Winu Project EPBC Act Referral Supporting Document

Rio Tinto Winu Pty Limited

JUNE 2020

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Template 2.8.1

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Abbreviations

Abbreviation	Description
AREH	Asian Renewable Energy Hub (EPBC 2017/8112)
DAWE	Department of Agriculture, Water and the Environment
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
IBRA	Interim Biogeographic Regionalisation of Australia
IPA	Indigenous Protected Area
IUCN	International Union for Conservation of Nature
MNES	Matters of National Environmental Significance
Mtpa	million tonne per annum
PMST	Protected Matters Search Tool
TAP	Threat Abatement Plan
TSF	Tailings Storage Facility
TSSC	Threatened Species Scientific Committee

Executive Summary

Rio Tinto Winu Pty Limited (the Proponent) is evaluating the development of a mineralised copper-gold deposit within the Winu Development Envelope. The Winu Development Envelope is located 320 km east of the town of Port Hedland and 130 km north of Newcrest Mining Limited's Telfer Mine, in the Pilbara region of Western Australia.

The Proposed Action includes the development of a single open pit mine and associated waste dumps, tailings storage facilities, processing plant, stockpiles and supporting infrastructure including aerodrome and camp facilities.

A number of surveys have been undertaken within the proposed mine location (Mine Development Envelope). These studies have determined the known or potential presence of a number of threatened and migratory species, protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). One of these species, the Greater bilby (*Macrotis lagotis*), has local populations; whilst an additional six species are considered to use the wider Study area in a transitory and/or sporadic manner.

The Proponent has undertaken a number of measures to avoid and reduce impacts. Most significantly, the Mine Development Envelope has been designed to avoid the more sensitive environmental areas for key MNES; the Mine Development Envelope has been reduced in area by 7.2% in order to avoid areas of current bilby occupation and active burrows. Additionally, a number of good practise environmental management measures will be implemented to manage impacts during construction and operation.

A detailed impact assessment in line with relevant EPBC Act policy guidance has been undertaken for the seven threatened and migratory species that are known or have the potential to occur in the wider Study area. For the majority of species, significant impacts are considered unlikely due to the Proponent's impact avoidance and reduction commitments and/or the transitory nature of species' presence and habitat usage. However, impacts to Greater bilby habitat cannot be fully avoided and up to 1,418 ha of habitat that meets the definition of 'habitat critical to the survival of the greater bilby' will be removed as a result of the Proposed Action.

Recognising that impacts to Greater bilby habitat cannot be fully avoided, a dedicated Greater Bilby Conservation and Management Plan will be developed to guide the implementation of management measures to ensure that potential impacts to the Greater bilby are minimised and appropriately managed.

1. Introduction

1.1 Background and purpose of this report

Rio Tinto Winu Pty Limited (the Proponent) is evaluating the development of a mineralised copper-gold deposit within the Winu Mine Development Envelope. The Winu deposit was discovered in 2017 by Rio Tinto in the Paterson Province in the Pilbara Region of Western Australia.

The Winu Mine Development Envelope is located approximately 320 km east of the town of Port Hedland and approximately 130 km north of Newcrest Mining Limited's Telfer Mine (**Figure 1-1**).

The Proponent seeks to progress expeditiously through the evaluation and implementation phases to bring a viable project into production in 2023.

The current evaluation study has identified a potentially viable mining operation that would produce a copper/gold concentrate to be transported by road to Port Hedland for export.

This document provides additional supporting information to inform the referral of the proposed construction and operation of the Winu mining development (the Proposed Action) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report includes an assessment of potential impacts of the Proposed Action on Matters of National Environment Significance (MNES) known or considered likely to occur in the area.

1.2 Proponent

The Proponent for the Proposed Action is Rio Tinto Winu Pty Limited (ABN: 63 128 066 777, ACN: 128 066 777), which is a member of the Rio Tinto Group of companies.

The Proponent contact person in relation to the environmental assessment and approvals process for this referral and Proposed Action is:

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1.3 Description of Proposed Action

The key site mining facilities to be developed as part of the Proposed Action include:

- A single open-cut pit mine.
- Run-of-Mine (RoM) Pad and associated haul roads.
- Waste rock dumps and topsoil stockpiles.
- Centralised mineral processing facility, nominally consisting of primary crushing, grinding, flotation circuit, concentrate dewatering and tailings thickener.

- Non-process infrastructure (NPI).
- Power plant.
- Mixed use tailing storage facilities (TSFs).
- Mine dewatering and water supply borefield.
- Upgrade of the existing emergency airstrip to a code 3C aerodrome facility to accommodate direct flights from Perth or regional centres.
- An accommodation (Camp) facility.

The target mining rate is approximately 7 million tonnes per annum, subject to change as the Project progresses. Mine dewatering will be required with water used to meet processing and dust suppression needs and any surplus reinjected back into nearby aquifers. Dewatering requirements are subject to change depending upon the results of hydrogeological studies and state approvals.

1.4 Nomenclature used in this report

1.4.1 Proposed Action footprint

The Proposed Action footprint nomenclature used throughout this document refers to the direct impact footprint of the Proposed Action, which includes the mine pit, ROM pad, waste rock dumps, stockpiles, process plant facilities, NPI, TSFs, camp, power plant, roads and aerodrome. All elements of the Proposed Action footprint are conceptually shown on **Figure 1-2.**

1.4.2 Mine Development Envelope

The Mine Development Envelope nomenclature used throughout this document refers to the 12,398 ha package of land in which the mine and associated facilities of the Proposed Action footprint sits (**Figure 1-2**). The Mine Development Envelope has been designed to avoid sensitive environmental receptors, but also ensure that sufficient area for all planned activities is available.

1.4.3 Wider Study area

The wider Study area nomenclature used throughout this document refers to the general region and surroundings in the vicinity of, and including, the Mine Development Envelope and the AREH Development Envelope. The wider Study area is shown on **Figure 1-1.**

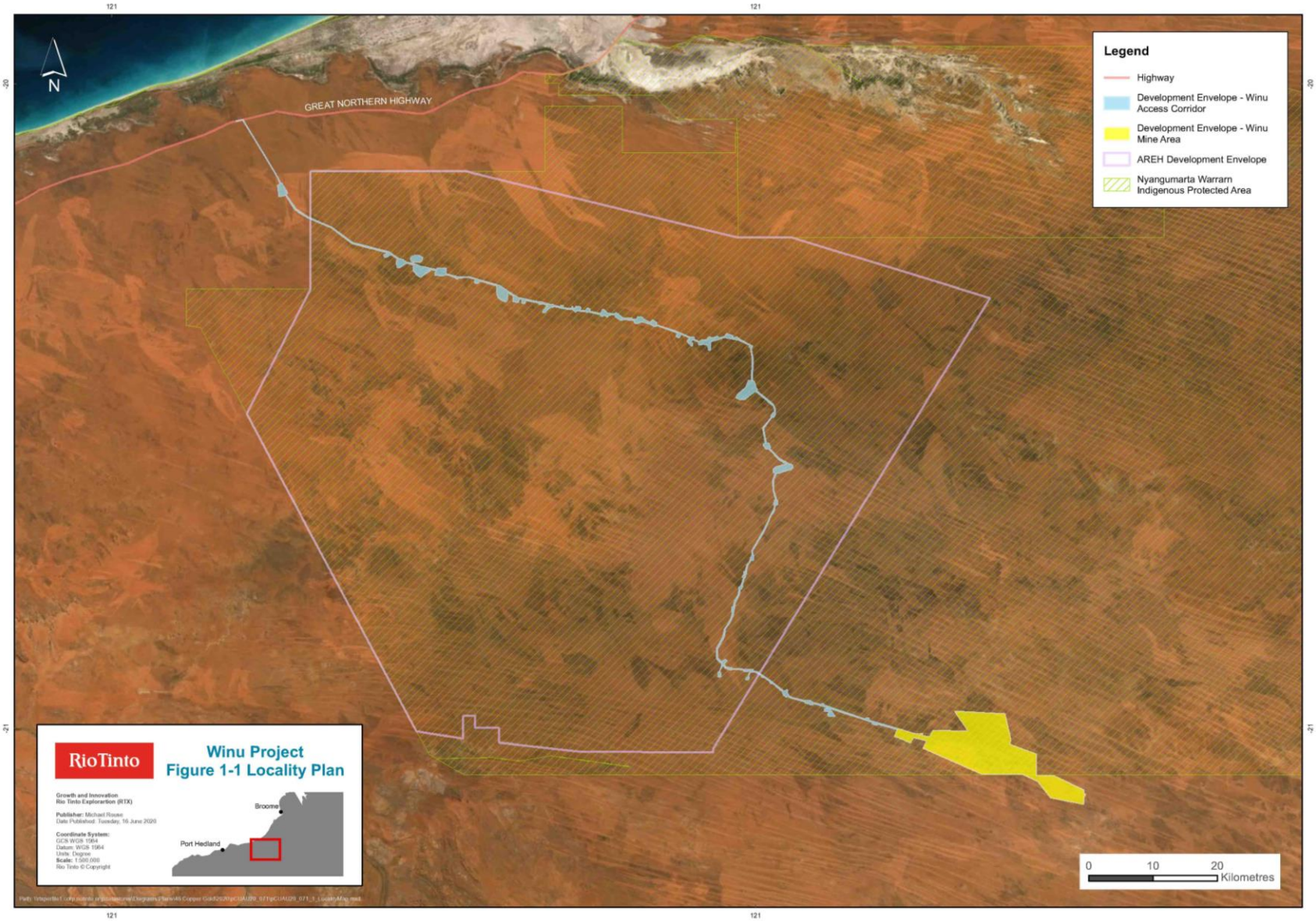

Figure 1-1: Locality

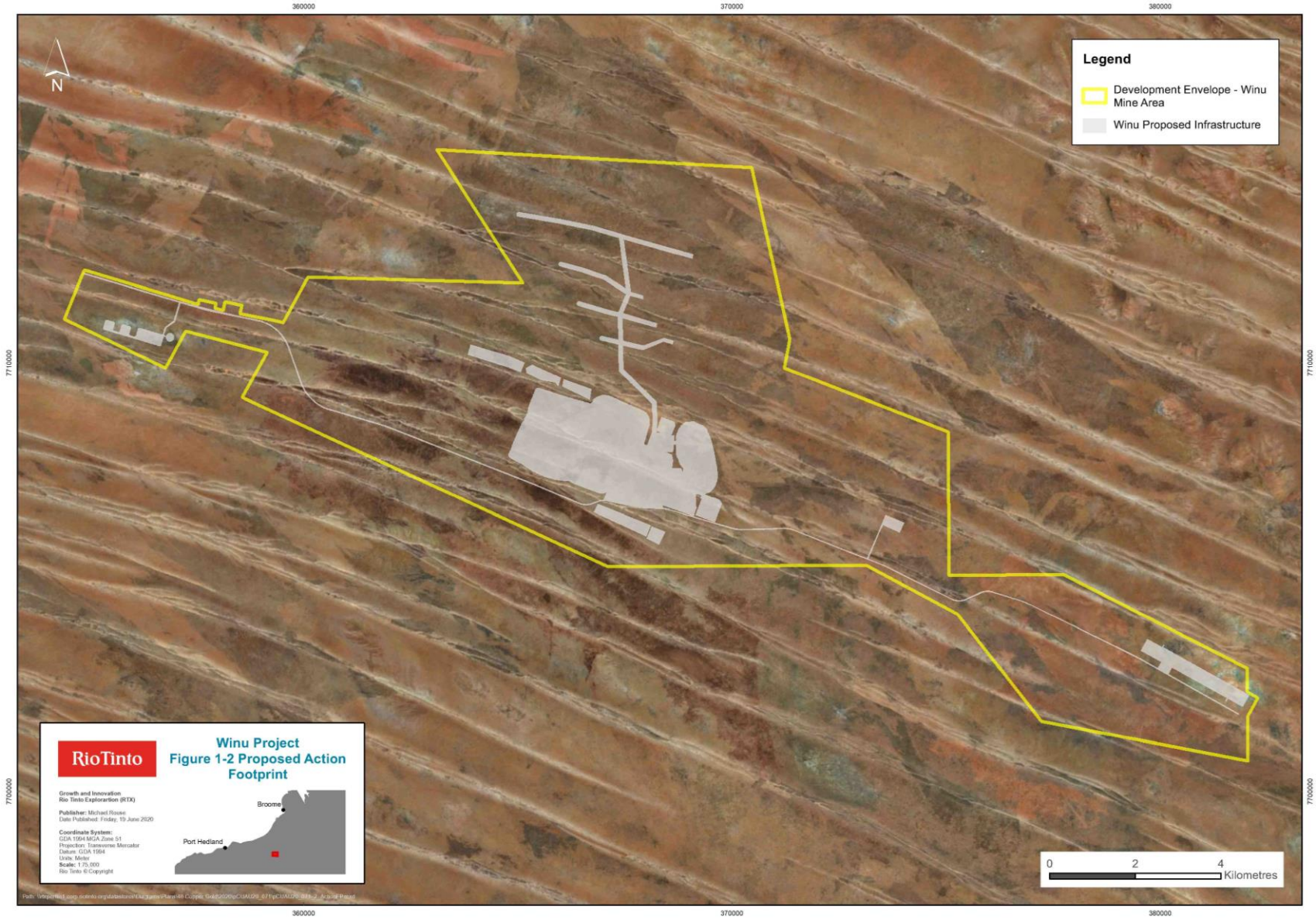

Figure 1-2: Proposed Action footprint

1.5 Timeframes

First ore production is planned in 2023. Construction is planned to commence immediately all required approvals are secured, which is scheduled in Q2 2021. Some early works might commence (subject to approvals or exemptions) in Q1 2021.

1.6 Project alternatives and justification

The justification for the Proposed Action is predicated on there being sufficient demand for Winu product in the global market and on the Proposed Action being able to be economically developed in the medium-long term. To date, the outcome of ongoing studies indicate there is sufficient product demand and the forecast economics for implementation, operation and closure of the Proposed Action is positive. Future prospects for further copper-gold mineralisation around Winu is also positive.

Aspects of the Proposed Action where alternatives have been evaluated include:

- **On-site power generation:** Options considered include trucked LNG for power station and diesel for mobile fleet (current case). Hybrid (solar/wind) is also being evaluated. The current evaluation study concludes that a diesel only power station was not consistent with current corporate policies and expectations and was thus not the preferred option; and that a renewable energy source (the hybrid option) should continue to be evaluated
- **Tailings Storage Facilities:** Options considered include conventional thickened centre-line & downstream raised and Central Thickened Discharge (CTD) and variants of both (current case). The current evaluation study concludes that the conventional thickened downstream raised facility may be feasible.
- **Layout of infrastructure:** Options considered include various iterations of layout arrangements involving waste rock dumps, tailings storage facilities, process plant, non-process infrastructure and administration facilities, topsoil stockpiles, explosive storage facilities, camp, internal access roads. The proposed conceptual layout as presented in this document has been designed taking into consideration minimising disturbance footprint, utilising existing landforms in design, environmental receptors, camp resident wellbeing (dust/noise) and Traditional Owner (heritage) concerns; establishing a workable, efficient and economically viable operation.
- **Mine Development Envelope:** The Mine Development Envelope options considered include an original Mine Development Envelope covering the extent of the biological survey area (Biota 2020a, 2020b) incorporating an area found to contain known MNES Greater bilby burrows, and a minimum sized Mine Development Envelope excluding existing known MNES Greater bilby burrows (current case). The original Mine Development Envelope was selected on the basis of providing sufficient allowance for project layout, including flexibility for any identified heritage sites or other avoidance areas, and potential future development scenarios. The latter option has been adopted (see **Section 6.1**) as the current evaluation study concludes that it would achieve a better environmental outcome (by excluding the known MNES burrows) while providing sufficient area to meet the requirements of the Proposed Action.

2. Stakeholder engagement

2.1 Key stakeholders

Key stakeholders have been identified based on the Rio Tinto group of companies experience in project development in Western Australia. The following key stakeholders were identified:

State Government Agencies

- Department of Water and Environmental Regulation (DWER)
- Environmental Protection Authority Services (EPA Services) of the DWER
- Department of Mines, Industry Regulation and Safety (DMIRS)
- Department of Biodiversity, Conservation and Attractions (DBCA)
- Department of Planning, Lands and Heritage
- Pilbara Ports Authority (PPA)
- Main Roads Western Australia

Commonwealth Government Agencies

- Department of Agriculture, Water and the Environment (DAWE)

Non-government Organisations / Other

- Nyangumarta Warrarn Aboriginal Corporation
- Western Desert Lands Aboriginal Corporation
- Yamatji Marlpa Aboriginal Corporation
- Warrawagine Cattle Company (Pastoral Lease Holder)

The Mine Development Envelope lies largely within the Nyangumarta Native Title Determination within the Nyangumarta Warrarn Indigenous Protected Area (IPA), and partially overlaps the Martu Native Title Determination. The IPA covers an area of 28,240 km^2 (**Figure 1-1**). This IPA was established in 2015 after the Traditional Owners of the land entered into a voluntary agreement with the Australian Government for the purposes of promoting biodiversity and cultural resource conservation. The IPA is currently managed by Traditional Owners in accordance with the Nyangumarta Warrarn IPA Plan of Management 2015 – 2020. This plan does not prohibit mining in the IPA (nor do any other instruments).

2.2 Stakeholder consultation

The Proponent is cognisant of the need to identify concerns of stakeholders and has sought to consider stakeholder views during the consultation process for the Proposed Action. It is anticipated that consultation will continue with key State Government and Commonwealth Government agencies and non-government organisations during the environmental assessment process and in the lead up to, and during, implementation of the works.

The consultation has enabled issues to be raised and discussed with stakeholders. Where appropriate, issues raised and management measures developed to address key issues have been considered in the

planning and design phase for the Proposed Action and in the preparation of this referral supporting document.

A summary of the stakeholder consultation undertaken for the Proposed Action is presented in **Table 2-1** below.

Table 2-1: Records of stakeholder consultation

Stakeholder	Date	Topics discussed	Relevant items
EPA Services of DWER	12 April 2019	• Brief overview/scope • Ongoing consultation approach • Factors of importance (waste mineral management)	• EPA Services accepted Winu being discussed via existing regime of Rio Tinto/EPA Services monthly project status meetings, as required. • EPA Services will need to understand biological issues to provide advice on the need for a referral. • EPA Services raised environmental sensitivities of waste minerals management for some recent copper projects – especially for TSFs, mineral waste characterisation and waste rock landforms.
	5 September 2019	• Project overview/scope • Possible level of assessment under the Environmental Protection Act 1986 (Part IV) • Environmental factors relevant to potential assessment • State approvals pathway options	• The Proponent outlined the key relevant environmental factors. EPA Services noted some uncertainty around Subterranean Fauna and Social Surroundings factors but that increased certainty on the assessment approach would be based on outcome of subterranean fauna desktop assessment and verification surveys and outcomes/progress of discussions with Traditional Owners. • EPA Services noted the decision to refer the project to the DAWE under the EPBC Act. • Agreement reached for another pre-referral meeting after planned studies are completed and Traditional Owner agreement discussions are progressed to further discuss the primary environmental approvals pathway.
	6 December 2019	• Project overview/scope • Possible level of assessment under the Environmental Protection Act 1986 (Part IV) • Environmental factors relevant to potential assessment • State approvals pathway options	• The Proponent provided an update of project scope, including key developments since previous meeting including results of sub-terranean fauna surveys and progress of discussions with Traditional Owners (in Principle support received). • EPA Services noted the need for additional information relating to Greenhouse Gase emissions, surplus water management; • Agreement reached to provide a presentation with updated project information
	4 March 2020	• Information memo providing updated detail about potential environmental impacts • Latest results of investigations	• Proponent provided updated presentation outlining project scope and providing additional information as requested by EPA Services, including Greenhouse Gas emissions, surplus water management proposal • EPA Services agreed to review provided information and revert if any additional information required
	20 April 2020	• Project overview/scope	• Proponent undertook to re-assess approvals pathway and refer the project pursuant to Section 38 if deemed appropriate

Stakeholder	Date	Topics discussed	Relevant items
		• Suggestion that the project be referred under section 38 of the EP Act	
DMIRS	13 April 2019	• Key environmental issues – water availability in the region • Potential approvals pathways	• DMIRS indicated that water allocations in the region are tight and DWER should be approached early to discuss water availability. • DMIRS referred to the April 2016 Guidelines for Mining Proposals and indicated key areas that DMIRS focus on, including biological findings, Closure Plan, Risk Assessment, mineral waste characterisation (tailings/waste dumps) and its management.
	30 August 2019	• Project overview/scope • Potential approvals pathways	• DMIRS indicated that the project was within its regulatory scope and expertise, but that the EPA Services will determine whether it warranted Part IV assessment. • Agreement reached that further consultation with DMIRS and EPA Services was required on the primary environmental approvals pathway.
	21 November 2019	• Exploration activity update • Winu development Project overview • Ongoing exploration programme for Winu / Paterson	• Advised DMIRS of intention to present details to EPA • Sought confirmation that DMIRS considered the scope fo the Winu Project within their scope of expertise and regulatory authority • DMIRS reinforced expectation for an Exploration Environmental Management Plan for ongoing exploration activities
	17 December 2019	• Project overview/scope • General approvals strategy for ongoing exploration activities	• Proponent advised DMIRS of outcome of discussions with EPA Services • Programme of Work approvals strategy • Exploration Environmental Management Plan
DAWE	4 September 2019	• Project overview/scope • State assessment status • Existing information for referral and other documentation • MNES species overview – potential, likely, known occurrences • Potential impacts of the Proposed Action • Environmental management approaches • Predicted environmental outcomes	• Advice was provided that the Proposed Action is a stand-alone small-scale project that is not part of a bigger package of additional smaller copper projects. • MNES survey outcomes outlined and the species to be considered in the referral. • Intention was to refer and the expectation is that the Proposed Action is likely to be a controlled action - DAWE indicated that a Preliminary Documentation process may be applicable, which would allow additional information to be provided after its determination on the referral. • The proposed approach to offsets for bilby is to implement a Bilby Conservation and Management Plan in line with the Commonwealth draft recovery plan for the species. The plan will specifically include Traditional Owner engagement. DAWE were supportive of that approach for environmental offsets. • The State process was still under discussion, but an update would be provided to DAWE.

Stakeholder	Date	Topics discussed	Relevant items
		• Timeframes and consultations	
	11 June 2020	• Project overview/scope • State assessment status update	• Confirmation of intention to submit referral of the Winu Project as a Proposed Action • Preparation of Bilby Management Plan as an offset
Nyangumarta Warrarn Aboriginal Corporation Nyangumarta Warrarn Indigenous Protected Area (NWIPA)	12 March 2019	• Project and study updates provided to the Nyangumarta Board of Directors • Employment opportunities and business capabilities update • Planned post wet season biological surveys in study area (April/May 2019) and NWIPA Ranger involvement	• Agreement obligations, employment and other economic benefits, cultural heritage protection raised and discussed. • Invitation to NWIPA Rangers to participate in biological surveys accepted.
	April – May 2019	• Dates and plans for NWIPA Ranger participation on biological surveys (April/May 2019)	• Dates and logistics for NWIPA Rangers participation in biological surveys agreed, including mobilisation.
	30 July 2019	• Project and study update including findings and outcomes of Phase 1 post wet season biological surveys to the Nyangumarta Board of Directors • Phase 2 post dry season biological surveys schedule	• Discussion on all work on NWIPA. • Approvals pathway being discussed with State and Commonwealth regulators.
	August 2019	• Planning for Phase 2 biological surveys with NWIPA Ranger participation and Martu participation	• Support and plans agreed for the NWIPA Manager and Rangers to carry out initial site visit, assessment and trapping of feral cats in September 2019. • Support and plans agreed for the participation of NWIPA Rangers on the Phase 2 biological surveys for 16 to 27 September 2019.
	26 and 29 August 2019	• Update to NWAC CEO and YMAC regarding project and proposed development	• Understanding of cumulative impact on environment, water, country requested.
	2 to 6 September 2019	• Nyangumarta Elders visit to Winu and wider Project area	• Site visit to carry out consultation and cultural awareness training.

Stakeholder	Date	Topics discussed	Relevant items
	16 to 18 September 2019	• Project update to the Board on environmental approvals pathways • Status of Phase 2 biological surveys	• Progress to date. • Phase 2 biological surveys underway with NWIPA Ranger participation. • Shared next steps: • Proponent will liaise with the State and Commonwealth regulators on environmental approvals requirements • Sampling for subterranean fauna and location of black-flanked rock-wallabies • Draft EPBC referral supporting document will be shared with Nyangumarta
	14-16 October 2019	• Site visit around Winu drilling locations and proposed locations • Project updates including hydrology studies • Discussions on next steps in engagement	• Site visit conducted and project updates provided.
	28-29 October	• Project update to NWAC Board and Elders including Flora and Fauna survey key findings; study progress; hydro and project layout	• Findings from May flora and fauna survey and update on analysis of data from phase 2 flora and fauna surveys conducted in late September
	18-20 November 2019	• Presentations to NWAC Board, CEO, Elders and Community meeting	• Complete update on all activities and work on Winu project including flora and fauna surveys and project next steps.
	February – May 2020	• Updates on Project and Studies to the NWAC technical team, CEO, Board and Elders (COVID Impacting attendance)	• Additional detail on the Commonwealth and State lodgements upcoming including the EPBC referral and proposed Bilby management plan and subsequent co-development and implementation of the key management measures with the Traditional Owners
Western Desert Lands Aboriginal Corporation (WDLAC)	21 February 2019	• Project and study updates provided to the WDLAC Board of Directors • Update provided on 2018 work completed and the proposed 2019 program to the Board	• Agreement obligations, employment and other economic benefits, cultural heritage protection raised and discussed.

Stakeholder	Date	Topics discussed	Relevant items
		• Additional works on joint-venture tenure, Rio Tinto Exploration tenure and Winu and Paterson regional work • Elders visit, ethno-botanical and cultural awareness training	
	May 2019	• Pitjikarli Elders visit to site, ethnographic-botanical survey, cultural awareness training	• Conducted preliminary ethno-botanical survey, cultural awareness training sessions, and ethnographic consultation.
	12 August 2019	• Project and study update, including Phase 1 post wet season biological surveys to the WDLAC Board of Directors • Approvals pathway	• Outcomes and findings of Phase 1 biological surveys outlined. • Approvals pathway being discussed with State and Commonwealth regulators. • Discussion on participation in upcoming biological surveys with development opportunity through support of Biota (Winu biological consultant) and NWIPA Rangers.
	28 August 2019	• Update to WDLAC CEO, directors and staff regarding project and proposed development • Planning for Martu participation in Phase 2 post dry season biological surveys	• Introduction of Agreement negotiation team. • Plans made for the participation of Martu in the Phase 2 biological surveys (scheduled for 16 to 27 September 2019) with support of NWIPA Rangers.
	20 September 2019	• Broad project update to the Board subcommittee, including environmental approvals pathways • Phase 2 biological surveys with Martu participation	• Progress to date. • Proponent continuing to liaise with State and Commonwealth regulators on environmental approvals pathways. • Draft EPBC referral supporting document will be shared with WDLAC.
	25 September 2019	• Further project update to the Board subcommittee, including environmental approvals pathways	• No specific outcome agreed/response provided.
	18 October 2019	• Discussion on status of engagement to date and next	• No specific outcome agreed/response provided.

Stakeholder	Date	Topics discussed	Relevant items
		steps for engagement, including discussions on hydrology studies	
	14-15 November 2019	• Project and studies update to the WDLAC Board, Elders committee and CEO	• Included updates on the findings of the phase 1 and 2 flora and fauna surveys
	February – May 2020	• Updates on Project and studies to the WDLAC Board and CEO	• Additional detail on the Commonwealth and State lodgements upcoming including the EPBC referral and proposed Bilby management plan and subsequent co-development and implementation of the key management measures with the Traditional Owners

3. Existing environment

3.1 Existing studies and surveys

A number of ecological surveys have been undertaken within and around the Mine Development Envelope and the wider Study area, which has enabled a detailed understanding of the existing flora and fauna values of the Mine Development Envelope and the wider Study area. A summary of the results of these surveys is provided below.

3.1.1 Mine Development Envelope surveys

A wet season flora survey was undertaken of the Mine Development Envelope from 12 to 17 May 2019 (Biota 2020a) with the participation of the Nyangumarta Rangers within the IPA and consisted of 32 quadrats, two relevés and 206 mapping observations. A terrestrial fauna survey of the Mine Development Envelope was also undertaken from 12 to 20 May 2019 (Biota 2020b) and involved:

- 11 trapping sites totalling 1,092 trap nights comprised of
  - 533 pitfall trap nights
  - 284 funnel trap nights
  - 275 Elliot trap nights
- 9 hours conducting bird surveys
- 19 hours conducting nocturnal searches
- 11 motion sensitive camera sites, totalling 36 camera trap nights
- 6 ultrasonic bat recorder sites, totalling 13 recording nights
- 6 automated audio recorder sites (targeting night parrot), totally 36 recording nights
- 1 marsupial mole trench

As part of the fauna survey, a targeted survey for the Greater bilby was also undertaken in May 2019 (Biota 2020b). The survey included ten 2 ha sign plots and ten unbounded transect searches.

An additional targeted bilby survey was undertaken in September 2019 within the Mine Development Envelope (Biota 2020b), with the participation of both the Nyangumarta Rangers and Martu representatives. This survey was conducted in accordance with DBCA guidelines for surveys to detect the presence of bilbies (DBCA 2017) and involved:

- 2 ha sign plot surveys (consisting of ten plots)
- Transect searches to record sign evidence of bilby (13 unbound foot traverses covering 68 km)

This survey recorded signs positively attributable to the bilby and subsequently a bilby abundance study was undertaken (Biota 2020c). This study was conducted in September 2019 following advice received by DBCA on the level of survey effort required to determine if the individuals present within the Mine Development Envelope represent part of a significant source population. The methodology involved:

- Traversing strip transects to collect bilby scats
- Extracting DNA from the scats to genotype individual bilbies
- Using the data provided to estimate abundance.

A summary of the outcomes of these surveys, as they relate specifically to individual listed fauna and listed migratory species, is provided in **Sections 7** and **8** below.

3.1.2 Other surveys in the region

Additional detailed ecological studies have been undertaken in the AREH Development Envelope over a large area (>660,000 ha) adjacent to the Mine Development Envelope (Biota 2018). The closest border of the AREH Development Envelope is approximately 20 km west of the Mine Development Envelope. Surveys have also recently been conducted for areas of the RAC Development Envelope (Biota 2020) which will connect to the Mine Development Envelopment and traverses through the AREH Development Envelope.

A dry season fauna survey was carried out in the AREH Development Envelope from 24 August to 5 September 2017, with a wet season fauna survey undertaken from 13 March to 21 March 2018 (Biota 2018). The combined effort of these two surveys in the AREH Development Envelope involved:

- 16 trapping sites, totalling 4,065 trap nights comprised in part of:
  - 2,250 pitfall trap nights
  - 900 funnel trap nights
  - 715 Elliot trap nights
- 23 hours conducting bird surveys
- 8 motion sensitive camera sites, totalling 36 camera trap nights
- 10 ultrasonic bat recorder sites, totalling 28 recording nights
- 12 automated audio recorder sites (targeting night parrot), totally 2,340 recording nights

In addition to the survey effort summarised above, a number of transect searches and point searches were also conducted within the AREH Development Envelope (Biota 2018) including:

- 16 general diurnal searches in habitat with the potential to support species of conservation significance
- 32 transect walks targeting Greater bilby
- 21 diurnal search sites targeting rocky areas that are potential habitat for black-flanked rock-wallaby and northern quoll
- 42 habitat assessments conducted via helicopter to confirm representative habitat types
- 2 nights of nocturnal road spotting

Additional surveys were also undertaken for sections of the RAC Development Envelope that fall outside of the AREH Development Envelope, as well as the RAC diversion (Biota 2020).

Spring flora surveys were undertaken for each of these sections of the RAC Development Envelope from 22 to 27 August 2019 and 26 September 2019, with dry season fauna surveys occurring from September 21 to 26 2019 (Biota 2020). These surveys included:

- Vegetation mapping and assessment
  - Entirety of the diversion mapped on foot
- Targeted flora surveys
  - Eight quadrats and five relevés

- Fauna habitat mapping;
  - Foot traverses in unburnt areas
- Targeted bilby survey;
  - Unbounded transect searches within unburnt areas of potential bilby habitat to target the Greater bilby
- Targeted Black-footed Rock Wallaby survey:
  - Searches for potential individuals and signs (scats and tracks) in potential habitat (rock piles) located near the RAC diversion
  - Habitat assessment of the potential habitat including potential food sources (e.g. *Ficus* spp.)

3.2 Terrestrial vegetation

No Commonwealth listed threatened flora species or threatened ecological communities have been recorded in the Mine Development Envelope, nor are any threatened flora species or ecological communities considered likely or have the potential to occur in the Mine Development Envelope.

The Mine Development Envelope is located within the Great Sandy Desert bioregion, within the Mackay subregion. The vegetation of the Mackay subregion is described as 'tree steppe grading to shrub steppe in the south; comprising open hummock grassland of *Triodia pungens* and *Triodia schinzii* with scattered trees of *Owenia reticulata* and *Corymbia* spp., and shrubs of *Acacia* spp., *Grevillea wickhamii* and *G. refracta*, on Quaternary red longitudinal sand dune fields'.

The Mine Development Envelope consists of eleven vegetation types which are associated with three broad landforms; longitudinal sand dunes and associated swales; inter-dunal sand plains; and stony rises and outcroppings (Biota 2020a). The vegetation was in excellent condition, barring small areas of cleared tracks and the airstrip in the eastern portion of the Mine Development Envelope (Biota 2020a).

Two vegetation units on dunes were considered to be of elevated conservation significance, as they supported high numbers of three species listed under the Western Australian *Biodiversity Conservation Act 2016* as Priority 3 flora species: *Corynotheca asperata, Indigofera ammobia* and *Sauropus arenosus.* In addition, some areas of vegetation on sand plains contained large numbers of the Priority 2 species *Goodenia hartiana,* and small numbers of the Priority 3 species *Tribulopis marliesiae.*

The Mine Development Envelope does not contain any groundwater dependent vegetation, nor were any weed species recorded during the flora survey.

3.3 Terrestrial fauna habitats

Four broad habitat types have been identified in the Mine Development Envelope (Biota 2020b), including:

- Shrub and spinifex on sandplain
- Longitudinal sand dune ridge
- Gravelly lateritic rise
- Clayey sand plain with termitaria

These habitat types align broadly with the landforms present within the Mine Development Envelope, and all habitat types observed are common and well represented through the Great Sandy Desert bioregion (Biota 2020b). Further description of these habitats (from Biota 2020b) is presented below in **Table 3-1** and shown on **Figure 3-1.**

Table 3-1: Fauna habitat types in the Mine Development Envelope

Habitat type	Description	Extent in Mine Development Envelope (ha)
Shrub and spinifex on sandplain	The dominant habitat of the Mine Development Envelope. Substrate comprised of red sand. Vegetation was typical of the Great Sandy Desert bioregion, comprising open hummock grasslands dominated by *Triodia schinzii* with scattered trees of *Owenia reticulata* and shrubs of mixed Acacia species	6,932 (55.9%)
Longitudinal sand dune ridge	The sand dunes were typically long linear dunes trending east-west, with red sand substrate. The vegetation was dominated by *Corymbia chippendalei, Erythrophleum chlorostachys* and *Owenia reticulata* low woodland and scattered trees over mixed *Acacia* low open shrublands over open hummock grasslands dominated by *Triodia schinzii.*	2,607 (21.0%)
Gravelly lateritic rise	Isolated habitat type within the Mine Development Envelope, comprising low rises with substrate covering of laterite gravel and pebbles. Vegetation comprised scattered *Grevillea wickhamii* subsp. *hispidula* over *Mirbelia viminalis* low shrubland over *Triodia brizoides* open hummock grassland.	304 (2.45%)
Clayey sand plain with termitaria	Isolated habitat type within the Mine Development Envelope, the substrate comprised clayey sand and vegetation supported *Acacia bivenosa* shrubland over *Triodia brizoides* open hummock grassland. The majority of this habitat had been recently burnt.	105 (0.85%)
Not surveyed	This area has not been subject to on-ground surveys due to a recent change to the Development Envelope. However, this habitat is considered to be consistent with the four broad habitat types identified previously and therefore has the same value to fauna that potentially occur within the area.	2,450 (19.8%)

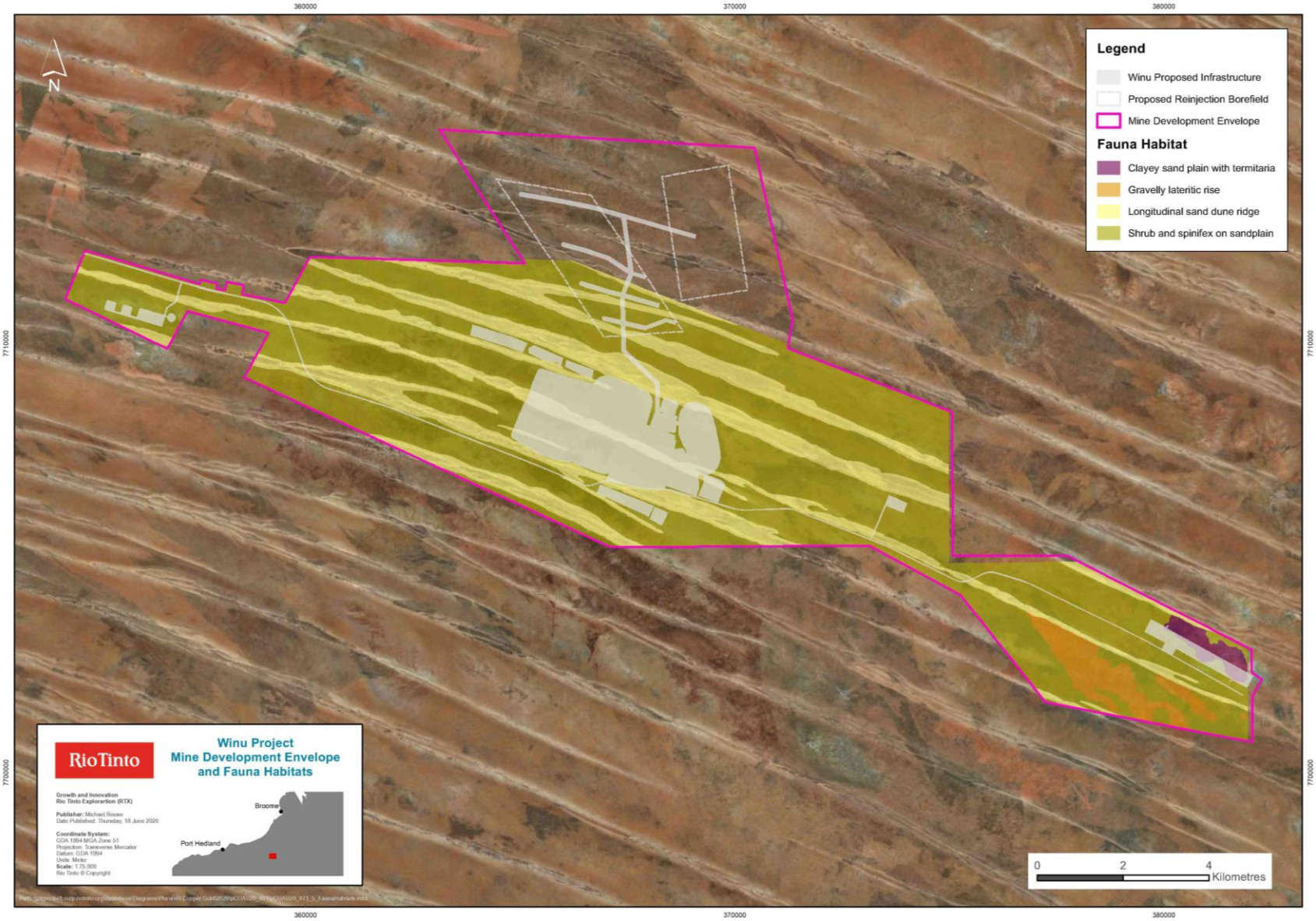

Figure 3-1: Terrestrial fauna habitats in the Mine Development Envelope

3.4 MNES occurrence

Database searches were conducted for the wider Study area using EPBC Act Protected Matters Search Tool (PMST; including a 20 km buffer) (**Appendix A**). Additional information regarding records of species was sourced from publicly available databases (e.g. Atlas of Living Australia) and previous studies conducted within or in the vicinity of the wider Study area. **Table 3-2** below summaries the results of the PMST.

Table 3-2: Results of the PMST search

MNES	PMST results
World Heritage Properties	None
National Heritage Places	None
Wetlands of International Importance (Ramsar sites)	None
Great Barrier Reef Marine Park	None
Commonwealth Marine Areas	None
Listed Threatened Ecological Communities	None
Listed Threatened Species	7 – see below and Appendix B (Likelihood of Occurrence)
Listed Migratory Species	10 – see below and Appendix B (Likelihood of Occurrence)

One threatened species is known to have local populations within the Mine Development Envelope, the Greater bilby (*Macrotis lagotis*; V). Potential impacts from the Proposed Action are assessed in detail for the Greater bilby in **Section 7** below.

Five additional species have been recorded or have the potential to occur within the Development; however, rather than having well established local populations, their presence is considered to be transitory and/or sporadic. These species are also assessed below (**Section 8**) and include Princess parrot (*Polytelis alexandrae*; V), Oriental plover (*Charadrius veredus*; M), Oriental pratincole (*Glareola maldivarum*; M), Fork-tailed swift (*Apus pacificus*; M) and Gull-billed tern (*Gelochelidon nilotica*; M).

The remaining species are considered unlikely to occur. In particular, extensive dedicated studies have been undertaken for the night parrot (*Pezoporus occidentalis*; E) in the wider Study area. The species has not been detected despite the survey effort (a combined total of 2,376 nights of automated acoustic recording over 18 sites)[1], undertaken across two seasons. Habitat condition improved between the survey periods and therefore detectability was increased during the second season's survey (Biota 2018).

[1] Additional surveys were also undertaken in September 2019 across seven sites within the Mine Development Envelope and no calls were recorded (Biota in prep).

Habitat condition for the night parrot in the wider Study area is generally poor, despite improvements between survey seasons. Preferred nesting habitat of the species includes old growth spinifex hummocks, at least 40-50 cm in size (DPaW 2017a). The AREH Development Envelope and Mine Development Envelope are dominated by spinifex on sandplain, potentially supporting suitable sized hummocks for nesting; however, much of the area has been recently burnt (Biota 2018; Biota 2020b). Fire reduces habitat suitability for the species by removing large and mature spinifex hummocks from the landscape. Consequently, no evidence of suitable nesting habitat or foraging habitat was recorded.

A likelihood of occurrence assessment for all MNES fauna species is provided in **Appendix B**.

4. Guidance relevant to the impact assessment

The following EPBC Act guidance has been considered in assessing the significance of potential impacts to MNES associated with the Mine Development Envelope.

4.1 Significant impact guideline

The MNES Significant Impact Guidelines (DoE 2013) provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under the EPBC Act and whether or not a referral is required for a decision by the Australian Government Minister for the Environment on whether assessment and approval is required.

The analysis presented in this report has been formulated based on the approach to impact assessment required under the EPBC Act. It brings together an understanding of environmental values and types of potential impacts in order to analyse the effect on MNES. There are a number of concepts which are commonly applied under the EPBC Act to assess the significance of impacts to MNES. These are defined in MNES Significant Impact Guidelines (DoE 2013). In accordance with these guidelines, the assessment in this report is presented within the context of the following key concepts:

- Habitat critical to the survival of a species
- A population – this relates particularly to groups of Endangered or Critically Endangered listed species under the EPBC Act
- An important population – this relates particularly to species listed as Vulnerable under the EPBC Act
- Important habitat for migratory species
- Ecologically significant proportion of the population of a migratory species.

The meaning of these concepts is defined in the text box below.

WHAT IS HABITAT CRITICAL TO THE SURVIVAL OF A SPECIES?

Habitat critical to the survival of a species refers to areas that are necessary:

- *for activities such as foraging, breeding, roosting, or dispersal;*
- *for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);*
- *to maintain genetic diversity and long term evolutionary development; or*
- *for the reintroduction of populations or recovery of the species or ecological community.*

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/ or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

Source: DoE 2013.

WHAT IS A POPULATION OF A SPECIES?

A 'population' is an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

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

WHAT IS AN IMPORTANT POPULATION OF A SPECIES?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- *key source populations either for breeding or dispersal;*
- *populations that are necessary for maintaining genetic diversity; and/or*
- *populations that are near the limit of the species range.*

WHAT IS AN IMPORTANT HABITAT FOR A MIGRATORY SPECIES?

An area of 'important habitat' for migratory species is:

- *habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or*
- *habitat that is of critical importance to the species at particular life-cycle stages; and/or*
- *habitat utilised by a migratory species which is at the limit of the species range; and/or*
- *habitat within an area where the species is declining.*

WHAT IS AN ECOLOGICALLY SIGNIFICANT PROPORTION?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates).

WHAT IS THE POPULATION OF A MIGRATORY SPECIES?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Source: DoE 2013.

4.2 Approved conservation advice and recovery plans

Approved Conservation Advice and Recovery Plans are in place for the MNES considered for detailed impact assessment in the sections below. These guidance documents can identify overall conservation

objectives, critical habitat, important populations, key threats and priority management actions. They are also relevant to the assessment process as the Minister must consider the content of approved conservation advices and must not act inconsistently with a recovery plan when considering whether to approve a Proposed Action.

Guidance relevant to this Proposed Action is presented below, noting that there may be recovery objectives or priorities in addition to those presented below; however, these are not considered relevant to this assessment.

4.2.1 Approved conservation advice objectives and priorities

Table 4-1 presents the relevant conservation objectives and priorities for each MNES known or with the potential to occur in the Mine Development Envelope and for which there is a species-specific conservation advice or listing advice.

Table 4-1: Approved conservation advice

Guidance	Objective or priorities
Conservation advice *Macrotis lagotis* greater bilby (TSSC 2016a)	Conservation objectives: • Maintain the current distribution of bilbies and seek to expand this distribution. • Implement landscape-scale control of introduced predators at key bilby sites. • Maintain the existing insurance populations of feral predator-free islands and fenced areas, and potentially increase the number of these insurance populations. • Develop and implement a national monitoring program for bilbies.

	Conservation actions:
	• Conservation and management:
	  ○ Management of invasive species including feral cats, foxes and rabbits.
	  ○ Minimise habitat loss and fragmentation, with a focus on creating sufficiently large areas to support subpopulations of up to 10,000 individuals.
	  ○ Minimise large scale fires and promote mosaics of vegetation with heterogeneous structure and age classes.
	  ○ Development of a meta-population management plan.
	  ○ Increase stakeholder engagement with all potentially relevant parties.
	• Survey and monitoring:
	  ○ Implement national monitoring and survey protocols to assess national trends.
	  ○ Implement an integrated monitoring program of threats (especially fire, predators) at important occupied habitat, to assess the effectiveness of current management actions and inform future management actions.
	• Information and research:
	  ○ Develop a prioritised, targeted research program incorporating social, cultural and ecological elements which informs effective Greater bilby conservation.

Guidance	Objective or priorities
Conservation advice *Polytelis alexandrae* princess parrot (TSSC 2018)	The primary conservation action for the princess parrot is to maintain breeding habitat by undertaking active fire management and control of domestic and invasive species. Conservation and management priorities: • Implementation of appropriate fire management regimes. • Invasive species control. • Illegal collection deterrence through the suppression of exact nest locations. • Stakeholder engagement to promote conservation across land tenures.

4.2.2 Draft Recovery Plan for the Greater Bilby (*Macrotis lagotis*)

The Draft Recovery Plan for the Greater Bilby (Commonwealth of Australia 2019) (Commonwealth Draft Recovery Plan) is a revision of the National Recovery Plan for the Greater Bilby (Pavey 2006). The Commonwealth Draft Recovery Plan aims to halt decline and support recovery of the Greater bilby and provides for the research and management actions necessary to maximise the Greater bilby's chances of long-term survival in nature (Commonwealth of Australia 2019).

The Commonwealth Draft Recovery Plan includes on-ground conservation and management actions, which are planned to occur within a monitoring framework that measures the impact of management. The Commonwealth Draft Recovery Plan includes supporting actions to promote the role of Aboriginal people and land managers in bilby conservation, provide governance and coordination, establish and maintain monitoring and survey, and undertake research to inform management.

The Commonwealth Draft Recovery Plan has four key objectives with associated performance criteria, as detailed below:

- **Objective 1:** The size of the Greater bilby population has grown
  - Performance criterion 1: In 2029, indices of abundance at a sample of sites show growth compared to 2019. The samples sites are to be identified by the recovery team within 12 months.
- **Objective 2:** The area occupied by the Greater bilby has been maintained or increased
  - Performance criterion 2(a): In 2029, the bilby continues to occupy key sites that were occupied in 2019. These sites include Sangsters Bore (NT), Matuwa (WA), Warburton (WA), Kiwirrkurra (WA), Astrebla Downs (Qld), and any other site identified by the recovery team.
  - Performance criterion 2(b): In 2029, the distribution of the Greater Bilby has been maintained or increased since 2019. To be calculated using extent of occurrence methods based on presence-only data.
- **Objective 3:** The genetic diversity of the Greater bilby has been maintained and retains the potential for evolutionary change through adaption and selection
  - Performance criterion 3: In 2029, genetic diversity is estimated to be equivalent to that present in 2019. The measure is to be defined by the meta-population management plan.
- **Objective 4:** Aboriginal organisations, communities, and individuals have a greater role in bilby conservation.

- Performance criterion 4: In 2029, there has been an increase in the number and locations of Aboriginal people who are actively engaged in bilby recovery, from leadership and agenda setting to on-ground works.

The Commonwealth Draft Recovery plan has identified a range of 'bilby recovery sites', which includes all locations where it is possible that bilbies may persist, either naturally or as a result of being reintroduced. The Nyangumarta Warrarn IPA is listed as a bilby recovery action site in the Commonwealth Draft Recovery Plan.

A range of recovery actions have been developed within the Commonwealth Draft Recovery Plan. The application of each action varying at each site according to local conditions and the way key threats interact. The effectiveness of actions at a local scale may be reliant on adapting actions to those circumstances.

The overall supporting strategies outlined in the Commonwealth Draft Recovery Plan for monitoring and Traditional Owner engagement are outlined in **Table 4-2** and **Table 4-3**.

The on-ground recovery actions relevant to the Nyangumarta Warrarn IPA are presented in **Table 4-4** and **Table 4-5**; note, not all actions included in the Commonwealth Draft Recovery Plan are relevant to the Nyangumarta Warrarn IPA and thus are not presented.

Table 4-2: Supporting strategy – monitoring, survey and information management

Action	Description
1a	Continue or start bilby population monitoring and bilby surveys to establish baseline and measure management impact: • Facilitate and co-ordinate monitoring and survey, including through initiatives such as the Bilby Blitz Programme. • Promote regular (annual and five-yearly) surveys of bilby sites by local communities using methods that generate comparable data. • Include sites necessary to measure against recovery plan performance criteria. • Use methods relevant to the circumstances and conditions, such as sign or track plots, burrow visits, cameras, thermal imaging etc. • Collate, analyse and report on data generated from monitoring and surveys.
1b	Identify sample sites at which growth of bilby population will be measured (see performance criterion 1) within 12 months.
1c	Identify any other sites for occupancy survey necessary for reporting against performance criterion 2(a).
1d	Develop and publish monitoring and survey protocols.
1e	Standardise and implement occupancy/habitat survey methods for bilbies, predators and herbivores across the range of the bilby.
1f	Investigate and establish, if feasible, a 'national database' or 'national map', combining existing data (mapping etc.) to enable on-ground recovery actions. Include layers/data on climate, vegetation, geology and fire frequency mapping etc.

Table 4-3: Supporting strategy – Traditional Owner research and management

Action	Description
2a	Continue to facilitate awareness-raising activities in order to maintain focus on both the cultural significance of the bilby, and Indigenous ecological knowledge and skills in bilby management: • Conduct events to celebrate and share knowledge about bilby significance and conservation. • Provide opportunities to exchange knowledge and experience on cat control techniques between Traditional Owners, land managers and species management experts. Share stories, reports, and knowledge about the Greater Bilby, and information about ranger and Indigenous organisation conservation activities, through school activities, traditional media and social media.
2b	Facilitate Indigenous leadership and involvement in the Recovery Team through the Indigenous sub-committee, and professional development opportunities in recovery team policy and governance. This will ensure extant populations are managed, and maintain a focus on the cultural significance, traditional ecological knowledge and Aboriginal land management skills in bilby conservation.
2c	Build the knowledge, awareness and passion for bilbies in the younger generation, e.g. through junior Indigenous Ranger activities, that facilitates both intergenerational knowledge transfer and training in management.
2d	For each site, develop a spatially explicit and plain language annual action plan tailored to the needs of the land manager based on the recovery plan, suitable for use in the field by land managers.
2e	Based on annual action plan, consider revising Indigenous Ranger work plans to include relevant bilby recovery actions.
2f	Provide training and support for Indigenous Rangers to accurately and systematically monitor bilbies, e.g. data collection and management, for example, through Bilby Blitz Programme.

Table 4-4: On-ground action strategy – manage and monitor predators

Action	Description
4a	Implement cat control measures: • Undertake cat control using techniques applicable to the circumstances and local conditions, e.g., baiting, trapping, hunting, shooting, grooming traps, etc. Ensure that potential impacts on non-target species are considered and managed. • Schedule control activities to account for bilby and cat breeding cycles, prey availability, potential interactions with dingoes, etc. • Provide information, advice and training to landowners and managers to conduct localised cat management at known sites, using the right methods. • Continue refining and trialling new baits, attractants and other methods to develop effective cat control techniques for arid areas. • Provide opportunities to exchange knowledge and experience on cat control techniques between Traditional Owners, land managers and species management experts. • Ensure monitoring is established to determine the baseline and measure management impact.
4d	Establish baseline monitoring of bilbies and predators using agreed monitoring techniques: • Monitor factors/circumstances of predation that results in local extinctions. • Establish arrangements for data sharing and intellectual property management. • Establish local and centralised data management, analysis and reporting systems.
4e	Train Aboriginal land managers, including Traditional Owners and Indigenous Rangers to establish or improve predator control and management activities, including: • Standardised methods • Data management and reporting systems.
4f	Investigate and, if feasible, develop and make available baseline distribution data and maps of threats (cats, foxes, cattle, horse/donkey, camel, key weeds and fire histories) that can be used at a national scale for a general overview, and at a local site scale, so Indigenous Rangers can check and update the veracity of available data.

Action	Description
4g	Use results from above to develop regional predator management strategies (e.g. Tanami, southern WA, northern WA, southwestern Qld).
4j	Determine if foxes are extending their range in WA.

Table 4-5: On-ground action strategy – improve and maintain habitat

Action	Description
5a	Define, promote and implement region-specific fire management to minimise large-scale fires and promote mosaics, using traditional ecological burning and traditional Indigenous knowledge: • Undertake burning (including patch burning, traditional burning, linear fire breaks) at each known site. • Undertake landscape-scale fire management and limit the extent and spread of wildfires to protect sites and bilby habitat from unmanaged fire following high rainfall events. Consider aerial burning after extensive rainfall events that are likely to create conditions that result in widespread fires. • Develop fire management guidelines that protect specific habitat elements, such as key food resources (e.g. witchetty grubs). • Develop fire management guidelines for the following areas: Qld bilby sites, the Pilbara, Lancewood (NT) and Dampierland (IBRA).
5c	Compile traditional ecological knowledge about links between habitat, fire patterns and key bilby food availability.
5d	Ground-truth and refine bilby habitat model within the separate regions (e.g. using 2 ha plot and occurrence data, remote sensing data and vegetation mapping). Investigate relationship between modelled bilby habitat and fire history (e.g. area of habitat to area burnt), and development and climate.
5n	Develop guidelines for stocking levels based on stocking levels at grazed sites where the bilby has persisted.

4.2.3 Wildlife Conservation Plan for Migratory Shorebirds

The Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia 2015a) is relevant to the oriental plover and oriental pratincole. The objectives of the plan are:

- Protection of important habitats for migratory shorebirds has occurred throughout the East Asian-Australasian Flyway.
- Wetland habitats in Australia, on which migratory shorebirds depend, are protected and conserved.
- Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.
- Knowledge gaps in migratory shorebird ecology in Australia are identified and addressed to inform decision makers, land managers and the public.

4.3 Threat abatement plans

Threat Abatement Plans (TAPs) establish national frameworks to guide and coordinate Australia's response to threats to biodiversity. These documents identify research, management and other priority actions required to ensure the protection of threatened species. The Australian Government develops and facilitates the implementation of the plans through the establishment of partnerships and

cooperative programs. When considering the approval of a Proposed Action, the Minister must not act inconsistently with a TAP.

TAPs relevant to the Proposed Action, as based on the ecological data collected during dedicated surveys, are identified below.

4.3.1 Threat abatement plan for predation by feral cats (Commonwealth of Australia 2015b)

The goal of this TAP is to minimise the impact of feral cats on biodiversity by:

- Protecting affected threatened species.
- Preventing further species and ecological communities from becoming threatened.

The TAP has four objectives, as follows:

- Effectively control feral cats in different landscapes.
- Improve effectiveness of existing control options for feral cats.
- Develop or maintain alternative strategies for threatened species recovery.
- Increase public support for feral cat management and promote responsible cat ownership.

4.3.2 Threat abatement plan for predation by the European red fox (DEWHA 2008b)

This TAP identifies localised fox control measures applicable in specific areas of high conservation value and where:

- Chances of reinvasion must be nil or very close to it.
- All foxes must be accessible and at risk during the control operation.
- Foxes must be killed at a higher rate than their ability to replace losses through breeding.

Where local eradication is not possible, two strategies for localised management can be used, as follows:

- Sustained management, where control is implemented on a continuing, regular basis; or
- Intermittent management, where control is implemented at critical periods of the year when damage is greatest and short-term control will reduce impacts to acceptable levels.

4.3.3 Threat abatement plan for competition and land degradation by rabbits (Commonwealth of Australia 2016).

The goal of this TAP is to minimise the impact of rabbit competition and land degradation on biodiversity in Australia and its territories by:

- Protecting affected threatened species and ecological communities.
- Preventing further species and ecological communities from becoming threatened.

The TAP has four main objectives, as follows:

- Strategically manage rabbits at the landscape scale and suppress rabbit populations to densities below threshold levels in identified priority areas.
- Improve knowledge and understanding of the impact of rabbits and their interactions with other species and ecological processes.

- Improve the effectiveness of rabbit control programs.
- Increase engagement of, and awareness by, the community of the environmental impacts of rabbits and the need for integrated control.

4.3.4 Threat abatement plan for competition and land degradation by unmanaged goats (DEWHA 2008a)

The goal of this TAP is to minimise the impact of unmanaged goat competition and land degradation on biodiversity in Australia and its territories by:

- Protecting affected native species and ecological communities.
- Preventing further species and ecological communities from becoming threatened.

The TAP has five main objectives, as follows:

- Prevent unmanaged goats occupying new areas in Australia and eradicate them from high conservation-value 'islands'.
- Promote the maintenance and recovery of native species and ecological communities that are affected by competition and land degradation by unmanaged goats.
- Improve knowledge and understanding of unmanaged goat impacts and interactions with other species and other ecological processes.
- Improve the effectiveness, target specificity and humaneness of control options for unmanaged goats.
- Increase awareness of all stakeholders of the objectives and actions of the TAP, and of the need to control unmanaged goats.

5. Potential impacts

The Proposed Action has the potential risk to result in some impact to MNES from construction and operation.

Each potential impact is discussed in **Section 5.1** and **Section 5.2** below. Mitigation measures that will be implemented to avoid and reduce impacts are outlined in **Section 6**.

5.1 Direct construction impacts

If not appropriately managed, the construction phase of the Proposed Action is likely to result in impacts to ecologically sensitive features of the environment primarily through vegetation clearance and works associated with the establishment of the Proposed Action infrastructure.

Construction activities considered likely to have a risk to MNES include:

- Vegetation clearing, earthworks and excavation
- Vehicle movements
- Generation of dust, noise, vibration or light
- Storage and use of chemicals and liquid and solid waste, spills and leaks

The potential impacts to MNES as a result of construction activities include:

- Disturbance to or loss of habitat
- Habitat degradation or species disturbance (including contamination from spills and disturbance from dust, noise, vibration or light)
- Fauna mortality or injury

Each construction activity and associated impact is described in detail in the following sections. These impacts may operate within and/or immediately adjacent to the Mine Development Envelope.

5.1.1 Disturbance to or loss of habitat

Clearing of up to 1,418 ha of vegetation for mining, processing and associated infrastructure within the Mine Development Envelope will reduce the extent of available habitat for fauna known or likely to occur. Earthworks (including excavation) also have the potential to cause direct disturbance to bilby burrows (although currently known active burrows are located outside the Mine Development Envelope).

For the purposes of the current assessment, it is assumed that all vegetation will be removed within the Proposed Action Footprint presented in **Figure 1-2**.

5.1.2 Habitat degradation or species disturbance

Construction activities can increase access by feral predators (e.g. wild dogs, cats and foxes) to areas of retained vegetation and habitat thereby increasing the level of predation. In additional, clearing of vegetation may force threatened fauna to move through cleared areas to reach suitable habitat. These

altered movement patterns may result in increased predation of threatened species by feral predators, causing injury and mortality.

A number of pest species have been recorded in the Mine Development Envelope, including *Canis lupus familiaris* (wild dog), *Felis catus* (feral cat) and *Vulpes vulpes* (red fox). Control measures will need to be implemented to ensure feral animal populations do not increase.

In addition to disturbance caused by vegetation clearing, the construction phase for the Proposed Action has the potential to disturb habitat and species through dust emissions, noise and vibration impacts and light emissions.

Inappropriate disposal of liquid and solid waste, including spills and leaks from transfers (fuel, chemicals) and inadequate storage of wastes may result in contamination of surrounding land. Direct impacts may include toxic impacts on vegetation (results in degradation or loss of habitats) and direct toxic impact on fauna (from contact, inhalation or ingestion).

5.2 Ongoing operation impacts

After the Proposed Action infrastructure is constructed, the ongoing presence of infrastructure and the operation of the Proposed Action can have the potential for adverse direct and indirect impacts to MNES. The key ongoing operational impacts include:

- Fragmentation and edge effects
- Disturbance from vehicles, noise, light and vibration
- Dewatering and surplus water handling

Each potential impact associated with the ongoing operations of the Proposed Action is described in detail in the following sections.

5.2.1 Fragmentation and edge effects

The relevance, extent and severity of impacts from potential fragmentation of landscape habitat features (e.g. fire and barriers to movement of fauna) needs to be considered on a species-specific level; however, given the current Proposed Action footprint, and its configuration in the surrounding landscape, it is unlikely that significant long-term barriers to movement will be created.

Edge effects associated with clearing vegetation and site disturbance are an important consideration, as clearing and disturbance can increase the opportunities for pest species to move throughout the landscape. In addition, the risk of ignition and spread of fire is increased through the use of machinery and equipment that generate sparks, use of flammable chemicals and changes to the structure or composition of vegetation.

5.2.2 Disturbance from vehicles, noise, light and vibration

Once the Proposed Action infrastructure is constructed, there will be vehicle and equipment movement within the Mine Development Envelope and on some sections of public roads during the operational phase. Vehicles may damage or destroy vegetation and fauna habitat if vehicles deviate from established roads where the roads are not an appropriate width. Vehicles and machinery may also kill or injure fauna on impact.

The updated access road will be used for the Proposed Action and will have around two road-trains per day hauling copper and gold concentrate products to Port Hedland plus additional heavy vehicle traffic to deliver materials. There will also be increased light vehicle traffic associated with the Proposed Action.

The impact for noise and light emissions (disturbance to species) are still relevant in the operation phase, albeit on a smaller scale and intensity, but on a more continuous basis, than the construction phase.

5.2.3 Dewatering and surplus water handling

Mine dewatering to access the target ore will be required and will result in lowering of the groundwater level near the mine pit, with the greatest drawdown around the mine and effects decreasing in extent radially outward from the mine pit. Dewatering will not result in direct or indirect impacts on MNES as there are no MNES species or ecological communities reliant on groundwater and there is no Groundwater Dependent Ecosystem in the Mine Development Envelope or immediate surrounding area. Surplus water will be stored in earthen structures or re-injected into local aquifers. Standing (stored) water facilities may attract additional fauna and/or predators into the Mine Development Envelope.

6. Measures to avoid and reduce potential impacts to MNES

6.1 Impact avoidance during project design

The Proponent has implemented key measures to avoid potential impacts to threatened species during the design phase of the Proposed Action.

The original Mine Development Envelope was 13,362 ha in size and encompassed an area of significant current activity by the Greater bilby, including a number of active burrows. This entire original Mine Development Envelope was surveyed and now constitutes the ecological survey area (Biota 2020a, 2020b). In order to reduce potential impacts to this species, the Proponent has undertaken a redesign of the Mine Development Envelope, reducing its size to 12,398 ha (i.e. a 7.2% reduction in area), with the revised Mine Development Envelope specifically avoiding the area of significant current Greater bilby activity.

6.2 Environmental management measures

The Proponent is also committed to avoiding, minimising and managing potential impacts throughout the construction and operation phases of the Proposed Action. Specific commitments include:

- Minimising ground disturbance as far as practicable and undertaking progressive rehabilitation of disturbance areas
- Excluding the location of active Greater bilby burrows from the Mine Development Envelope (refer **Section 6.1**)

A comprehensive suite of management measures has been developed for the Proposed Action and have been provided for all MNES known and likely to occur. These mitigation and management measures are to be implemented throughout the relevant stages of the Proposed Action to protect all environmental values within the Mine Development Footprint. As such, the mitigation and management measures provide a holistic approach to minimising potential impacts to MNES and have been provided collectively (**Table 6-1**).

6.3 Greater bilby conservation and management plan

Recognising the impacts to Greater bilby habitat cannot be fully avoided, Rio Tinto aims to develop a dedicated Greater bilby conservation and management plan to guide the implementation of management measures to ensure that potential impacts to the Greater bilby are minimised and appropriately managed. This will also provide a mechanism to deliver compensatory measures for any potentially significant residual impacts to the species (i.e. offsets).

The Proponent has developed a draft plan (ELA 2020b), which is in line with the key recovery objectives for the Greater bilby, as outlined in the Commonwealth Draft Recovery Plan for the Greater Bilby (Commonwealth of Australia 2019). A key component of the conservation and management plan is to fund Traditional Owner and/or Indigenous Ranger-led programs to undertake broad scale monitoring of the species across the wider Study Area, with a particular focus on the region surrounding and within the Mine Development Envelope. The purpose of the monitoring is to increase the understanding of the presence and habitat use of the species and include Indigenous ecological knowledge and skills in

bilby management. This directly links back to Supporting Strategies One and Two of the Commonwealth Draft Recovery Plan.

In addition to this, the Proponent's conservation and management plan supports key activities in line with the On-ground Strategies for the Nyangumarta Warrarn IPA within the Commonwealth Draft Recovery Plan such as managing and monitoring predators and improving and maintaining habitat. Currently proposed management actions include feral animal control and traditional ecological burning and Indigenous fire management.

Table 6-1: Environmental management measures

Potential impact	Performance target	Management measure	Project phase	Responsibility
Vegetation clearing	No clearing outside the approved Proposed Action Mine Development Envelope No direct loss of, or serious injury to MNES fauna individuals as a result of the Proposed Action	Clearing is only to occur within approved areas.	Construction	Construction contractor
		No-go zones will be established around any active MNES fauna breeding places (should they be identified during pre-clearance surveys) and any other fauna habitat features to be retained.	Pre-construction	Construction contractor
		Areas of any no-go zones will be demarcated with flagging prior to the commencement of clearing and the no-go zones are to remain adequately marked for the duration of clearing activities.	Construction	Construction contractor
		A suitably qualified person will monitor all clearing works in known MNES habitat and undertake relocation of fauna species where required.	Construction	Construction contractor Suitably qualified person
Degradation of habitat	No evidence of soil compaction or soil erosion in areas of retained habitat as a result of the Proposed Action	Erosion and sedimentation control measures will be implemented during all construction activities, to prevent erosion and control sediment on the site.	Construction Operation	Construction contractor
		Vehicles and machinery to remain on approved and/or existing tracks to reduce soil compaction.	Construction Operation	Construction contractor
		Undertake remediation and rehabilitation of areas.	Construction Closure	Construction contractor
	No pollution by significant spill or leaks of hazardous materials.	All hazardous materials will be managed in accordance with standard operating procedures for transport, handling and storage as per the requirements of AS-1940. Hazardous materials are to be provided and stored in sealed, labelled containers, without leaks.	Construction Operation	Construction contractor

Potential impact	Performance target	Management measure	Project phase	Responsibility
		All vehicles and equipment to be cleaned in designated wash bays fitted with suitable pollution control equipment.		
Pest species incursion	No increased evidence of feral predators within the Mine Development Envelope	No domestic animals permitted within the Mine Development Envelope.	Pre-construction Construction Operation	All personnel and contractors
		Undertake feral fauna control within cleared areas within the Mine Development Envelope in accordance with Bilby Conservation and Management Plan.	Construction Operation	Construction contractor
		Implement waste management measures in accordance with EP Act requirements.	Construction Operation	Construction contractor
Fire	No fire outbreaks caused by Proposed Action activities	All relevant construction and operation personnel to undertake training in fire prevention and management.	All Project stages	HSE Supervisor Construction contractor
		All site vehicles to be supplied with appropriate fire control equipment, which will be regularly maintained.	Construction	Construction contractor
		Smoking and the use of cigarette lighters only permitted in designated smoking areas.	All Project stages	All personnel
		Develop and implement hazardous materials storage, handling and disposal procedures.	Construction Operation	Construction contractor
		No burning of cleared vegetation.	Construction	Construction contractor
		Hot works permits will be followed at all times.	Construction	Construction contractor
Vehicle strike	No direct loss of, or serious injury to MNES fauna individuals as a result of the Proposed Action	All construction and operation personnel to undergo induction training on MNES fauna values and vehicle speed limits.	Construction Operation	Construction contractor

Potential impact	Performance target	Management measure	Project phase	Responsibility
		Implement speed limits within the Mine Development Envelope which all vehicle and machinery must adhere to.		
Entrapment	No direct loss of, or serious injury to MNES fauna individuals as a result of the Proposed Action	The length of any open trenches will be minimised and backfilling must be undertaken progressively. Duration of open excavations will be minimised and backfilled immediately following completion of construction. Fauna egress (e.g. ramp) and fauna refuge will be installed in all excavations left open overnight. Trench inspections for fauna and clearance to be carried out within two hours of sunrise and before sunset, unless backfilled, in which case inspection shall precede backfilling, as identified below. Trenches shall be inspected by construction crews half an hour prior to backfilling and if trapped fauna are present, a fauna handler will be notified and engaged to assist, prior to backfilling.	Construction	Construction contractor
Noise and vibration	No excessive noise or vibration near known habitat	Preferentially locate any processing plant infrastructure in areas of least ecological sensitivity. Correctly functioning noise attenuation devices (e.g. mufflers) must be installed and maintained on all equipment brought and used during construction activities to minimise noise pollution disturbance to species habitat. Ensure all vehicles and machinery are serviced and maintained to minimise machinery noise and vibration	Design Construction Operation	Proponent Construction contractor
Dust emissions	No air pollution incidents/events caused by excessive dust generation	Appropriate dust controls (including but not limited to water carts, non-toxic stabilisers, or	Construction Operation	Construction contractor

Potential impact	Performance target	Management measure	Project phase	Responsibility
		other) to be implemented throughout construction as required to prevent and minimise dust impacts to the surrounding environment. Enforce vehicle speed limits.		

7. Greater bilby (*Macrotis lagotis*)

7.1 Species description

The Greater bilby is listed as Vulnerable under the EPBC Act. The species occurs in two main separate geographic areas; one extending from the western desert region of the Northern Territory and Western Australia to the Pilbara and Kimberley regions, and one in south-western Queensland.

The species is solitary and shelters in burrows during daylight and intermittently during the night. Across its distribution it occupies three main habitat types; open tussock grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (TSSC 2016a). The Greater bilby is an omnivore that digs for food, with a diet that consists of invertebrates such as lepidopteran larvae, termites, ants, grasshoppers, spiders and beetles, and other items such as seeds, bulbs and fungi (TSSC 2016a).

Bilbies are highly mobile and can have large foraging ranges, with adult females moving up to 1.5 km between burrows on consecutive days, and adult males moving 2–3 km and up to 5 km between burrows on consecutive days (Commonwealth of Australia 2019). Studies have indicated an average home range of 0.18 km^2 for females and 3.16 km^2 for males, with numerous active and disused burrows present within this range (Commonwealth of Australia 2019).

Breeding of the Greater bilby varies depending on seasonal conditions and food availability, producing litters of one to three young, and in ideal conditions, up to four litters per year. Young remain in the pouch for approximately 75 days after which they remain in the maternal burrow for two weeks prior to dispersing (TSSC 2016a).

The draft recovery plan notes that the concept of an 'important population' is not relevant to the conservation of the Greater bilby (Commonwealth of Australia 2019). This is because the species is intended to be managed as a meta-population with spatially separated populations interacting as individual members move from one population to another (Commonwealth of Australia 2019). All locations where Greater bilby are known to occur are considered important.

Habitat critical to the survival of the species is defined in the draft recovery plan at a bioregional scale that takes into account the combination of plants, animals, geology, landforms, and climate that is relevant to a geographical unit (Commonwealth of Australia 2019). This can be considered to include:

- Any area where the species is known or likely to occur as shown on the Distribution Map on the Greater Bilby SPRAT Profile
- Any location outside the above area where bilbies are found to occur
- Any area, between the areas noted above, that may be periodically occupied by bilbies
- Any area which bilbies may naturally colonise or may feasibly be reintroduced.

The key threats to the Greater bilby are also outlined in the draft recovery plan and include (Commonwealth of Australia 2019):

- Predation by foxes, feral cats, dingoes and wild dogs
- Habitat loss and fragmentation

- Domestic and other introduced species
- Unmanaged fire
- Loss of Traditional Owner knowledge and land management
- Reduction in population resilience and genetic fitness in wild and intensively managed populations

7.2 Occurrence in the wider Study area

Evidence of Greater bilby has been recorded within close proximity of the Mine Development Envelope[2].

Recent fauna surveys (Biota 2020b) recorded evidence positively attributable to the Greater bilby, comprising recent diggings, scats and tracks. Active burrows were identified within one primary locale outside the current Mine Development Envelope during the unbounded transect searches conducted during the recent fauna surveys (Biota 2020b) (**Figure 7-1**). Within the active Greater bilby areas (located outside the current Mine Development Area), observed tracks were assigned with high certainty due to the clear gait pattern and foot imprints. Two scat piles were also found in association with digging evidence into the base of *Acacia monticola* and *Acacia ancistrocarpa* shrubs in the primary locale (Biota 2020b). Numerous burrow entrances were found in association with positively attributable tracks, scats and diggings, and were therefore assigned as high certainty active burrows (Biota 2020b). No images of the Greater bilby were recorded from motion cameras established at the entrances of active burrows (Biota 2020b).

Within the current Mine Development Envelope, the fauna survey recorded other diggings close to an inactive burrow. These diggings were old and mostly isolated and were likely to be indicative of past presence of the Greater bilby (Biota 2020b) in that location. An additional burrow found in another location in the Mine Development Envelope could not reliably be attributed due to the absence of other fresh, positive sign (Biota 2020b).

A follow-up bilby abundance study genotyped DNA collected from scats to identify three individuals active in close proximity of the Mine Development Envelope (Biota 2020c). Although there were not enough recapture events to estimate abundance, the results of this study suggest that the population of bilbies within the immediate vicinity of the Mine Development Envelope is low in abundance and does not represent a regionally significant source population when compared to regional abundance data provided by DBCA (Biota 2020c; DBCA 2018a; DBCA 2018b). These individuals do, however, form part of a larger important population in this region of the Great Sandy Desert (Biota 2020c).

The habitat of the species varies across the landscape in which bilbies persist, and this is influenced by climatic zones, soil, vegetation types, and landforms (Commonwealth of Australia 2019). Bilbies are

[2] When surveyed, the bilby burrows were positioned within the Mine Development Envelope study area prior to it being rationalised (as discussed in Section 6.1). For clarity of discussion below, this area has been termed the 'active Greater bilby area'.

highly mobile and have large foraging ranges, with some key food sources dependent on fire history (Commonwealth of Australia 2019). Throughout Western Australia, three landforms have been identified as habitat; residual landforms, fluvial landforms and plains and dune fields (Cramer et al. 2016). Within the Mine Development Envelope, landforms present are consistent with plains and dune fields (Biota 2020b).

Biota (2020b) developed a set of criteria (refer **Table 7-1**) to determine the habitat suitability across Mine Development Envelope for the Greater bilby. The criteria were developed with the knowledge that the Greater bilby is known to be highly mobile and moving into areas of potential habitat when conditions are favourable and out of areas when resources are depleted (Biota 2020b). The criteria are primarily focused on foraging resources, with Greater bilby tending to burrow within and close to foraging areas.

Table 7-1: Greater bilby habitat suitability criteria

Habitat suitability	Criteria
High	1. Habitat supporting long-lived shrubs or forbs known to contain root-dwelling larvae and other important food source plants in unburnt and long unburnt areas (e.g. *Acacia monticola, A. dictyophleba, A. melleodora, A. stellaticeps, A. hilliana, Senna notabilis* and *Indigofera georgei),* and/or; 2. Habitat supporting short-lived shrubs or forbs known to contain root-dwelling larvae and other important food source plants in recently burnt areas (e.g. *Senna notabilis* and *Yakirra australiensis).*
Moderate	3. Habitat supporting plant species that are broadly typical of suitable bilby habitat in the Great Sandy Desert (e.g. other *Acacia* spp., *Melaleuca* spp. and *Triodia* grasslands), but with no mapped records of important food source plant species.
Low	1. Habitat does not meet any of the criteria listed above.

Habitat for the Greater bilby throughout the Mine Development Envelope is shown on **Figure 7-2**. The majority of the Mine Development Envelope was assessed as high suitability bilby habitat (7,048 ha, representing 56.8% of the total Development Envelope), based on the presence of suitable food source plants within vegetation of an appropriate fire history age. The remaining portions of the area were assessed as moderately suitable (2,820 ha) Greater bilby habitat or were not surveyed (2,449 ha) (Biota 2020b). The areas which have not been surveyed due to a recent change to the Development Envelope have not been assessed using the habitat suitability criteria. However, habitat within this area is considered to be consistent with the bilby habitat previously identified in the remainder of the Development Envelope (a combination of high and moderate suitability bilby habitat). The entire Development Envelope is therefore considered to be habitat critical to the survival of the species as per the definition in the Commonwealth Draft Recovery Plan (Commonwealth of Australia 2019).

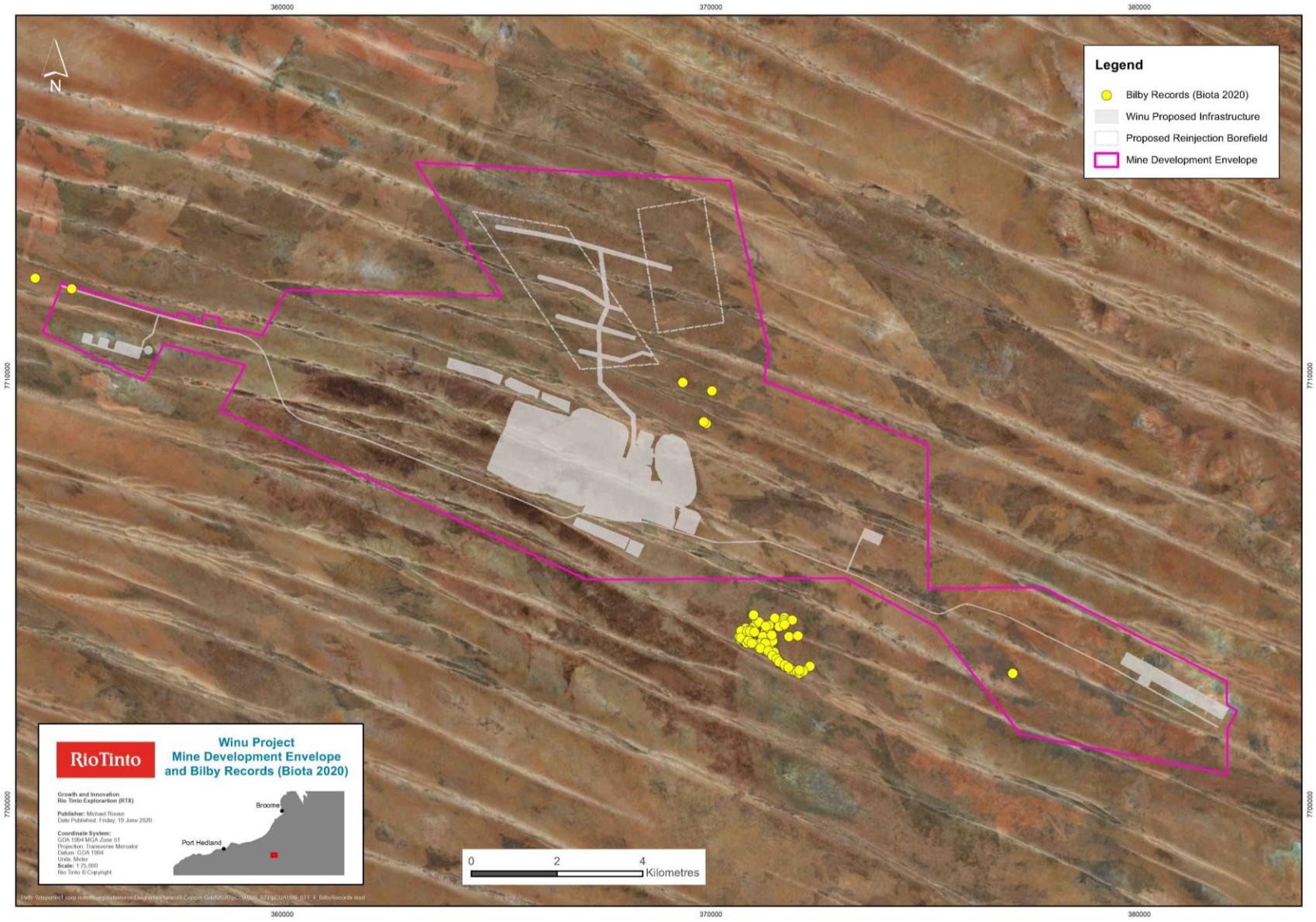

Figure 7-1: Greater bilby records around the Mine Development Envelope

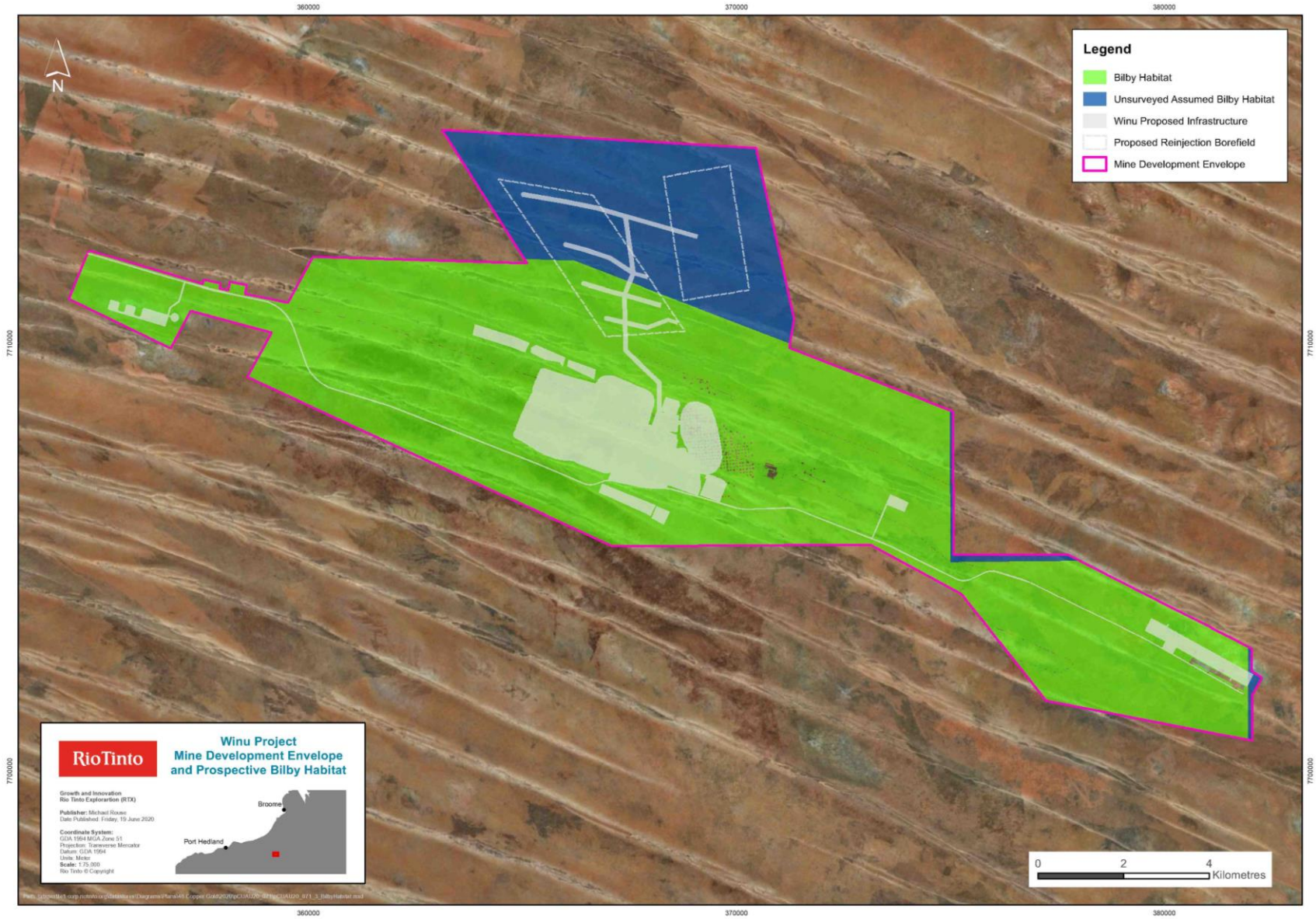

Figure 7-2: Greater bilby habitat within the Mine Development Envelope

7.3 Significant residual impact assessment

Table 7-2 assesses the Proposed Action's impact to Greater bilby against the significant impact criteria outlined in *EPBC Act policy 1.1 – MNES Significant Impact Guidelines* (DoE 2013) for listed threatened species and ecological communities (see **Section 4.1**).

Table 7-2: Significant impact criteria – Greater bilby

Significant impact criteria	Significant impact	Response to criteria
Lead to a long-term decrease in the size of an important population	No	The concept of an individual, local population being considered 'an important population' is not relevant to the Greater bilby as the species is intended to be managed as a meta-population (Commonwealth of Australia 2019). Nonetheless, the species has been recorded in close proximity to both the Mine Development Envelope and the road access corridor and all known records are considered important. The habitat within the Mine Development Envelope is considered to be habitat critical to the survival of the species as per the definition in the draft recovery plan (Commonwealth of Australia 2019). The Proposed Action will result in the clearing of 1,418 ha within the Mine Development Envelope. This habitat provides some level of foraging and potential burrowing habitat for the Greater bilby, although was not observed to be actively occupied during field surveys. All habitats within the Proposed Action footprint are common and widespread throughout the Great Sandy Desert, with a large portion of habitat remaining within and adjacent to the Mine Development Envelope post clearing for the Proposed Action. The Greater bilby is highly mobile and moves frequently throughout a large foraging home range. A number of good practice environmental management measures will be implemented to avoid and reduce the likelihood of impacts to individuals. Importantly, the Proponent has pro-actively rationalised the boundaries of the Mine Development Envelope to avoid all currently identified active Greater bilby burrows and minimise potential impacts to known burrowing habitat. It is considered unlikely the Proposed Action will lead to a long-term decrease in the size of the Greater bilby meta-population or local population considering suitable habitat for the species (including active burrows) will remain in and around the Mine Development Envelope and wider Great Sandy Desert region.
Reduce the area of occupancy of an important population	No	Area of occupancy (AOO) is defined as the area within a species' extent of occurrence (EOO) which is occupied by that species (IUCN 2012). The population of Greater bilby that may utilise the Mine Development Envelope is considered to be important. The entirety of the Mine Development Envelope provides suitable foraging and potential future burrowing habitat for the Greater bilby, as does the surrounding environment throughout the Great Sandy Desert region. A number of good practice environmental management measures will be implemented to avoid and reduce the likelihood of impacts to individuals. Importantly, the Proponent has pro-actively rationalised the boundaries of the Mine Development Envelope to avoid all currently identified active Greater bilby burrows and minimise potential impacts to known burrowing habitat. The Greater bilby will continue to have access to the full suite of habitat (both within the Mine Development Envelope and in the wider Great Sandy Desert region) needed to maintain their AOO. Whilst the Proposed Action will

Significant impact criteria	Significant impact	Response to criteria
		remove habitat for the species and thereby reduce the AOO, in the context of the habitat available in the wider region, this is not expected to have significant impacts to the species.
Fragment an existing important population into two or more populations	No	The Proposed Action will result in the clearing of vegetation within the Mine Development Envelope which provides varying quality of habitat (both foraging and burrowing) for the Greater bilby. The species is highly mobile, with a large home range, particularly for males (Commonwealth of Australia 2019). The Proposed Action is unlikely to fragment the existing Greater bilby population given the following: • Complete avoidance of known active burrows near the Mine Development Envelope (via project design); • Retention of very large areas of habitat within the Mine Development Envelope and wider Great Sandy Desert region; • Mobility and large home-range of the species; and • The assumed persistence of the population outside of the Proposed Action footprint.
Adversely affect habitat critical to the survival of a species	Yes	Critical habitat for Greater bilby includes any area where the species is known or likely to occur either as shown on the Distribution Map on the SPRAT profile, or any location outside of this area (Commonwealth of Australia 2019). The Mine Development Envelope contains critical foraging and potential future burrowing habitat for the Greater bilby habitat, but known active burrows are located outside the Mine Development Envelope. Importantly, large areas of similar critical foraging and burrowing habitat will remain within the Mine Development Envelope and wider Great Sandy Desert region. The Proposed Action will result in the clearing of 1,418 ha of habitat critical to the survival of the Greater bilby and consequently, the Proposed Action has the potential to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	No	The breeding cycle of the Greater bilby varies depending on seasonal conditions and food availability within the species' foraging range. Although the Proposed Action will result in the removal of some Greater bilby habitat, food resources will continue to be available within the wider region. The Proponent has pro-actively rationalised the boundaries of the Mine Development Envelope to avoid all currently identified active Greater bilby burrows, which will protect young in burrows. The Proposed Action is unlikely to disrupt the breeding cycle of the species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely	The most recent ecological surveys (Biota 2020a, Biota 2020b) confirmed numerous burrows in the Mine Development Envelope that formed the study area, which were assigned high certainty active burrows due to the presence of positively attributable tracks, scats and diggings. The Proponent has pro-actively rationalised the boundaries of the Mine Development Envelope to avoid all currently identified active Greater bilby burrows and minimise potential impacts to burrowing habitat. In addition, a number of good practice environmental management measures will be implemented to avoid and reduce the likelihood of impacts to individuals. A dedicated Bilby Conservation and Management Plan will be designed and implemented to provide on-ground recovery actions for the species (e.g. feral predator control and fire management).

Significant impact criteria	Significant impact	Response to criteria
		The habitat present across the Mine Development Envelope varies in quality for the Greater bilby but is classified as critical habitat as per the draft recovery plan. Habitat loss and fragmentation is identified as a key threat (Commonwealth of Australia 2019); however, the implementation of general good practice management measures, plus the additional species-specific management measures, will see the retention and protection of large amounts of bilby habitat both within and adjacent to the Mine Development Envelope and the wider Great Sandy Desert region. The Proposed Action is unlikely to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, particularly when large extents of contiguous high-quality habitat will remain adjacent to the Proposed Action footprint within the Mine Development Envelope and throughout the Great Sandy Desert region.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	No	Pest species that are harmful to Greater bilby (e.g. feral cats and wild dogs) are already known to occur within the region including the Mine Development Area. With the implementation of good practice environmental management measures during construction and operation, the Proposed Action is unlikely to increase the current risk of harm from pest species, with pest management controls proposed to reduce the risk of harm. There are no known invasive species that are potentially harmful to Greater bilby or that could become established in the Mine Development Envelope as a result of the Proposed Action.
Introduce disease that may cause the species to decline	No	Currently, there are no known diseases harmful to Greater bilby. There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.
Interfere with the recovery of the species	No	The draft recovery plan for the species (Commonwealth of Australia 2019) aims to halt decline and support recovery of the Greater bilby through on-ground conservation and management, which are planned to occur within a monitoring framework that measures the impact of management. The draft recovery plan includes supporting actions to promote the role of Aboriginal people and land managers in bilby conservation (Commonwealth of Australia 2019). The Proponent is developing and will implement a Greater bilby management and conservation plan that is specifically in-line with the recovery objectives listed for the Nyangumarta Warrarn IPA bilby recovery action site (see Section 4.2.1). Development of the associated management plans and implementation of those plans will be done in partnership with the relevant Traditional Owner group and their Rangers. A range of good practice environmental management measures will also be implemented for the Proposed Action to minimise potential impacts on the Greater bilby (e.g. pest animal control, fire control, etc). On this basis, the Proposed Action is considered unlikely to interfere with the recovery of the species.

8. Other MNES

A number of other MNES are known or have the potential to use the Mine Development Envelope in a transient manner, but do not have local populations that are well established. These species are not considered to have important populations or habitat critical to their survival in the Mine Development Envelope. The potential impacts of the Proposed Action have been assessed below with consideration given to these species' limited presence within the Mine Development Envelope.

8.1 Princess parrot (*Polytelis alexandrae*)

Princess parrot is listed as Vulnerable under the EPBC Act.

The most recent fauna surveys (Biota 2020b) did not record the princess parrot within the Mine Development Envelope. Although the princess parrot does have the potential to occur in the Mine Development Envelope based on the availability of some potentially suitable foraging habitat, the likelihood of occurrence is considered low. Importantly, the Mine Development Envelope does not contain any *Eucalyptus* trees or *Allocasuarina* trees that would provide suitable breeding or roosting resources for the species. Surveys in the wider Study area within the AREH Development Envelope (Biota 2018) did not record the species, nor was suitable habitat for the species present.

The species displays eruptive behaviour and its occurrence across its likely range is sporadic and fluctuating. The shrub and spinifex on sandplains habitat within the wider Study area may satisfy habitat requirements for the species. However, there are no records of the species within 50 km of the Mine Development Area and this scarcity of records suggests that the species' utilisation of the Mine Development Envelope is likely rare. The species is unlikely to rely on the minimal habitat in the Mine Development Envelope for long-term maintenance or to maintain genetic development.

At present, there are no species-specific policy guidelines on what constitutes habitat critical to the survival of the species, or what an important population is. An assessment of 'critical habitat' and 'important population' was made based on guidance within the significant impact guidelines.

The species has not been recorded within the wider Study area. The princess parrot may be transient in the Mine Development Envelope as a response to spinifex seeding events. The individuals that may periodically occur in the Mine Development Envelope are unlikely to be in numbers that would constitute a key source population for breeding or dispersal, or a population necessary for maintaining genetic diversity.

When considered against the significant impact criteria, it is not considered that the Proposed Action will have a significant impact on princess parrot for the following reasons:

- The Mine Development Area is considered unlikely to support an important population of this species. If princess parrot were to occur, it is most likely as a transient visitor during its nomadic movements.
- The Mine Development Envelope contains suitable habitat for the species and individuals may periodically occur in the shrub and spinifex on sandplains, to forage on spinifex during feeding events. The Proposed Action will result in the clearing of suitable foraging habitat; however,

suitable foraging habitat will continue to be available in the Mine Development Envelope and wider Study area. The habitat within the Mine Development Envelope is unlikely to support breeding and nesting.

- The princess parrot is a highly mobile and dispersive species that is considered likely to be able to move around any installed infrastructure. The extent of impact on habitat is small in context of the habitat that will remain available within the Mine Development Envelope. The scale of impact from the Proposed Action will not cause fragmentation of foraging habitats.
- The primary conservation action for the princess parrot is to maintain breeding habitat by undertaking active fire management and control of domestic and invasive species. The Proposed Action will not result in the clearing of any breeding habitat for the species. In addition, the Proponent is committed to continue managing feral fauna in areas under its control to prevent predation of threatened fauna by feral predators.

8.2 Oriental plover (*Charadrius veredus*)

The oriental plover is listed as Migratory under the EPBC Act. It is a non-breeding visitor to Australia, where it occurs primarily in northern regions (DoEE 2019).

The oriental plover has been recorded within the Mine Development Envelope during September 2019 surveys (Biota in prep). During this survey, most observations were made on the margins of the airstrip and nearby sparsely-vegetated clay pans and involved small flocks of 2-20 individuals. There was also at least one observation of a single bird overflying sand dunes to the south of the exploration camp.

The sparsely-vegetated clay pans and exploration related disturbance areas within the Mine Development Envelope are considered fairly typical inland habitat for this species. These habitat types are limited in extent within the Mine Development Envelope and it is therefore not expected that large flocks of birds would occur (especially when compared to the known large aggregations of tens of thousands of birds that occur in coastal areas, such as Eighty Mile Beach [DoEE 2019]).

The species is present in Australia during the non-breeding season in September to April and during this time is mobile in response to prevailing conditions. Their presence in the Mine Development Envelope is expected to be sporadic and they are considered unlikely to remain during the over-wintering season, when most have migrated to the northern hemisphere. This is supported by the lack of observations during targeted fauna surveys undertaken in May 2019 (Biota 2020b).

As a migratory shorebird, important habitat for this species is defined in *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Commonwealth of Australia 2017). Important habitat includes areas that are recognised as internationally important and/or support 0.1% of the flyway population of single shorebird species (among other requirements). Currently, 0.1% of the flyway population for oriental plover is estimated at 230 individuals (Hansen et al. 2016). Based on observations during the September 2019 field survey, the local population of oriental plover is an order of magnitude less than this, and therefore the site is not considered to provide important habitat for this species.

When considered against the significant impact criteria, it is not considered that the Proposed Action will have a significant impact on oriental plover for the following reasons:

- The Proposed Action footprint contains non-breeding habitat that provides a small area of foraging habitat. The habitat within the Mine Development Envelope is not considered to be important habitat. Consequently, the Proposed Action is not expected to substantially modify, destroy or isolate an area of important habitat.
- The numbers of birds observed within the Mine Development Envelope are small, particularly when considered in the context of large aggregations that are known to occur in coastal areas in northern WA (DoEE 2019). Any potential impacts to individuals as a result of the Proposed Action are therefore unlikely to impact the population more broadly, nor disrupt the lifecycle of the species.

8.3 Oriental pratincole (*Glareola maldivarum*)

The oriental pratincole is listed as Migratory under the EPBC Act. It is a non-breeding visitor to Australia, where it is widespread in northern regions (DoEE 2019).

The oriental pratincole has not been recorded within the Mine Development Envelope; however, potential foraging habitat is present. The species has also been recorded from four locations within the AREH Development Envelope (Biota 2018), including along the eastern end of the Nyungamarta Highway.

Oriental pratincoles use generally similar foraging habitats to oriental plovers (as described above), but take much of their insect prey aerially, so will forage over a wider range of habitat types and are less affected by the specific ground cover. Areas of the Proposed Action Footprint would provide suitable foraging habitat for oriental pratincole.

Like the oriental plover, the oriental pratincole is present in Australia during the non-breeding season in September to April and during this time is mobile in response to prevailing conditions. Their presence in the Mine Development Envelope would only be sporadic and they are considered unlikely to remain during the over-wintering season, when most have migrated to the northern hemisphere.

As a migratory shorebird, important habitat for this species is defined in *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species* (Commonwealth of Australia 2017). Important habitat includes areas that are recognised as internationally important and/or support 0.1% of the flyway population of single shorebird species (among other requirements). Currently, 0.1% of the flyway population for oriental pratincole is estimated at 2,280 individuals (Hansen et al. 2016). Based on observations during the September 2019 field survey, the local population of oriental pratincole is expected to be considerably less than this, and therefore the site is not considered to provide important habitat for this species.

When considered against the significant impact criteria, it is not considered that the Proposed Action will have a significant impact on oriental pratincole for the following reasons:

- The Proposed Action footprint contains non-breeding habitat that provides some potential foraging habitat. Consequently, the Proposed Action is not expected to substantially modify, destroy or isolate an area of important habitat.

- The numbers of birds observed within the wider Study area are small, particularly when considered in the context of large aggregations that are known to occur in coastal areas in northern WA (DoEE 2019).

8.4 Fork-tailed swift (*Apus pacificus*)

The fork-tailed swift is listed as Migratory under the EPBC Act. It is a non-breeding visitor to all state and territories of Australia (DoEE 2019).

The fork-tailed swift has not been recorded within the Mine Development Envelope or wider Study area; however, there are records of the species from the wider locality and suitable habitat for the species is present. The species has the potential to be recorded in the Mine Development Envelope as a periodic overhead visitor.

Important habitat for fork-tailed swift is defined in the *Draft referral guideline for 14 migratory birds listed under the EPBC Act* (Commonwealth of Australia 2015). Important habitat for the fork-tailed swift includes its non-breeding habitat. The lack of previous records for this species, combined with the fact that the species is almost exclusively aerial and does not rely on terrestrial habitat suggest that the habitat within the Mine Development Envelope would only be utilised irregularly with the species occurring as an overhead visitor at most. Consequently, this area is unlikely to contain important habitat or an 'ecologically significant proportion' of a population of fork-tailed swift as it does not regularly support 0.1% of the flyway population (100 individuals).

When compared against the significant impact criteria, it is not considered that the Proposed Action will have a significant impact on fork-tailed swift for the following reasons:

- The Proposed Action footprint contains non-breeding habitat that provides limited foraging resources for fork-tailed swift. As the species is almost exclusively aerial within Australia, it is unlikely to rely on any terrestrial habitat within the Mine Development Envelope and this habitat is not be considered to be important. Consequently, the Proposed Action is not expected to substantially modify, destroy or isolate an area of important habitat.
- The Proposed Action footprint does not contain an ecologically important proportion of the population of fork-tailed swift. Given the species is almost exclusively aerial in Australia, with a wide distribution, the clearing of vegetation for the Proposed Action is unlikely to seriously disrupt the life cycle of the species.

8.5 Gull-billed Tern (*Gelochelidon nilotica*)

The gull-billed tern is listed as Migratory under the EPBC Act. However, it should be noted that there are two populations of Gull-billed Tern that occur in Australia, a resident population *Gelochelidon nilotica* subsp. *macrotarsa* and a migratory population *G. nilotica* subsp. *affinis*. Most authorities now recognise the non-migratory, resident Australian population (subsp. *macrotarsa*) as a distinct species, based on differences in plumage, structure, ecology and genetics. This is referred to below as the Australian [gull-billed] tern.

Australian [gull-billed] terns are nomadic and occur widely across Australia, including both coastal and inland areas, but generally remain within Australia. They breed colonially on inland wetlands, and forage

over sheltered coastal and inland wetlands, and over open grassland and bare ground. The migratory [sub]species is a non-breeding migrant to Australia and is associated primarily with coastal habitats in Australia.

The gull-billed tern was observed within the Mine Development Envelope as a single individual flying over the exploration camp late in the afternoon during the September 2019 field survey. This individual was determined to be from the Australian resident population based on plumage.

The individual observed within the Mine Development Envelope was likely prospecting for suitable habitat but is unlikely to have remained in the area for long given the current conditions. This [sub]species would only be expected to use the area for foraging if heavy rains resulted in the existence of shallow wetland areas, or if large insects (especially grasshoppers) are present in large numbers following good rainfall. The [sub]species is unlikely to use the Mine Development Envelope for breeding unless shallow wetlands form following very heavy rainfall events, and such habitat within the vicinity of the Mine Development Envelope would be of lesser importance compared to the extensive habitat at larger wetland areas in the region such as Walyarta (Mandora Marsh).

The migratory [sub]species is more closely associated with coastal habitats in Australia and it is considered less likely to occur within the Mine Development Envelope. It would not breed there as it is a non-breeding visitor to Australia.

As per the species' listing as migratory under the EPBC Act, an assessment of potential impacts from the Proposed Action has been undertaken for the Australian [gull-billed] tern (i.e. the non-migratory [sub]species).

When considered against the significant impact criteria, it is not considered that the Proposed Action will have a significant impact on Australian [gull-billed] tern for the following reasons:

- The species has only been observed as a single individual within the Mine Development Envelope and it is anticipated that it would have been moving through the landscape rather than utilising habitat resources in the area.
- The habitat within the Mine Development Envelope is only considered to be suitable for foraging after heavy rainfall. However, after rainfall events, other areas within the region would provide more extensive and important habitat resources for the species.
- Given the above, it is not considered that the Mine Development Envelope provides important habitat for this species, nor does it support an ecologically significant proportion of the population. Impacts, if any, to this species would affect small numbers of individuals and comprise the removal of small areas of non-essential habitat.

9. Predicted outcomes for MNES and conclusion

On the basis of the above information and assessment, it is considered that the only potential impact on MNES from the Proposed Action will be to the Greater bilby. The species is known to occur adjacent to the Mine Development Envelope and up to 1,418 ha of habitat considered critical to the survival of the species will be removed as a result of the Proposed Action. This habitat includes foraging and potential future burrowing habitats. Impacts to Greater bilby have been substantially reduced during the design phase of the Proposed Action, and a number of mitigation measures have been proposed to minimise the potential impacts on the Greater bilby. In addition, to mitigate the potential residual impacts to the Greater bilby, the Proponent will develop a Greater bilby conservation and management plan. This plan will include both good practice general environmental measures to avoid and reduce impacts, as well as an ongoing program to better understand and manage Greater bilby habitat within the wider Study area. It is the intention that this work will be implemented in close collaboration with the Traditional Owners and their Rangers and will be in-line with the objectives and key actions of the Commonwealth Draft Recovery Plan for the Greater bilby.

It is considered unlikely that there will be further significant impacts to the Greater bilby or other MNES as a result of the Proposed Action for the following reasons:

- A number of good practice environmental management measures will be implemented to avoid and reduce the likelihood of impacts to Greater Bilby, including a dedicated Greater Bilby Conservation Management Plan
- The boundaries of the Mine Development Envelope have been pro-actively rationalised to avoid all currently identified active Greater bilby burrows and minimise potential impacts to known burrowing habitat.
- Large areas of habitat critical to the survival of the Greater bilby will remain within the Mine Development Envelope and wider Great Sandy Desert region compared to that which will be cleared or disturbed due to the Proposed Action.
- There is no important habitat for threatened and migratory birds in the Mine Development Envelope and these areas do not support an ecologically significant proportion of these species.

In summary, the Proponent predicts the following outcomes for the Proposed Action:

- Habitat critical to the survival of the Greater bilby and an important population of this species will continue to be available around the Mine Development Envelope and immediate surrounds, as well as elsewhere within the Great Sandy Desert region.
- Management and conservation measures to be implemented for the Proposed Action will be aligned with the actions detailed in the Commonwealth Draft Greater Bilby Recovery Plan for the Nyangumarta Warrarn IPA ‘Bilby Recovery Site’ and mutually developed and implemented in partnership with the relevant Traditional Owner group and their Ranger program to support the recovery of this species.
- Suitable habitat for all other identified threatened and migratory species will continue to be present in the Mine Development Envelope and the wider Study area.

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Appendix A Protected Matter Search Tool Results

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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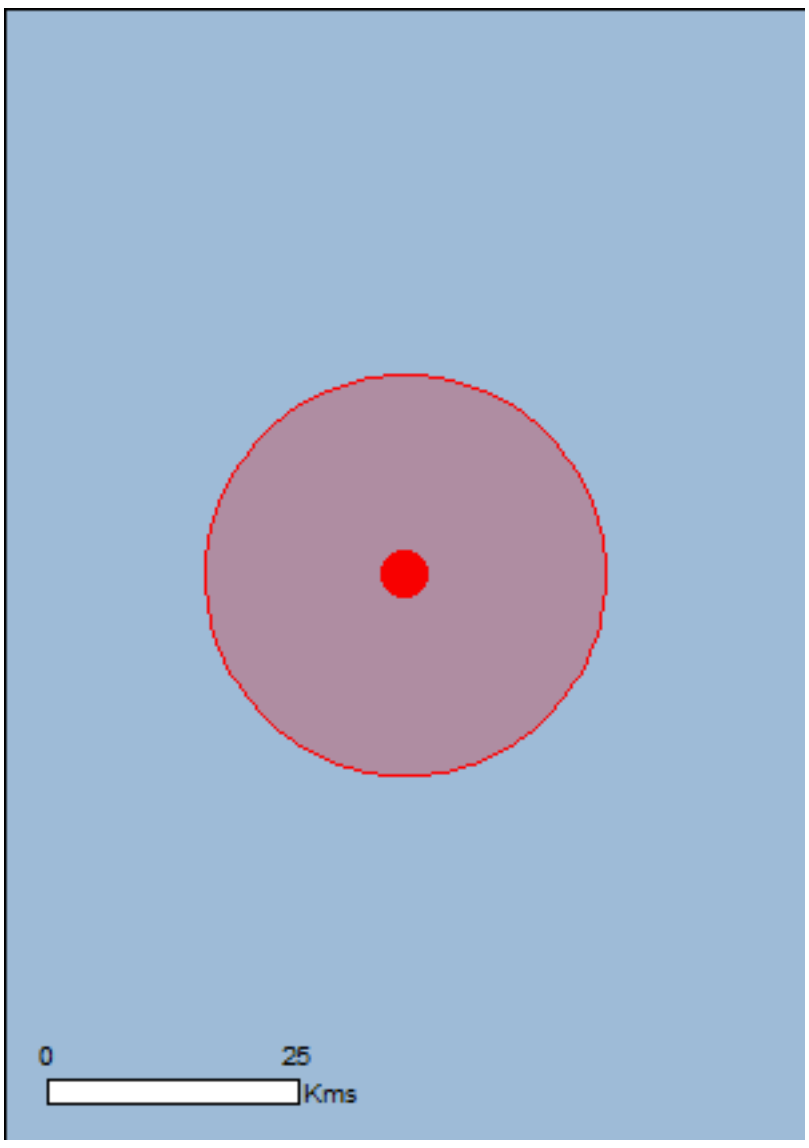

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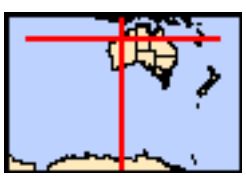

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	7
Listed Migratory Species:	10

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	5
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Polytelis alexandrae		
Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Nyangumarta Warrarn	WA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

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

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

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

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

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

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

Coordinates

-20.72626 121.736

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B Likelihood of occurrence assessments

Database searches were conducted for the Mine Development Envelope and the wider Study area using the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (including a 20 km buffer).

Additional information regarding records of species was sourced from publicly available databases (e.g. Atlas of Living Australia) and previous studies conducted within or in the vicinity of the Mine Development Envelope.

A likelihood of occurrence assessment was completed on a total of 16 species derived from the desktop assessment, comprised of listed threatened species and migratory species. This likelihood of occurrence assessment was based the species habitat requirements compared with the habitat which is present within the wider Study area and known records of the species within a 20 km radius of the Mine Development Envelope, (sourced from publicly available information sources and previous studies of the area).

The criteria used to assess the likelihood of threatened and migratory species occurring within the Mine Development Envelope and wider Study area is:

- Known – Species has previously been recorded in the Mine Development Envelope within the last five years.
- Likely – Species has previously been recorded in the wider Study area within the last 10 years and important habitat (foraging or breeding) is abundant and/or good condition general habitat is present within the Mine Development Envelope.
- Potential – Species has not been recorded in the Mine Development Envelope or wider Study area, however limited and/or moderate condition general habitat is present within the Mine Development Envelope
- Unlikely – Species has not been recorded within the last 10 years in the wider study area or within 20 km of the Mine Development Envelope, suitable general habitat for the species is not present in the Mine Development Envelope and/or is highly disturbed or degraded, the current known distribution does not include the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Birds					
Calidris ferruginea	Curlew Sandpiper	CE/M	Occurs around the coast of Australia, with smaller number widespread inland. The curlew sandpiper does not breed in Australia. Mainly occurs on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons. The species forages on mudflats and nearby shallow water and generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Numenius madagascariensis	Eastern Curlew	CE	The species has a primarily coastal distribution, where it is found in all states of Australia. It does not breed in Australia. Throughout its non-breeding season it is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Pezoporus occidentalis	Night Parrot	E	The current distribution of the night parrot is not known. Most habitat records are of *Triodia* (Spinifex) grasslands and/or chenopod in the arid and semi-arid zones. Additional sightings have occurred in *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura (*Mulga) woodland, treeless areas and bare gibber Roosting and nesting sites are consistently reported as within clumps of dense vegetation, primarily old and large Spinifex clumps (long unburnt), but sometimes other vegetation types.	Unlikely	The species was not recorded during targeted survey of the Mine Development Envelope, nor has it been recorded during targeted surveys in the wider Study area. No evidence of suitable nesting or foraging habitat was recorded in the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Polytelis alexandrae	Princess Parrot	V	Inhabits sand dunes and sand flats in the arid regions of Western Australia, the Northern Territory and South Australia. The main population is believed to be concentrated in the Great Sandy, Gibson, Tanami and Great Victoria Deserts. The species occurs in open savanna woodlands and shrublands that usually consist of scattered stands of Eucalyptus (including *E. gongylocarpa*, *E. chippendalei* and mallee species), Casuarina or Allocasuarina trees; an understorey of shrubs such as Acacia (especially *A. aneura*), Cassia, Eremophila, Grevillea, Hakea and Senna; and a ground cover dominated by *Triodia* species.	Potential	Species has not been recorded within the Mine Development Envelope or wider Study area. However, suitable habitat is present within the Mine Development Envelope. The species is highly nomadic and may potentially occur to forage on spinifex during seeding events.
Rostratula australis	Australian Painted Snipe	E	The australian painted snipe has been recorded at wetlands in all states of Australia and is most common in eastern Australia. Generally inhabits shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Mammals					
Dasyurus hallucatus	Northern Quoll	E	The northern quoll occupies a diversity of habitats across its range which includes rocky areas, eucalypt forest and woodlands, rainforests, sandy lowlands and beaches, shrubland, grasslands and desert.	Unlikely	The species has not been recorded and suitable habitat does not occur in the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Macroderma gigas	Ghost Bat	V	The ghost bat's current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley, northern parts of the Northern Territory, the Gulf of Carpentaria, coastal and near coastal eastern Queensland from Cape York to near Rockhampton, and western Queensland. They currently occupy habitats ranging from the arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope area and the species was not recorded during targeted surveys.
Macrotis lagotis	Greater Bilby	V	Within Western Australia, the greater bilby is known from the Gibson Desert, Little Sandy Desert, Great Sandy Desert and parts of the Pilbara and Southern Kimberley. The remaining populations of the species occupy three main habitats: open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas	Known	Species has been recorded within the wider Study area. Suitable habitat and evidence of the species has been recorded in the Mine Development Envelope.
Migratory birds					
Actitis hypoleucos	Common Sandpiper	M	The common sandpiper is found along all coastlines of Australia with the population concentrated in northern and western Australia. The species utilises a wide range of coastal wetlands and some inland wetlands and is mostly found around muddy margins or rocky shores and rarely on mudflats. Forages in shallow water and on bare soft mud at the edges of wetlands and is known to perch on posts, jetties, moored boats and other artificial structures.	Unlikely	Suitable habitat does not occur in Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Apus pacificus	Fork-tailed Swift	M	The fork-tailed swift is a non-breeding vagrant to all states and territories of Australia. The species is almost exclusively aerial and mostly occurs over inland plains but sometimes above foothills or in coastal areas. They are found over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh.	Potential	Suitable habitat is present in the Mine Development Envelope and the species may occur intermittently as an overhead visitor.
Calidris acuminata	Sharp-tailed Sandpiper	M	The sharp-tailed sandpiper migrates to Australia, mostly to the south-east where it is widespread in both inland and coastal locations and in both freshwater and saline habitats. The species prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline salt lakes inland. They forage and roost at the edges of wetlands on wet open mud or sand.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Calidris melanotos	Pectoral Sandpiper	M	The pectoral sandpiper is a non-breeding vagrant that is rarely recorded in Western Australia. The species prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Charadrius veredus	Oriental Plover	M	The oriental plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Immediately after arriving in non-breeding grounds in northern Australia, the species spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. They usually forage among short grass or on hard stony bare ground. The species sometimes roost on soft wet mud or in shallow water of beaches and tidal mudflats.	Known	Species has been recorded within the Mine Development Envelope.
Gelochelidon nilotica	Gull-billed Tern	M	Australian [gull-billed] terns are nomadic and occur widely across Australia, including both coastal and inland areas, but generally remain within Australia. They breed colonially on inland wetlands, and forage over sheltered coastal and inland wetlands, and over open grassland and bare ground. The migratory [sub]species is a non-breeding migrant to Australia and is associated primarily with coastal habitats in Australia.	Known	Non-migratory sub-species has been recorded in the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Glareola maldivarum	Oriental Pratincole	M	Within Australia the oriental pratincole is widespread in northern areas, especially along the coasts of the Pilbara region and the Kimberley Division in Western Australia. The species usually inhabits open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas. They often occur near terrestrial wetlands, such as billabongs, lakes or creeks, and artificial wetlands such as reservoirs, salt works and sewage farms, especially around the margins. They usually roost in bare areas such as clay pans or areas with low vegetation, such as saltmarsh or airfields.	Likely	Species has been recorded within the wider Study area and potential foraging habitat is present within the Mine Development Envelope.
Hirundo rustica	Barn Swallow	M	The barn swallow occurs in northern Australia, on Cocos-Keeling Island, Christmas Island, Ashmore Reef and patchily along the north coast of the mainland from the Pilbara region, Western Australia, to Fraser Island in Queensland. It is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted in or over freshwater wetlands, paperbark woodland, mesophyll shrub thickets and tussock grassland.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Motacilla cinereal	Grey Wagtail	M	The grey wagtail inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. Outside of the breeding season it occupies a wider variety of habitats, including farmyards, sewage farms and forest tracks.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.

Scientific Name	Common Name	EPBC Act Status	Habitat and Distribution	Likelihood	Justification
Motacilla falva	Yellow Wagtail	M	The yellow wagtail is a regular summer migrant to coastal Australia. It occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.
Pandion haliaetus	Osprey	M	The distribution of the osprey around the northern coast (south-western Western Australia to south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach. The species occurs in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia. They require extensive areas of open fresh, brackish or saline water for foraging.	Unlikely	Suitable habitat does not occur in the Mine Development Envelope.

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