a species (termed minimum convex polygon). Unless a development is near the edge of a species' distribution and the development is likely to contract that minimum convex polygon, then it is very unlikely that a development will reduce the extent of occurrence of a species.	No
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	The Project is highly unlikely to lead to the introduction or spread of any invasive species detrimental to intertidal areas, or that is a threat to migratory birds that inhabit intertidal environments.	No
Introduce disease that may cause the species to decline ***(that may cause the population to decline)***	The Project is highly unlikely to introduce disease into the downstream environment.	No
Interfere with the recovery of the species	**Curlew sandpiper and eastern curlew** There is no Commonwealth or State recovery plan for these species. DAWE (2020v) and DAWE (2020w) state that no recovery plan is required and that the approved conservation advice for the species provides sufficient direction to implement priority actions and mitigate against key threats. The conservation advice for the species states the following Australian objectives: • Achieve a stable or increasing population. • Maintain and enhance important habitat. • Disturbance at key roosting and feeding sites reduced. • Raise awareness of curlew sandpiper within the local community. **Great knot, lesser sand plover and red knot** There is no Commonwealth or State recovery plan for these species. DAWE (2020x, y and z) state that no recovery plan is required and that the approved conservation advice for these species provides sufficient	No

Significant impact criteria	Response	Significant impact?
	direction to implement priority actions and mitigate against key threats. The conservation advices for these species states an extensive range of conservation and management actions, survey and monitoring priorities and information and research priorities. These include, but are not limited to: • Protect important habitat in Australia • Support initiatives to improve habitat management at key sites. • Maintain and improve protection of roosting and feeding sites in Australia • Advocate for the creation and restoration of foraging and roosting sites • Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia. • Undertake work to more precisely assess species life history, population size, distribution and ecological requirements particularly across northern Australia. The Project will not interfere with these actions. **Yellow chat** The recovery plan for yellow chat (Houston and Melzer 2008) states the following recovery objectives for the species: • Protect, enhance and manage yellow chat habitat. • Increase knowledge and awareness of the Capricorn yellow chat throughout the community, industry and landholders. • Address known threats, identify and quantify potential threats. The Project will not interfere with these actions. **Australian painted snipe** There is no recovery plan for this species. The conservation advice (TSSC 2013) states a range of actions support the recovery of the species in relation to: • Habitat loss, disturbance and modification. • Invasive weeds. • Trampling, browsing and grazing. • Animal predation or competition. • Fire. • Conservation information and education. The Project will not interfere with these actions.	

Vulnerable Species

There are two Vulnerable bird species listed under the EPBC Act known to occur in the downstream environment including bar-tailed godwit (EPBC Act – V/ MS; NC Act - V) and greater sand plover

(EPBC Act – V/ MS; NC Act – V). Beach-stone curlew (NC Act – V) is also known to occur and is listed as Vulnerable under the NC Act.

Impacts to these species have been assessed in accordance with the EPBC Act MNES Significant Impact Guidelines 1.1 (DE 2013) and the QEOP Significant Residual Impact Guidelines (DEHP 2014) as presented in Table 14-37. Based on this assessment, the Project is not expected to result in a significant residual impact to habitat for these threatened bird species.

Table 14-39: Significant impact assessment – vulnerable species (downstream)

Significant impact criteria	Response	Significant impact?
Lead to a long-term decrease in the size of an important population ***(local population)***	When considering all sites combined from surveys by Jaensch (2009), western Broad Sound supported nationally important numbers of bar-tailed godwit. Greater sand plover has been recorded at roost sites in western Broad Sound in recent years (refer Appendix A9h), although not in nationally important numbers. Habitat critical to the survival of a species refers to, amongst other things, areas that are necessary for activities such as foraging, breeding, roosting, or dispersal. Both species have been recorded at roost sites in western Broad Sound in recent years, as such it is considered likely that habitat critical to the survival of greater sand plover occurs in Broad Sound. Whilst there are known populations of these species present in the downstream environment, as well as habitat critical to the survival of these species, there will be no direct impact on these habitat areas, or any populations of these species, as the Project is located at least 10 km upstream of any suitable habitat areas and there is no direct impact on the downstream environment. Furthermore, as described in Section 14.4.3, 14.4.4 and 14.4.5 potential indirect impacts to downstream habitats as a result of groundwater drawdown, surface water changes and erosion of stream banks or are not anticipated. As such, the Project will not: • Lead to a long-term decrease in the size of an important population *(local population)* • Fragment an existing important population into two or more populations *(result in genetically distinct populations forming as a result of habitat isolation)* • Disrupt the breeding cycle of an important population • Adversely affect habitat critical to the survival of a species *(cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species) or* • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No
Fragment an existing important population into two or more populations ***(result in genetically distinct populations forming as a result of habitat isolation)***		No
Disrupt the breeding cycle of an important population		No
Adversely affect habitat critical to the survival of a species ***(cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species)***		No
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline		No

Significant impact criteria	Response	Significant impact?
Reduce the area of occupancy of an important population ***(Reduce the extent of occurrence of the species)***	As described above, the Project will not directly, or indirectly, impact habitat for these species. As such, it will not reduce the area of occupancy of these species. Extent of occurrence refers to the area bounded by an imaginary line around all known records of a species (termed minimum convex polygon). Unless a development is near the edge of a species' distribution and the development is likely to contract that minimum convex polygon, then it is very unlikely that a development will reduce the extent of occurrence of a species.	No
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The Project is highly unlikely to lead to the introduction or spread of any invasive species detrimental to intertidal areas, or that is a threat to migratory birds that inhabit intertidal environments.	No
Introduce disease that may cause the species to decline ***(that may cause the population to decline)***	The Project is highly unlikely to introduce disease into the downstream environment.	No
Interfere substantially with the recovery of the species	**Bar-tailed godwit and Greater sand plover** There is no Commonwealth or State recovery plan for these species. DAWE (2020) states that no recovery plan is required for these species and that the approved conservation advice for the species provides sufficient direction to implement priority actions and mitigate against key threats. The conservation advices for these species includes an extensive list of conservation and management actions, survey and monitoring priorities and information and research priorities. This includes, but is not limited to: • Protect important habitat in Australia. • Support initiatives to improve habitat management at key sites. • Maintain and improve protection of roosting and feeding sites in Australia. • Advocate for the creation and restoration of foraging and roosting sites. • Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia. • Undertake work to more precisely assess the species life history, population size, distribution and ecological requirements. The Project will not interfere with the actions presented in the conservation advices. **Beach-stone curlew** There is no recovery plan for the beach-stone curlew.	No

14.6.6 Summary of Significant impacts on MNES and MSES

As a result of the impact assessment presented in the preceding sections, the Project is expected to result in significant residual impacts to a number of MNES and MSES as summarised in Table 14-40 and Table 14-41, respectively. A combination of land based offsets and financial settlement offsets will be provided for significant residual impacts on MNES and MSES as described in Section 14.8.

Table 14-40: Summary of Significant Residual Impacts to MNES

MNES	Significant Residual Impact Conclusion	Significant Residual Impact Area (ha)		Offset to be Provided
Listed threatened species under the EPBC Act	The Project will result in a significant residual impact on habitat for species listed as Vulnerable under the EPBC Act including greater glider, koala, squatter pigeon and ornamental snake.	Greater glider	281.0	Land based offset under EPBC Act Offset Policy
		Koala	324.6	
		Squatter pigeon	306.6	
		Ornamental snake	18.8	
Threatened ecological communities under the EPBC Act	The Project will not result in a significant residual impact on a TEC listed under the EPBC Act.			
Listed migratory species under the EPBC Act	The Project will not result in a significant residual impact on a listed migratory species under the EPBC Act.			

Table 14-41: Summary of Significant Residual Impacts to MSES

MSES	Significant Residual Impact Conclusion	Significant Residual Impact Area (ha)		Offset to be Provided
RE that are endangered or of concern	The Project will result in a significant residual impact on Of Concern RE 11.3.4 and RE 11.4.2.	RE 11.3.4	40.7	Land based offset under QEOP
		RE 11.4.2	110.8	
RE that is an area of essential habitat for endangered or vulnerable plants or animals	The Project will result in a significant residual impact on prescribed RE that is essential habitat for the greater glider, koala and squatter pigeon.	Greater glider	15.0	Land based offset under EPBC Act Offset Policy
		Koala	110.4	
		Squatter pigeon	28.9	
RE located within a defined distance of a relevant watercourse	The Project will result in a significant residual impact on watercourse vegetation associated with RE 11.3.4 and 11.3.25.	RE 11.3.4	4.3	Land based offset under QEOP
		RE 11.3.25	78.8	Combination of direct land-based offset and financial settlement offset under QEOP
Habitat for an animal that is listed as endangered, vulnerable or special least concern as per the NC Act	The Project will result in a significant residual impact on habitat for species listed as Vulnerable under the NC Act including greater glider, koala, squatter pigeon and ornamental snake.	Greater glider	281.0	Land based offset under EPBC Act Offset Policy
		Koala	324.6	
		Squatter pigeon	306.6	
		Ornamental snake	18.8	

MSES	Significant Residual Impact Conclusion	Significant Residual Impact Area (ha)	Offset to be Provided
RE that intersect with an area shown as a wetland on the vegetation management wetlands map	The Project will not result in a significant residual impact on RE that intersect a wetland on the vegetation management wetlands map.		
RE that contains a connectivity area	The Project will not result in a significant residual impact on connectivity.		
Designated precinct, in a strategic environmental area	The Project will not result in a significant residual impact on a designated precinct in a strategic environmental area.		
Plants that are endangered or vulnerable under the NC Act	The Project will not result in a significant residual impact on plants that are endangered or vulnerable.		
A koala habitat area as defined under the Nature Conservation (Koala) Conservation Plan 2017, section 7B(1)	The Project will not result in a significant residual impact on koala habitat as defined under the Nature Conservation (Koala) Conservation Plan 2017, section 7B(1).		
Any protected area under the NC Act	The Project will not result in a significant residual impact on any protected area under the NC Act.		
Any legally secured offset area	The Project will not result in a significant residual impact on a legally secured offset area.		

14.6.7 Cumulative Impacts

The Project may have impacts on environmental values that act cumulatively with those of other projects in the region. The contribution of past and present projects is inherent in the impact assessment, as these projects are influencing the environmental baseline upon which the impact assessment is based. However, reasonably foreseeable future projects should also be considered, in the context that these projects may have environmental impacts that act cumulatively with those of the Project.

The catchment and coastline surrounding the Project Area is relatively undeveloped, dominated by rural lands that are used for grazing. There are no known large-scale industrial or mining developments proposed within the catchment of the Project. The Commonwealth Department of Defence is currently developing an expansion of the existing Shoalwater Bay Defence Training Area. A future expansion of the existing Shoalwater Bay Defence Training Area is located partly in the catchment of Broad Sound, approximately 50 km to the north-east of the Project. Therefore, there is some potential for the impacts of the Project to act cumulatively with those of the Defence project. Potential cumulative impacts relate to changes to water quality within Broad Sound and parts of the GBR. However, the potential for cumulative impacts is considered to be very low, because:

- Impacts of the Project on downstream values including water quality are not expected, particularly as far downstream as Broad Sound.
- Broad Sound and Shoalwater Bay are subject to a very large tidal influence, reducing the risk of cumulative impacts on water quality from both projects.
- The Defence project will be implemented in accordance with environmental guidelines to mitigate impacts on the environment, including local water quality values.

- The Defence project maintains a very large buffer zone (up to 50km) to ensure there is no impact on surrounding land or business from its military training operations.
- The Project will result in a net reduction in sediment discharges to the GBR, reducing the risks of impacts from sediment discharges acting cumulatively with the Defence project.

14.7 Mitigation, Management and Monitoring

14.7.1 Environmental Management Framework

CQC have prepared a draft EMP for construction and operation of the Project. The draft EMP is contained in Appendix 12 and has been developed to manage and mitigate potential environmental impacts, and to assist CQC to comply with relevant environmental approvals and permit conditions. The draft EMP has been prepared generally in accordance with the Commonwealth Environmental Management Plan Guidelines (Commonwealth of Australia 2014) and is modelled on the AS/NZS ISO 14001 (Standards Australia 2016) Plan-Do-Check-Act (PDCA) continual improvement model.

Appendix C of the draft EMP provides the specific, sub-plans for managing environmental impacts. The following sub plans are relevant to this chapter:

- General Acid Sulfate Soil Management Plan (ASSMP)
- Hazardous Materials Management Plan (including spill management) (HMMP)
- Land Use Management Plan (LUMP), including:
  - Biodiversity Management Strategies
  - Weed and Pest Management Plan (WPMP) and
  - Bushfire Management Plan (BfMP).
- Mineral Waste Management Plan (MWMP)
- Surface Water Management Plan (SWMP) and
- Groundwater Management and Monitoring Plan (GMMP).

The management plans in Appendix C of the draft EMP are high-level at this stage and will be updated following Project approval to reflect the final Environmental Authority (EA) and EPBC Act Conditions.

In addition to the plans in Appendix C of the draft EMP, a number of more detailed management plans have been prepared in response to the government submissions on SEIS v2. These are referenced by the draft EMP and will be enshrined into the final EMP as sub-plans. The following key detailed plans are also relevant to this chapter:

- Draft Significant Species Management Plan (SSMP – Appendix A9e) – The purpose of the Draft SSMP is to reduce the environmental impacts of the Project on listed species and their habitat, through the development of mitigation and monitoring measures for implementation prior to construction, during construction, during operations and as part of the decommissioning process.
- Draft GDE Management and Monitoring Plan (GDEMMP – Appendix A10e) – The Draft GDEMMP describes the mitigation and monitoring measures that will be implemented to manage the impacts of the Project on GDEs. A series of triggers and corrective actions have been developed for each GDE, to facilitate an assessment of the impacts of the Project during various development stages, and to inform an assessment of the suitability of mitigation measures to

manage impacts. An adaptive management approach will be implemented, with the results of monitoring relevant indicators for each GDE informing the ongoing re-evaluation of Project impacts and associated mitigation measures.

- Progressive Rehabilitation and Closure Plan (PRCP) – A rehabilitation framework has been developed which will be developed into a PRCP. The framework describes how final landforms associated with the Project will be rehabilitated after mining activities. Runoff from disturbed areas has the potential to reduce water quality in the receiving environment, with rehabilitation a key management measure to address this risk in the long term.

Measures to minimise, mitigate and monitor impacts on terrestrial values, as identified in this chapter, will be delivered through the implementation of the EMP and the sub-plans outlined above. It is important to note that the EMP and sub-plans are currently in draft form and will be finalised following Project approval to reflect the final EA and EPBC Act Conditions. This will involve consolidation of all mitigation, management and monitoring measures proposed throughout the SEIS chapters and plans into the EMP and sub-plans. Specific measures from the EMP and sub-plans to be implemented, and relevant to this chapter, are summarised below. For complete details of all mitigation measures refer to the plans.

14.7.1.1 Vegetation Clearing

- Project design elements will ensure that the minimum amount of land required for construction and operation will be disturbed.
- Construction activities will be completed during the dry season where possible, to reduce the potential of construction-related erosion and scour, with areas stabilised as much as practicable prior to wet season rains.
- A detailed plan showing approved vegetation clearing areas is to be prepared prior to any works on the site, and the boundaries of ‘no-go’ areas drawn on construction plans.
- Prior to construction, boundaries of clearing and 'no-go' areas will be clearly pegged/flagged on the ground prior to clearing commencing. Training for all personnel will include information on identifying these marked areas.
- No lay down areas or materials storage will be located within wetland areas or areas of retained vegetation.
- Erosion and sediment controls outlined in the ESCP will be implemented.
- Records must be retained tracking the removal, stockpiling and movement of topsoil, particularly where the topsoil contains weed species.
- Where topsoil is not utilised in earthworks, it should be dispersed onto prepared landscaping and revegetation areas immediately to minimise deterioration of soils.
- Where topsoil is to be stockpiled:
  - Stockpiles should have a maximum height of 2 m.
  - Stockpiles should be revegetated to prevent soil erosion and weed invasion and to maintain soil microbes.
  - Stockpiles should be located well away from works areas, access paths and overland flow paths.
- Habitat areas to be cleared will be thoroughly checked by a fauna spotter-catcher prior to clearing.

- Fauna-spotter catcher will be present for all vegetation clearing activities. The spotter-catcher will be required to hold a Permit to Take or Interfere with Wildlife.
- Clearing activities must avoid damage to the roots, trunks and canopy of adjacent retained vegetation.
- Bank stabilisation will take place post-construction as necessary to allow for revegetation and to reduce scour potential.
- Regular inspections will be undertaken of cleared area extents to ensure retained vegetation is not being directly or indirectly impacted by construction activities.
- Weekly monitoring shall be conducted of retained vegetation to detect any damage or decline in the health and condition of retained vegetation within the construction site and adjacent sites.

14.7.1.2 Groundwater Drawdown

A draft GMMP has been developed as part of the Project's EMP. The monitoring program will be implemented to ensure that adequate groundwater monitoring and data analysis is undertaken to establish changes to groundwater levels and quality associated with the Project.

A draft GDEMMP has also been prepared with the aim of minimising and managing the environmental impacts of the Project on GDEs through the development of mitigation and monitoring measures for implementation prior to construction, during construction, during operations and post operations. As part of the draft GDEMMP a monitoring program has been developed for GDEs, to determine whether mitigation and management measures are adequate and successfully implemented. This work will build upon the baseline studies completed during the EIS and SEIS.

In addition, a revegetation program will be implemented in areas within the riparian corridor expected to be affected by groundwater drawdown with the aim of building ecological resilience. Revegetation will include expansion of the existing riparian corridor by a width of 10 m. A revegetation program will be designed to ensure the planting of drought tolerant, and non-groundwater dependent, species of similar ecological function as those with the potential to be impacted. This will ensure that existing habitat for terrestrial species is maintained, as well as reducing the potential for consequential impacts such as erosion and sedimentation which may be associated with vegetation loss. The revegetation program will be implemented from Project commencement ensuring sufficient timeframes for establishment of vegetation, given potential impacts as a result of changes to groundwater are not expected to commence until at least 10 years after Project commencement.

14.7.1.3 Road Crossings

Dedicated road crossing treatments will be implemented for greater glider where the proposed haul road transects Deep Creek. Consistent with best-practice approaches, a suite of treatments will include minimising the design width of the road (minimising canopy gap width) and the inclusion of suitably sized and located wooden glide poles at intervals along the length of the riparian habitat edge corresponding with the road crossing.

Implementation of a suite of design and management strategies will be incorporated within the road crossing of Deep Creek to facilitate safe and on-going koala movements. Complete details provided in the SSMP.

14.7.1.4 Weed and Pest Management

Weeds and Pests will be managed onsite in accordance with the WPMP. Key measures to be implemented under this plan include:

- Prior to construction commencing, a baseline weed and pest survey will be conducted in the Project footprint plus a 200m buffer. This will be used to prepare a digital weed map of the site identifying the distribution and density of weed infestations and will enable tracking changes over time. In addition, a register of pertinent information in relation to weed and pest distribution, numbers and control requirements will be established.
- Following the baseline survey, ongoing weed and pest monitoring surveys will be undertaken every two years, consisting of a survey during the dry season and a survey post-wet season.

Preventative methods proposed to reduce the risk of weeds being introduced into the area include:

- For shipped plant and machinery, a thorough washdown procedure will be required for all plant and machinery prior to it being shipped to site.
- All contractors bringing vehicles/plant onto the site will be required to complete a Weed Declaration Form, in which they formally declare that all required weed hygiene measures have been taken and that their vehicles/plant are free of weed material (in particular, weed seeds).
- Establish a weed wash-down facility at or near the entrance to the Project Site for any vehicles that do enter / leave the mining lease areas
- For vehicles and plant that are unable to provide a Weed Declaration Form wash down will be required.
- All weed washes will be documented and evidence maintained of weed wash-downs on or off-site.
- Clearing will be minimised to the area directly required for mining operations.
- Removal, stockpiling and movement of topsoil on the site will be tracked, particularly where the topsoil contains weed species. Top-soil from weed infestation areas (as identified in the pre-construction mapping) will be carefully stockpiled and if moved, not stored or reused in areas where those weeds are not present.
- Any weeds that are identified within the Project area will require appropriate treatment to reduce the potential for these species to spread to new areas. Should weed infestations occur, the treatment applications will be selected relevant to the species, the size and growth stage of each infestation and the timing of application.

14.7.1.5 Noise

- Providing appropriate training for staff to operate the equipment in order to minimise unnecessary noise emissions. This could be achieved during site inductions and regular training programs.
- Avoiding unnecessary revving of engines and switch off equipment when not required.
- Keeping internal roads well maintained.
- Using rubber linings in or constrained layer damping on, for example, chutes and dumpers to reduce impact noise.
- Minimising the drop heights of materials, in particular at the TLF.
- Use ultra-low noise idlers on the conveyors; the noise reduction associated with these are generally 5 - 10 dB(A).

- Positioning of overburden and topsoil piles in between haul roads and receptors, where practicable, to provide noise shielding.
- The movement of plant onto and around the site should have regard to the normal operating hours of the site and the location of any sensitive receptors as far as is reasonably practicable.
- Installation of an industry state-of-the-art fleet management system (such as Wenco) on the mining (and construction) equipment to limit the surface movement of equipment during the more sensitive noise times (such as night).
- Employing audible reversing warning systems on mobile plant and vehicles that are of a type that have minimal noise impact on persons outside sites. This may include alarms that automatically adjust volumes based on the surrounding noise environment or alarms that are non-tonal in nature (such as broadband or 'quack' alarms).
- As far as reasonably practicable, enclosing sources of significant noise. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements. A typical enclosure may provide 10 - 20 dB(A) depending on the material.
- Operating plant in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading should also be carried out away from such areas.
- Shutting down machines such as cranes that might have intermittent use. Such machines should be shut down between work periods or should be throttled down to a minimum.

14.7.1.6 Lighting

- In working areas adjacent to habitat, lighting should be consistent with the following guidelines:
  - Lights should be shielded beyond full cut-off to ensure that light falls only on the intended surfaces, and minimise direct light above the horizontal and minimise light spill along habitat edges.
  - Use light emitting diodes (LEDs) for lighting wherever possible.
  - Use long wavelength (550-700 nanometers; orange to red) lights wherever possible.
  - Lighting is to be designed to avoid the use of ultraviolet light and adjacent short wavelengths.
  - Avoid use of white lights that emit ultraviolet light and limit strong blue or green spectral elements (e.g. mercury vapour lights) as far as possible / practicable.
- Lighting for the road crossing over Deep Creek and along roads within remnant habitat on the western side of the Project area should be restricted to the minimum necessary to meet safety standards. Within these areas, consideration should be given to the use of red light which has the least effect on nocturnal mammals.
- Lighting design to minimise impact to greater gliders and koalas should be consistent with best practice and best available technology.
- A suitably qualified person should be consulted in regard to ecological considerations in the design process for night lighting within these areas of threatened fauna habitat.

14.7.1.7 Traffic

- Site protocols are to be established which restrict authorised area access by activity to the approved track network identified with the plan.

- For areas outside the Disturbance Footprint, establish an enforceable maximum vehicle speed limit of 60 km per hour.
- The installation of speed limit signage is to accompany awareness signage at the abovementioned strategic locations.
- Set an enforceable maximum vehicle speed limit of 50 km per hour between 1900hrs and 0500hrs for the following areas:
  - The crossing of Deep Creek and for a distance of 100 m either side.
  - The section of Mount Bison Road which traverses through remnant habitat on the western side of the Project and for a distance of 100 m east of that remnant vegetation.
  - The full extent of the haul road which extends along the western side of the Project area and connects between Mount Bison Road (in the south) and the Bruce Highway (in the north).
- Road signage to be used to increase awareness and alert drivers to the fact that koalas may cross the roadway in particular areas. Strategic locations for signage include:
  - On approaches to the crossing of Deep Creek.
  - On approach along Mount Bison Road to remnant vegetation on the western side of the Project area.
  - Along the haul road which continues north from Mount Bison Road to the Bruce Highway (western side of Project area).
- Implement measures to improve driver awareness, and thereby minimise the incidence of fauna-vehicle collisions, including:
  - The installation of general signage to signal the presence of native wildlife at road entry points to the site.
  - The installation of more specific signage treatments to be installed to signal areas within the site where there is an increased likelihood of encountering native wildlife on a road, roadside exits from contractor camps or where a road passes through / by habitats of particular value.
- All contractors shall attend environmental training as part of the site induction and instructed on their obligations in regard to movement restrictions and road speed limits.

14.7.1.8 Dust Management

Dust suppression measures primarily include the application of water to control dust emissions. The following dust suppression measures will be considered:

- Minimising topsoil and vegetation removal and revegetation of disturbed areas as soon as possible.
- Minimise pre-strip to a maximum of one block ahead.
- Pave areas where practical around offices, carparks, maintenance and storage areas.
- Visual monitoring of dust daily with ramping down of activities in the instance of high dust emissions.
- Watering of haul roads to suppress dust emissions.
- Minimising speed of on-site traffic, where applicable, to minimise wheel generated dust.
- Watering of Run of Mine stockpiles as required using water sprays and/or water cannons that are operated on timers.

- Fogging system on outlets from transfer points and sizing stations with the potential to generate dust.
- Maintain appropriate moisture content of product coal and reject material as they leave the CHPP which avoids the need for supplementary watering.
- Implement an Integrated Coal Moisture Regulating System to minimise dust emissions from the product coal stockpile and to ensure that product coal delivered for train-loading has a coal - surface water content at the optimum level to ensure the effectiveness of veneering of loaded coal. The Integrated Coal Moisture Regulating System will use a water spray or fogging systems to apply optimum levels of supplementary coal watering.
- Use of benign adhesives if water suppression methods are not effective. Should chemical suppressants be required to control dust, a risk assessment will be undertaken to assess potential for adverse impacts to water quality.
- Installing an overhead bin and train loading facility from the start of the operations to minimise coal dust and the potential loss of coal during train transit.

If adverse conditions are encountered during operation of the Project, additional dust suppression measures will be implemented.

14.7.1.9 Rehabilitation

Where impacts do occur, environmental values will be restored if possible, through the following measures:

- The Project Site will be destocked in the northern part during operations years 1 to 9, comprising an area of over 2,000 ha, and in the southern parts, during years 10 to 19 (674 ha).
- Management of destocked land on the property (presently mostly cleared) to allow for regeneration of the vegetation and restoration of habitat, focusing on riparian zones along Deep Creek and Tooloombah Creek.
- Cattle will also be removed from offset areas (approximately 2,800 ha), except where light grazing is required for fuel load and weed management.
- Progressive rehabilitation of disturbed areas will occur where possible to reduce the time between disturbance and rehabilitation.
- Removed topsoil will be placed and seeded in designated soil stockpile areas throughout the life of the Project.
- Removal of mine infrastructure and rehabilitation of all disturbed land to a stable, non-polluting and self-sustaining condition suitable for low-intensity cattle grazing.
- Any riparian vegetation that is damaged during construction will be rehabilitated.
- Any areas of vegetation impacted by hydrological changes will be revegetated and actively managed. Species representative of the REs affected will be used in this revegetation.

14.8 Offsets

CQC is committed to providing offsets to compensate for the Project's unavoidable direct and indirect significant residual impacts on MNES and MSES. A Biodiversity Offset Strategy (BOS) has been prepared to outline how the Project's offset requirements will be acquitted in accordance with the EPBC Act Environmental Offsets Policy (DSEWPaC 2012) and Queensland Environmental Offsets

Policy (Version 1.8; DES 2020c). The BOS and the Project's Draft Offset Delivery Plan is presented in Appendix 11 – Offsets.

As outlined in the BOS, the Project's offset package involves a combination of direct land-based offsets and a financial settlement offset (MSES only), as summarised in Table 14-42. Two land based offset properties have been identified to acquit the majority of the Project's offset requirements. These are Mamelon Station and [redacted] Brief descriptions of these properties are provided in the sections below. Watercourse RE 11.3.25 is unable to be completely offset on Mamelon and [redacted] and a financial settlement offset is proposed for the shortfall.

As outlined in the BOS, detailed field surveys were undertaken in both the impact and offset areas. Surveys included ground-truthing of RE mapping, assessment of habitat condition generally in accordance with the Guide to Determining Terrestrial Habitat Quality, Version 1.2 (DEHP 2017), targeted fauna surveys, habitat suitability assessments, assessment of the appropriateness and integrity of potential offset areas, and of potential management requirements.

Habitat quality scores for the MNES and MSES within the impact and offset areas were calculated generally in accordance with the Guide to Determining Terrestrial Habitat Quality, Version 1.2 (DEHP 2017). These scores are presented in Table 14-42. The offset area to be secured was determined based on the application of the EPBC Act Environmental Offsets Policy offsets assessment guide and the Queensland Environmental Offsets Policy land-based offset multiplier calculator. The offsets assessment guide (inputs, justifications and results) are presented in detail in the BOS, including detailed demonstration of how the offsets satisfy compliance with the EPBC Act Environmental Offsets Policy and the QEOP.

Based on these assessments Table 14-42 presents the total offset area to be secured on each property and the percent of offset acquitted. It is important to note that MSES offset requirements for essential habitat (greater glider, koala, squatter pigeon) and protected wildlife habitat (greater glider, koala, squatter pigeon, ornamental snake) are being provided through MNES offsets as the State cannot impose an offset condition for a prescribed activity that has the 'same, or substantially the same' impact on the 'same, or substantially the same' matter as the MNES, if it has already been assessed as a 'controlled action' under the EPBC Act. As such these MSES are not presented in the table below.

Table 14-42: MNES and MSES offset requirements

Protected Matter	Impact Habitat Quality Score	Impact (ha)	Mamelon			[redacted]			Total % acquit	Residual Impact (ha) to be offset via financial settlement offset
			Offset Habitat Quality Score	Offset area (ha)	% acquit	Offset Habitat Quality Score	Offset area (ha)	% acquit		
MNES										
Greater glider	7	281.0	7	2,428.4	100.03	-	-	-	100.03	
Koala	7	324.6	7	2,803.4	100.10	-	-	-	100.10	
Squatter pigeon	7	306.6	7	2,667.1	100.80	-	-	-	100.80	
Ornamental snake	5	18.8	-	-	-	7	121.1	102.37	102.37	
MSES										

Protected Matter	Impact Habitat Quality Score	Impact (ha)	Mamelon			[redacted]			Total % acquit	Residual Impact (ha) to be offset via financial settlement offset
			Offset Habitat Quality Score	Offset area (ha)	% acquit	Offset Habitat Quality Score	Offset area (ha)	% acquit		
RE 11.3.4	7	40.7	7	14.8	9.09	8	148.2	91.03	100.12	
RE 11.4.2	7	110.8	6	443.2	100.00	-	-	-	100.00	
Watercourse RE 11.3.4	7	4.3	7	14.8	86.05	8	2.4	13.95	100.00	
Watercourse RE 11.3.25	8	78.8	8	100.8	31.98	8	78.6	24.94	56.92	33.95

14.8.1 Land-based Offsets

14.8.1.1 Mamelon

Mamelon is a 6,259 ha property located in Ogmore, 25 km north-west of Marlborough, and is the proposed site for both the Project and one of the land-based offsets to acquit the Project's offset requirements. The total proposed Mamelon offset area of approximately 2,803 ha (Figure 14-40) is able to acquit the majority of the Project's MNES and MSES offset requirements, namely:

- Greater glider
- Koala
- Squatter pigeon (southern)
- Of concern RE 11.3.4 (partly acquit on Mamelon)
- Of concern RE 11.4.2
- Watercourse RE 11.3.4 (partly acquit on Mamelon) and
- Watercourse RE 11.3.25 (partly acquit on Mamelon).

The offset areas have been situated outside of the MLs, and any areas that may potentially be impacted by groundwater drawdown, to ensure the Project's activities do not adversely affect the offset areas. Potential indirect impacts associated with the Project, including impacts from dust generation, increased noise and increased traffic, are not considered to have a significant impact on the offset area and will be managed and monitored through the Project's EMP.

Within the wider landscape Mamelon is well connected to large remnant habitat patches to the west; remaining contiguous with an extensive tract of remnant vegetation, which includes Tooloombah Creek Conservation Park, immediately to the north-west of Mamelon. Habitat to the south and south-west of the property remain relatively patchy but maintain connected to extensive habitat associated with Broadsound Range (located to the south and west). Broadsound Range is itself part of a State-wide ecological corridor mapped under the BPA, as are coastal lands to the north and east.

14.8.1.1.1 Summary of Targeted Fauna Surveys to Confirm Suitability of Proposed Offsets

Targeted spotlighting surveys conducted in October and November 2019 by Austecology and CO2 Australia confirmed the presence of greater glider in the offset area, including foraging and denning in a variety of trees including *Eucalyptus crebra*, *E. platyphylla* and *E. populnea*. At least 22 greater glider were observed in November 2019 along and adjacent to Deep Creek in the east of Mamelon,

with additional individuals observed along Barrack Creek in Strathmuir to the east of Mamelon (Figure 14-40).

Targeted surveys conducted in October and November 2019 by Austecology and CO2 Australia confirmed the presence of no fewer than 18 koalas within the offset area; including one observed feeding within a *E. exserta* on the boundary between RE 11.11.1 and RE 11.5.8 in the north-west of the Mamelon offset area, others sheltering in *E. crebra* within an area of regrowth RE 11.4.2, with numerous records along alluvial watercourses on Mamelon (RE 11.3.25) (Figure 14-40). Additional evidence of their presence was confirmed throughout Mamelon in the form of characteristic scats and scratches.

Surveys in October and November 2019 by Austecology and CO2 Australia also confirmed the presence of six squatter pigeon on Mamelon, within the offset area, with a total of 25 confirmed records from Mamelon and adjacent Strathmuir (Figure 14-40). A further 58 squatter pigeon records are known from targeted surveys on those properties since March 2011. The complete results of field surveys within the offset area are presented in the BOS in Appendix 11 – Offsets.

14.8.1.2 [redacted]

[redacted] The total proposed [redacted] offset area of approximately 227 ha (Figure 14-41) has been identified specifically to acquit the Project's MNES and MSES offset requirements for those matters not fully acquit by the Mamelon offset area, namely:

- Ornamental snake
- Of concern RE 11.3.4 (partly acquit on Mamelon)
- Watercourse RE 11.3.4 (partly acquit on Mamelon) and
- Watercourse RE 11.3.25 (partly acquit on Mamelon).

The [redacted] property is situated in the Brigalow Belt bioregion, Belyando Downs subregion, [redacted] The offset area [redacted] is mapped within an area identified as a Priority 3 – Strategic Footprint of the Galilee Basin Strategic Offset Investment Corridor (SOIC; DEHP 2013). The Queensland Government has identified SOICs in each bioregion of Queensland with local input from regional natural resource management groups, ecology experts, landholders and local government. SOICs are identified as some of the best places in the landscape for environmental offsets as they mainly consist of core areas of largely intact remnant vegetation, generally associated with protected areas such as national parks, or areas that provide important links between those core areas.

The results of the field survey in May 2020 confirmed the presence of a single ornamental snake on the northern boundary of [redacted] in an area of RE 11.3.3. While only a single ornamental snake was observed, this nocturnal species is more readily detectable during the warmer months following rainfall; coinciding with the elevated availability of their preferred frog species prey. The confirmed presence of an ornamental snake this far outside of the regular survey season is indicative of the favourable habitat and conditions (e.g. presence of standing water) available to the species and that persist on [redacted].

Plate 14-3: Photo of ornamental snake confirmed in vicinity of offset area in north of [redacted]

14.8.2 Financial Settlement Offset

There is 33.95 ha of impacts on watercourse RE 11.3.25 that cannot be offset on Mamelon or [redacted]. To acquit this offset requirement a financial settlement offset is proposed to be made in accordance with the QEOP (Version 1.8; DES 2020b). The total cost of the financial settlement offset for the residual impacts on 33.95 ha of watercourse RE 11.3.25 (offset at 1:4 for an equivalent area of approximately 136 ha) is $665,835.65[34]. The details of the financial settlement offset are provided in the Project's Offset Delivery Plan (ODP, Attachment B) and following DES approval, payment will be made to the Queensland Government's Offset Fund prior to Project commencement.

14.8.3 Offset Implementation

A draft Offset Area Management Plan (OAMP) for Mamelon and [redacted] has been developed to guide the ongoing management and monitoring of the MNES and MSES offset areas. The draft OAMPs for Mamelon and [redacted] are attached to the Project's Offset Delivery Plan (Appendix 11) for regulator review. Following regulator endorsement of the offset's assessment guides and the OAMPs will be finalised and submitted to the Australian and Queensland Government for approval. The approved OAMPs will be implemented by CQC.

Offset areas on the Mamelon property are proposed to be legally secured through a Voluntary Declaration under the VM Act, as are offset areas on the [redacted] property, subject to necessary further discussions between CQC, the regulators and the landholders.

Offsets are proposed to be delivered in accordance with the tasks and timeframes in Table 14-43. These tasks and timeframes are subject to change due to a number of variables, including regulatory (Commonwealth and Queensland Government) approval, regulatory requirements, climatic conditions, stakeholder inactivity and other unexpected delays.

[34] This amount is based on a combined financial settlement payment for all MSES as presented in Chapter 15 – Aquatic and Marine Ecology. The total payment for all combined MSES offsets is $874,585.65.

Table 14-43: Proposed offset implementation process

Description	Target date for completion
Negotiate on and gain endorsement of final BOS, including offsets assessment guides, and ODP with regulators	Q4 2020
Commonwealth and Queensland government approval granted for the Project	Q4 2020
Commence construction	Q1 2021
Execute [redacted] Landholder Agreement	Q1 2021
Finalise OAMPs and submit to regulators	Q2 2021
Regulator review and anticipated approval of OAMPs	Q2 2021
Implement approved OAMPs	Q3 2021
Legally secure offset areas	Q3 2021
Five years post approval of the BOS, review and reconcile actual impacts with offsets and submit report to regulators	Q4 2025

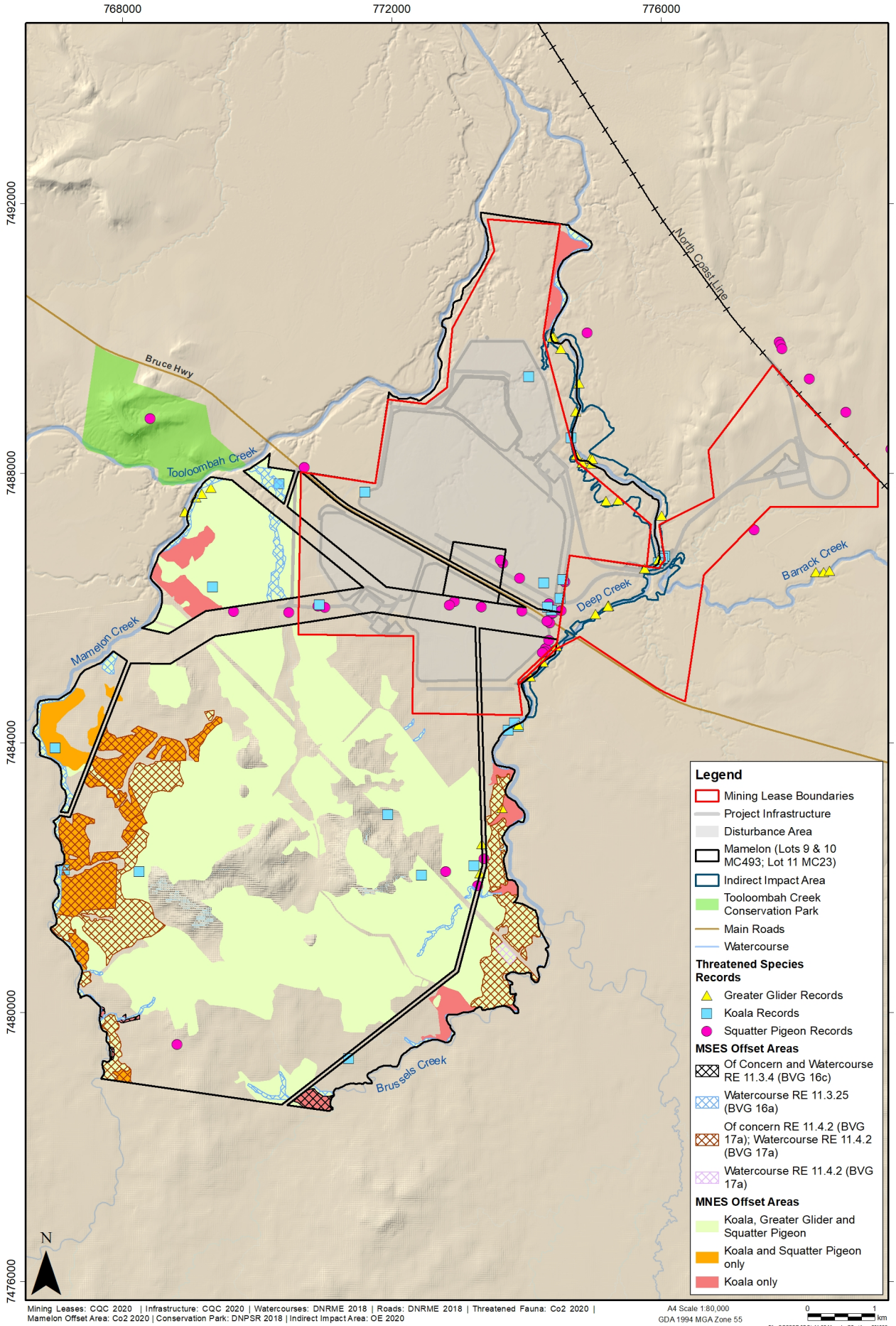
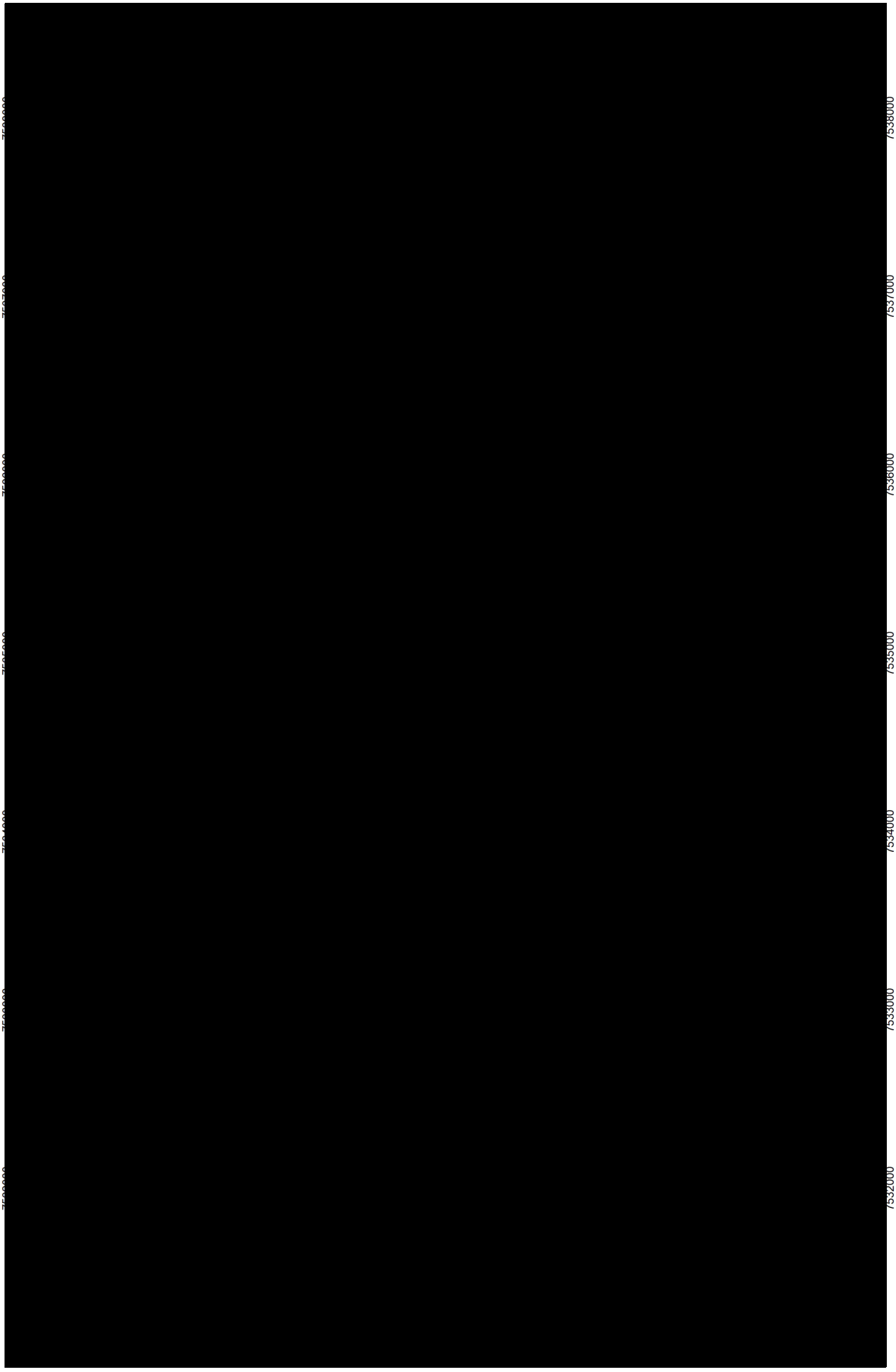


Figure 14-40: Mamelon offset area


538000
537000
536000
535000
534000
533000
532000

14.9 Qualitative Risk Assessment

The risk of impact on the terrestrial environment from Project activities has been assessed based on a qualitative risk assessment using risk levels 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.
- Low - Acceptable with review.

Table 14-44 summarises the results of the risk assessment including the initial risk rating and residual risk rating once mitigation measures are implemented. All impacts receive a residual risk of either Medium or Low through the implementation of mitigation measures. Key risks to the terrestrial environment identified through this process include:

- removal of habitat for threatened species as a result of vegetation clearing
- drawdown of groundwater impacting Terrestrial GDEs and habitat for fauna
- creek crossing causing loss of connectivity
- mortality of terrestrial fauna during vegetation clearing activities and
- mortality of terrestrial fauna due to vehicle collisions.

Table 14-44: Qualitative risk assessment

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
Vegetation clearing	• Removal of habitat for threatened species	Extreme	• Fauna habitat management measures incorporated within Project EMP and SSMP. • Vegetation adjacent to construction works will be appropriately marked to avoid unnecessary clearing / vegetation damage. • Project design elements will ensure that the minimum amount of land required for construction and operation will be disturbed. • A detailed plan showing approved vegetation clearing areas is to be prepared prior to any works on the site, and the boundaries of 'no-go' areas drawn on construction plans. • Prior to construction, boundaries of clearing and 'no-go' areas will be clearly pegged/flagged on the ground prior to clearing commencing. Training for all personnel will include information on identifying these marked areas. • No lay down areas or materials storage will be located within wetland areas or areas of retained vegetation. • Habitat areas to be cleared will be thoroughly checked by a fauna spotter-catcher prior to clearing. • Fauna-spotter catcher will be present for all vegetation clearing activities. The spotter-catcher will be required to hold a Permit to Take or Interfere with Wildlife. • Regular inspections will be undertaken of cleared area extents to ensure retained vegetation is not being directly or indirectly impacted by construction activities. • Weekly monitoring shall be conducted of retained vegetation to detect any damage or decline in the health and condition of retained vegetation within the construction site and adjacent sites. • Offsets to be provide for significant residual impacts on MNES and MSES.	Medium

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
	• 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	• Vegetation adjacent to construction works will be appropriately marked to avoid unnecessary clearing / vegetation damage. • Project design elements will ensure that the minimum amount of land required for construction and operation will be disturbed. • Construction activities will be completed during the dry season where possible, to reduce the potential of construction-related erosion and scour, with areas stabilised as much as practicable prior to wet season rains. • Clearing activities must avoid damage to the roots, trunks and canopy of adjacent retained vegetation. • Bank stabilisation will take place post-construction as necessary to allow for revegetation and to reduce scour potential. • Minimising topsoil and vegetation removal and revegetation of disturbed areas as soon as possible. • Minimise pre-strip to a maximum of one block ahead. • Pave areas where practical around offices, carparks, maintenance and storage areas. • Visual monitoring of dust daily with ramping down of activities in the instance of high dust emissions. • Watering of haul roads to suppress dust emissions. • Minimising speed of on-site traffic, where applicable, to minimise wheel generated dust. • Watering of Run of Mine stockpiles using water sprays and/or water cannons that are operated on timers. • Fogging system on outlets from transfer points and sizing stations with the potential to generate dust. • Maintain appropriate moisture content of product coal and reject material as they leave the CHPP which avoids the need for supplementary watering.	Low

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			• Implement an Integrated Coal Moisture Regulating System to minimise dust emissions from the product coal stockpile and to ensure that product coal delivered for train-loading has a coal - surface water content at the optimum level to ensure the effectiveness of veneering of loaded coal. The Integrated Coal Moisture Regulating System will use a water spray or fogging systems to apply optimum levels of supplementary coal watering. • Use of benign adhesives if water suppression methods are not effective. Should chemical suppressants be required to control dust, a risk assessment will be undertaken to assess potential for adverse impacts to water quality. • Installing an overhead bin and train loading facility from the start of the operations to minimise coal dust and the potential loss of coal during train transit.	
Habitat connectivity	• Creek crossing causing loss of connectivity	**Medium**	• Dedicated road crossing treatments for greater glider will be implemented where the proposed haul road transects Deep Creek. Consistent with best-practice approaches, a suite of treatments will include minimising the design width of the road (minimising canopy gap width) and the inclusion of suitably sized and located wooden glide poles at intervals along the length of the riparian habitat edge corresponding with the road crossing. • Implementation of a suite of design and management strategies will be incorporated within the road crossing of Deep Creek to facilitate safe and on-going koala movements	**Medium**
Direct fauna mortality	• Mortality of terrestrial fauna during vegetation clearing activities • Mortality of terrestrial fauna due to vehicle collisions	**High**	• Fauna management measures incorporated within Project EMP and SSMP. • Preclearance surveys carried out by qualified fauna spotter to remove resident fauna. • Fauna register implemented to record fauna encountered during clearing activities and vehicle collisions.	**Medium**

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			• Fauna infrastructure installed along haul road to reduce vehicle collisions at Deep / Barrack Creek crossing. • Site protocols are to be established which restrict authorised area access by activity to the approved track network identified with the plan. • For areas outside the Disturbance Footprint, establish an enforceable maximum vehicle speed limit of 60 km per hour. • The installation of speed limit signage is to accompany awareness signage at the abovementioned strategic locations. • Set an enforceable maximum vehicle speed limit of 50 km per hour between 1900hrs and 0500hrs for the following areas: - The crossing of Deep Creek and for a distance of 100 m either side. - The section of Mount Bison Road which traverses through remnant habitat on the western side of the Project and for a distance of 100 m east of that remnant vegetation. - The full extent of the haul road which extends along the western side of the Project area and connects between Mount Bison Road (in the south) and the Bruce Highway (in the north). • Road signage to be used to increase awareness and alert drivers to the fact that koalas may cross the roadway in particular areas. Strategic locations for signage include: - On approaches to the crossing of Deep Creek. - On approach along Mount Bison Road to remnant vegetation on the western side of the Project area. - Along the haul road which continues north from Mount Bison Road to the Bruce Highway (western side of Project area). • Implement measures to improve driver awareness, and thereby minimise the incidence of fauna-vehicle collisions, including:	

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			- The installation of general signage to signal the presence of native wildlife at road entry points to the site. - The installation of more specific signage treatments to be installed to signal areas within the site where there is an increased likelihood of encountering native wildlife on a road, roadside exits from contractor camps or where a road passes through / by habitats of particular value. • All contractors shall attend environmental training as part of the site induction and instructed on their obligations in regard to movement restrictions and road speed limits. • No domestic animals allowed onsite.	
Dust	• Impacts of coal dust settlement to onsite and offsite vegetation	**Medium**	• Minimising topsoil and vegetation removal and revegetation of disturbed areas as soon as possible. • Minimise pre-strip to a maximum of one block ahead. • Pave areas where practical around offices, carparks, maintenance and storage areas. • Visual monitoring of dust daily with ramping down of activities in the instance of high dust emissions. • Watering of haul roads to suppress dust emissions. • Minimising speed of on-site traffic, where applicable, to minimise wheel generated dust. • Watering of Run of Mine stockpiles using water sprays and/or water cannons that are operated on timers. • Fogging system on outlets from transfer points and sizing stations with the potential to generate dust. • Maintain appropriate moisture content of product coal and reject material as they leave the CHPP which avoids the need for supplementary watering. • Implement an Integrated Coal Moisture Regulating System to minimise dust emissions from the product coal stockpile and to	**Low**

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			ensure that product coal delivered for train-loading has a coal - surface water content at the optimum level to ensure the effectiveness of veneering of loaded coal. The Integrated Coal Moisture Regulating System will use a water spray or fogging systems to apply optimum levels of supplementary coal watering. • Use of benign adhesives if water suppression methods are not effective. Should chemical suppressants be required to control dust, a risk assessment will be undertaken to assess potential for adverse impacts to water quality. • Installing an overhead bin and train loading facility from the start of the operations to minimise coal dust and the potential loss of coal during train transit. If adverse conditions are encountered during operation of the Project, additional dust suppression measures will be implemented.	
Noise	• Potential impact of Project noise on local fauna populations	**Medium**	• Providing appropriate training for staff to operate the equipment in order to minimise unnecessary noise emissions. This could be achieved during site inductions and regular training programs. • Avoiding unnecessary revving of engines and switch off equipment when not required. • Keeping internal roads well maintained. • Using rubber linings in or constrained layer damping on, for example, chutes and dumpers to reduce impact noise. • Minimising the drop heights of materials, in particular at the TLF. • Use ultra-low noise idlers on the conveyors; the noise reduction associated with these are generally 5 - 10 dB(A). • Positioning of overburden and topsoil piles in between haul roads and receptors, where practicable, to provide noise shielding. • The movement of plant onto and around the site should have regard to the normal operating hours of the site and the location of any sensitive receptors as far as is reasonably practicable.	**Low**

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			• Installation of an industry state-of-the-art fleet management system (such as Wenco) on the mining (and construction) equipment to limit the surface movement of equipment during the more sensitive noise times (such as night). • Employing audible reversing warning systems on mobile plant and vehicles that are of a type that have minimal noise impact on persons outside sites. This may include alarms that automatically adjust volumes based on the surrounding noise environment or alarms that are non-tonal in nature (such as broadband or 'quack' alarms). • As far as reasonably practicable, enclosing sources of significant noise. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements. A typical enclosure may provide 10 - 20 dB(A) depending on the material. • Operating plant in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise sensitive areas. Where possible, loading and unloading should also be carried out away from such areas. • Shutting down machines such as cranes that might have intermittent use. Such machines should be shut down between work periods or should be throttled down to a minimum.	
Lighting	• Potential impacts of Project lighting on local fauna populations	**Medium**	• In working areas adjacent to habitat, lighting should be consistent with the following guidelines: - Lights should be shielded beyond full cut-off to ensure that light falls only on the intended surfaces, and minimise direct light above the horizontal and minimise light spill along habitat edges. - Use light emitting diodes (LEDs) for lighting wherever possible. - Use long wavelength (550-700 nanometers; orange to red) lights wherever possible.	**Low**

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			- Lighting is to be designed to avoid the use of ultraviolet light and adjacent short wavelengths. - Avoid use of white lights that emit ultraviolet light and limit strong blue or green spectral elements (e.g. mercury vapour lights) as far as possible / practicable. • Lighting for the road crossing over Deep Creek and along roads within remnant habitat on the western side of the Project area should be restricted to the minimum necessary to meet safety standards. Within these areas, consideration should be given to the use of red light which has the least effect on nocturnal mammals. • Lighting design to minimise impact to greater gliders and koalas should be consistent with best practice and best available technology. • A suitably qualified person should be consulted in regard to ecological considerations in the design process for night lighting within these areas of threatened fauna habitat.	
Fire	• 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	• Fire management measures developed and implemented within Project EMP. • Fire-fighting equipment maintained and regular staff training • Smoking onsite restricted to designated areas and no onsite burning / incineration practises. • Vegetation adjacent to site will be managed for fuel load risk through fire management regimes and weed management.	Low
Pests and weeds	• Degradation of vegetation communities and fauna habitat both on and offsite, including MSES and ESAs through weed invasion and proliferation	High	• Prior to construction commencing, a baseline weed and pest survey will be conducted in the Project footprint plus a 200m buffer. This will be used to prepare a digital weed map of the site identifying the distribution and density of weed infestations and will enable tracking changes over time. In addition, a register of	Low

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
	• Predation on local fauna due to increase of introduced predators attracted to site		pertinent information in relation to weed and pest distribution, numbers and control requirements will be established. • Following the baseline survey, ongoing weed and pest monitoring surveys will be undertaken every two years, consisting of a survey during the dry season and a survey post-wet season. • Preventative methods proposed to reduce the risk of weeds being introduced into the area include: - For shipped plant and machinery, a thorough washdown procedure will be required for all plant and machinery prior to it being shipped to site. - All contractors bringing vehicles/plant onto the site will be required to complete a Weed Declaration Form, in which they formally declare that all required weed hygiene measures have been taken and that their vehicles/plant are free of weed material (in particular, weed seeds). - Establish a weed wash-down facility at or near the entrance to the Project Site for any vehicles that do enter / leave the mining lease areas. - For vehicles and plant that are unable to provide a Weed Declaration Form wash down will be required. - All weed washes will be documented and evidence maintained of weed wash-downs on or off-site. - Clearing will be minimised to the area directly required for mining operations. - Removal, stockpiling and movement of topsoil on the site will be tracked, particularly where the topsoil contains weed species. Top-soil from weed infestation areas (as identified in the pre-construction mapping) will be carefully stockpiled and if moved, not stored or reused in areas where those weeds are not present.	

Hazard	Potential Impacts	Potential Risk	Control Measures	Residual Risk
			- Any weeds that are identified within the Project area will require appropriate treatment to reduce the potential for these species to spread to new areas. Should weed infestations occur, the treatment applications will be selected relevant to the species, the size and growth stage of each infestation and the timing of application.	
Changes to groundwater table	• Drawdown of groundwater impacting Terrestrial GDEs and habitat for fauna	High	• Implement the GMMP. • Implement the GDEMMP. • In addition, a revegetation program will be implemented in areas within the riparian corridor expected to be affected by groundwater drawdown with the aim of building ecological resilience.	Medium

14.10 Conclusion

Activities undertaken during the construction and operation of the CQC Project have the potential to impact the terrestrial environment if not managed properly. Important terrestrial ecological values identified within the Project Site, Near Surrounds or downstream environment include:

- Endangered and Of Concern RE
- Brigalow TEC
- SEVT TEC
- Terrestrial GDEs
- Threatened species and
- Migratory species.

The Project has the potential to result in direct and indirect impacts on these values through vegetation clearing, groundwater drawdown, surface water changes, erosion, and increases in dust, noise, lighting, weeds, pest animals and fire.

The impact assessment demonstrates that the primary pathway to impact on these values is through vegetation clearing and groundwater drawdown. As a result of this assessment it is concluded that these Project activities will result in a significant residual impact on the following MNES and MSES:

- Habitat for greater glider, koala and squatter pigeon
- Of Concern RE 11.3.4 and RE 11.4.2 and
- Watercourse RE 11.3.4 and RE 11.3.25.

The scale of these impacts will be primarily mitigated through the implementation of the Project's EMP, SSMP and GDEMMP. The purpose of the SSMP is to reduce the environmental impacts of the Project on listed species and their habitat, through the development of mitigation and monitoring measures for implementation prior to construction, during construction, during operations and as part of the decommissioning process.

Offsets will be provided in accordance with the Project's BOS. As outlined in the BOS, the Project's offset package involves a combination of direct land-based offsets and a financial settlement offset (MSES only). Two land based offset properties have been identified to acquit the majority of the Project's offset requirements. These are Mamelon Station and [redacted] Watercourse RE 11.3.25 is unable to be completely offset on Mamelon and [redacted] and a financial settlement offset is proposed for the shortfall. The total cost of the financial settlement offset for impacts on 33.95 ha of watercourse RE 11.3.25 is $665,835.65[35]. It is noted that in CDM Smith (2018) an offset was proposed for impacts on potential remnant ornamental snake habitat, despite the Project not having a significant impact on the species. Whilst the assessment presented in this SEIS also concludes that the Project will not have a significant residual impact on the species, the commitment made in CDM Smith (2018) continues to be honoured and an offset for ornamental snake will also be delivered as part of the BOS.

[35] This amount is based on a combined financial settlement payment for all MSES as presented in Chapter 15 – Aquatic and Marine Ecology. The total payment for all combined MSES offsets is $874,585.65.

14.11 Commitments

CQCs commitments in relation to the Project's terrestrial ecology assessment are provided in Table 14-45.

Table 14-45: Commitments – Terrestrial Ecology

Commitment
Finalise and implement the EMP including mitigation and monitoring measures, triggers and corrective actions.
Finalise and implement the WMP including operational rules and procedures to manage water within the Project Site.
Finalise and implement the ESCP to be certified by a suitably qualified person, prior to construction.
Finalise and implement the REMP detailing the monitoring and management measures for surface water in accordance with relevant guidelines including triggers and corrective actions.
Finalise and implement the GDEMMP for monitoring all identified GDEs including stygofauna and watercourse pools in the Project Area including triggers which will be evaluated, with corrective actions identified for implementation in response to the monitoring results.
Finalise and implement the SSMP including the development of mitigation and monitoring measures for implementation prior to construction, during construction, during operations and as part of the decommissioning process.
Develop and implement the PRCP describing how final landforms associated with the Project will be rehabilitated after mining activities.
Implement the Biodiversity Offset Strategy and Offset Area Management Plans.