



REPORT

Ecological Impact Assessment

Ardmore Phosphate Rock Project - Start-up Operation

Submitted to:

Centrex Metals Limited

Level 6, 44 Waymouth Street
Adelaide, SA 5000

Submitted by:

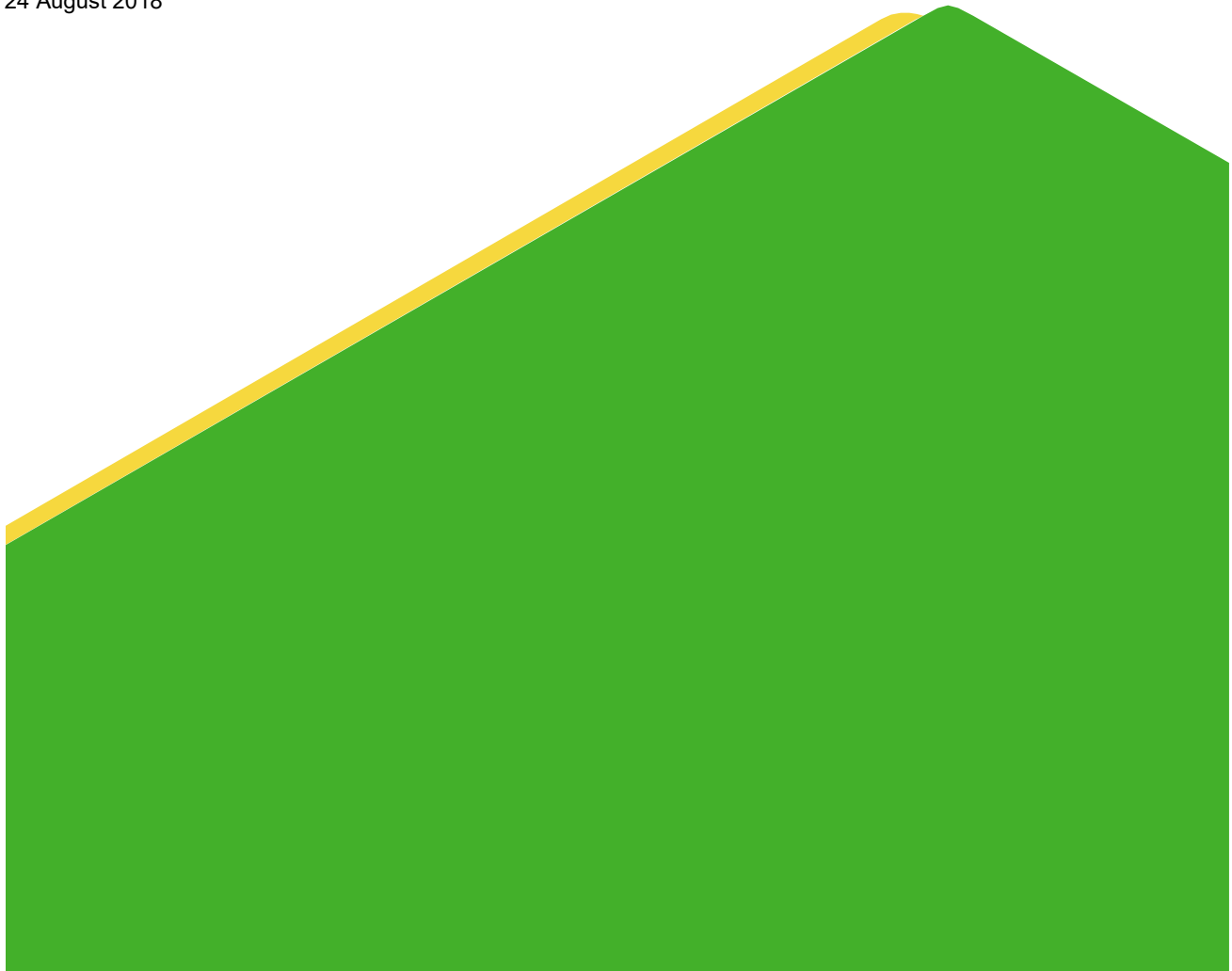
Golder Associates Pty Ltd

147 Coronation Drive Milton, Queensland 4064 Australia

+61 7 3721 5400

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Record of Issue

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Centrex Metals Limited	Gerard Bosch – Approvals and Stakeholder Manager	Rev 1 – Final	25/08/2018	PDF

Executive Summary

Introduction

Centrex Phosphate Pty Ltd (Centrex) proposes to develop the Ardmore Phosphate Rock Start-up Operation Project (Start-up Operation or the Project) to be constructed within the southern zone of the Mining Lease (ML), with a target to extract 70,000 t of ore using shallow open-cut strip mining over a two – three month period.

Baseline

Centrex commissioned Northern Resources Consultants (NRC) to conduct baseline terrestrial flora, fauna and aquatic ecology assessments to identify biodiversity values within the ML.

Desktop assessments identified one near threatened flora species, eight listed fauna species, and six migratory fauna species with potential relevance to the ML. Of these, only the Queensland-listed vulnerable Purple-necked Rock-wallaby (*Petrogale purpureicollis*) was recorded within the ML.

Regional ecosystem (RE) 1.3.7b, a Category B environmentally sensitive area (ESA) under the Queensland *Environmental Protection Regulation 2008* (EP Reg), was confirmed within the ML; however, the spatial extent on-the-ground was less than that represented in the regulated mapping. Essential habitat for the Purple-necked Rock Wallaby is mapped within the ML.

On-going disturbance from cattle grazing, feral animals, and invasive plant species were observed throughout the ML.

Methodology

The impact assessment followed a six-part process, broadly following those methods outlined in Treweek (1999), Secretariat for the CBD (2006), and Morris and Therivel (2009), and is in line with the requirements of the Matters of National Environmental Significance (MNES)-guidelines (*viz.*, DoE, 2013), and the DES's guideline *Application requirements for activities with impacts to land* (DEHP, 2017) (the land guidelines):

- 1) Identify key issues.
- 2) Delineate study areas/areas of interest.
- 3) Identify the timeframe for the assessment.
- 4) Describe the baseline (including current direct and indirect drivers of change to ecosystem processes and function, composition and structure, population behaviour).
- 5) Identify valued components, key questions, and indicators.
- 6) Conduct the impact assessment:
 - a) identify project interactions with the valued components
 - b) consider design and mitigation measures included in the project design
 - c) assess effects and classify direct and indirect impacts
 - d) describe the confidence in the impact predictions
 - e) determine follow-up and monitoring activities and additional mitigation measures not already considered.

Key issues in relation to the ecological values of the ML in the vicinity of the proposed Start-up Operation were identified through review of baseline environmental reports, and an understanding of the planned Start-up Operation.

Results

The Ardmore Phosphate Rock Project Start-up Operation was considered in terms potential impacts to MNES and MSES observed to occur or considered to have a moderate or high probability of occurring within the local study area. These were identified to be valued components; specifically, these were:

- MNES
 - Threatened and conservation significant flora.
 - Migratory species.
- MSES
 - ESAs.
 - Remnant vegetation associated with a watercourse or drainage feature.
 - State-mapped essential habitat.
 - Threatened fauna and conservation significant fauna.
 - Threatened and conservation significant flora.

Baseline assessments considered that vegetation communities within the ML to be represented across the greater regional area. Significant disturbance from cattle grazing and the invasion of pest plant species was observed across the ML.

In general, potential impacts to valued components would be limited to the site scale, that is the immediate area of clearing associated with the proposed Start-up Operation, be transient, and have an improbable to low probability of occurring. Impact severity would be minor to all valued components identified.

All impacts can be managed through avoidance, minimisation or reclamation, without the need for offsets.

Overall, it is considered that the Ardmore Phosphate Rock Project Start-up Operation will not have a significant impact on MNES and MSES.

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Important Information Relating to this Report

1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) has prepared this Ecological Impact Assessment Report on behalf of Centrex Metals Limited (Centrex) to support an amendment application to an Environmental Authority (EA). Centrex propose to develop a high-grade phosphate deposit located at Ardmore, approximately 128 km south of the city of Mt Isa and 23 km west of the town of Dajarra in North West Queensland (Figure 1). This is referred to as the Ardmore Phosphate Rock Project.

Centrex was transferred ownership of the Ardmore Mining Lease (ML 5542) in June 2017. ML 5542 is 2,209 hectares, with the target high-grade phosphorite deposit located within two separate areas, the 'Northern Zone' and the 'Southern Zone'. The application is for the Start-up Operation only (referred to as 'the Project'), which is a small-scale pit and demonstration plant to be constructed within the Southern Zone of the Mining Lease 5542 (ML5542). The operation will target to extract up to 70,000 t of ore using shallow open-cut strip mining over a 2 – 3 month period.

In Queensland, under the *Environmental Protection Act 1994* (EP Act), an environmental authority (EA) is required to conduct environmentally relevant activities (ERA) that are likely to cause environmental impacts. Mining is considered an ERA under the EP Act. The EA will include conditions to protect land from environmental harm and, where applicable, to ensure that the land is rehabilitated (DEHP, 2017a). Environmental harm includes any adverse, or potentially adverse effect, on an environmental value.

To proceed with mining activities on ML5542 Centrex must apply for an amendment to the existing Environmental Authority (EA) BRMN0037 under the EP Act. This document represents the ecological impact assessment (EclA) to support the application for an EA amendment for the Ardmore Start-up Operation. A subsequent EA will be submitted for any additional, full-scale production activities pending the outcome of the Start-up Operation phase.

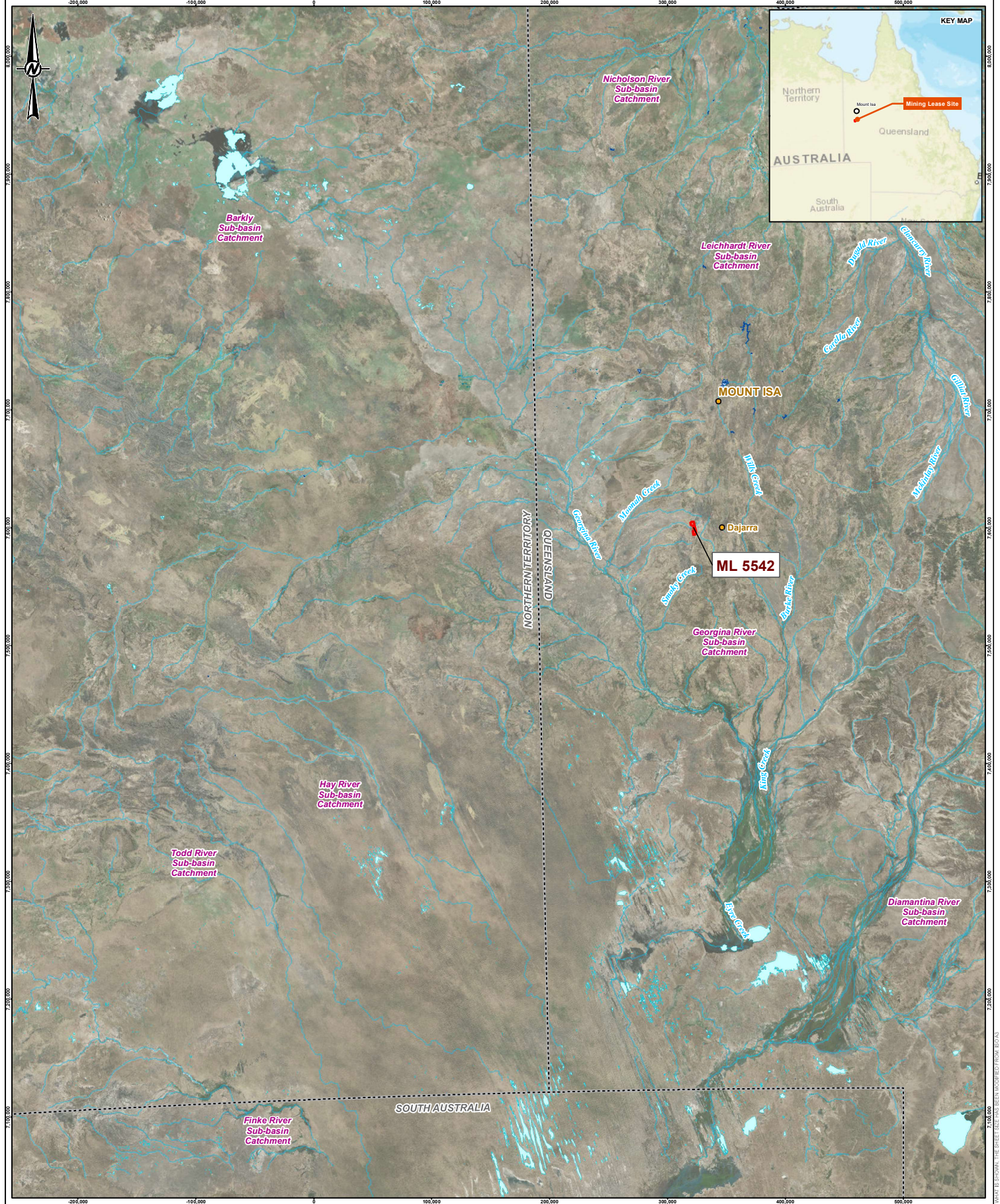
1.1 Project Description Overview

The Start-up Operation is proposed to be constructed within the southern zone of the ML (Figure 2), with a target to extract 70,000 t of ore using shallow open-cut strip mining over a 2 – 3 month period.

The Project will commence once all regulatory approvals are in place, which is anticipated to be in Q3 2018. Erection and commissioning of the plant infrastructure is expected to be completed in four – six weeks but will not occur until Q1 2019 due to the delivery time of the processing plant (24 weeks). The construction period for the pit will take approximately two – three weeks and the mining period six – eight weeks. Processing of the extracted ore is expected to be undertaken over seven - ten weeks following commissioning of the plant. Mined ore will be stockpiled on the ROM pad until the process plant is complete.

The Start-up Operation consists of a test pit, overburden storage facility, indurated storage facility, run-of-mine (ROM) pad, process plant infrastructure, a tailings storage facility (TSF) and associated bund (Figure 3). The Project will disturb a total area of approximately 15.99 ha. Of this, 7.81 ha will be for Project infrastructure, with an additional 3.88 ha of predicted disturbance incorporating the areas around and between the open pits, including a 10-m buffer around the infrastructure (Figure 2).

A 5 m wide corridor approximately 8.5 km in length will accommodate a water pipeline from two bores in the north of the ML to the processing facilities and an accompanying single vehicle access track for pipeline maintenance. The pipeline will be temporarily laid on the surface along a route from the north to the south of the ML as shown in Figure 2, buried at a depth of 0.5 m under three creek crossings and disturbing approximately 4.3 ha of vegetation in total. An access track will be formed along-side the water pipeline for maintenance purposes. Existing access haul road tracks at the site will be upgraded and utilised to minimise additional disturbance.



- LEGEND**
- Locality
 - Hydrology**
 - Major Watercourses
 - Waterbody**
 - Lake
 - Reservoir
 - Swamp
 - Centrex Mining Lease**
 - ML5542
 - State Boundary

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
CENTREX PHOSPHATE PTY LTD

CONSULTANT	DD/MM/YYYY	8/24/2018
	DESIGNED	DC
	PREPARED	DC
	REVIEWED	DP
	APPROVED	JR

NOTE(S)
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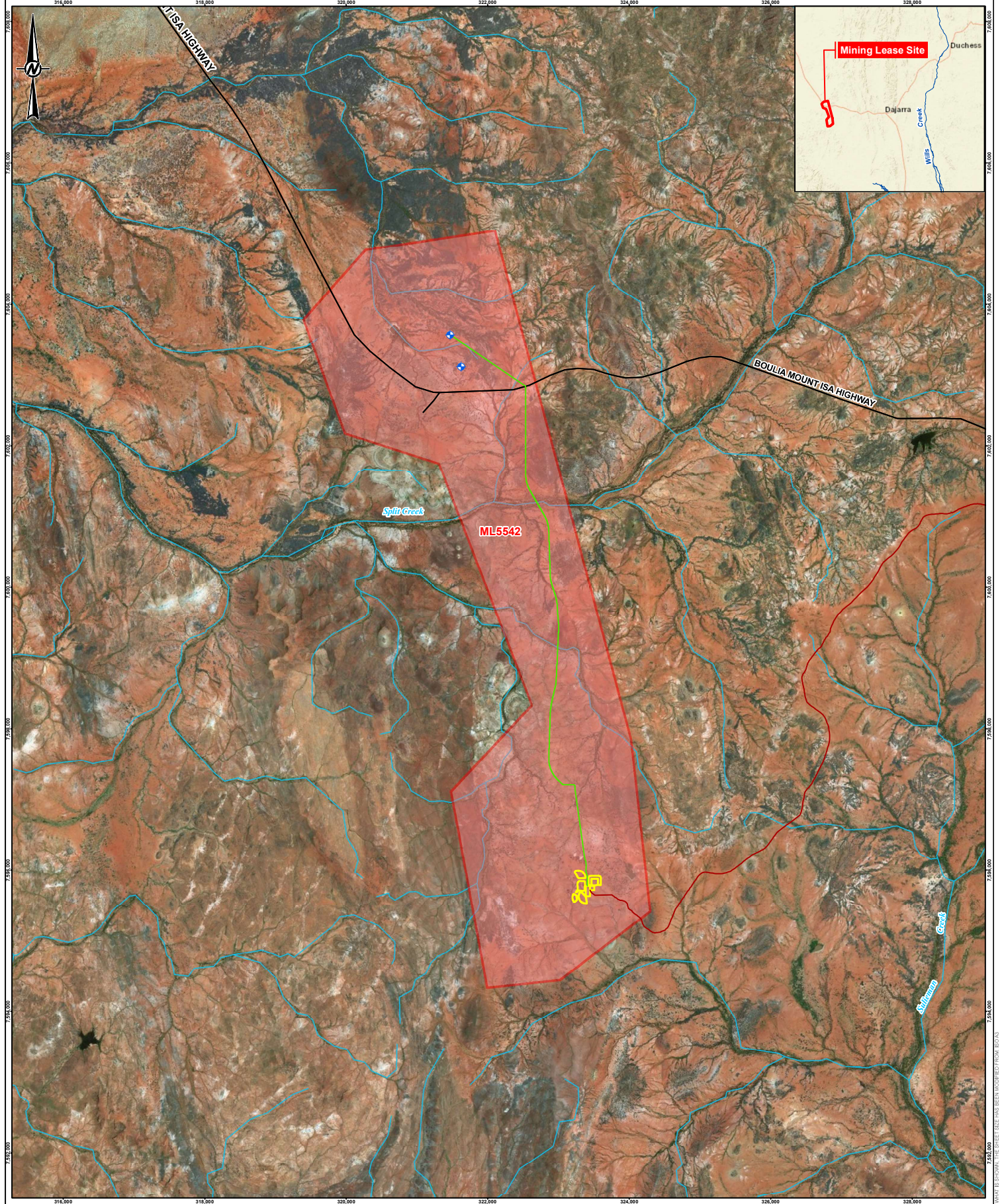
REFERENCE(S)
Locality, Mining Lease, Major Watercourses: © State of Queensland (DNRM) 2018
AusHydro Watercourses, AusHydro Waterbody: © Geoscience Australia
Reservoirs: © State of Queensland (DNRM) 2016
Basin, Sub-Basin Catchments: © State of Queensland (Department of Natural Resources and Mines) 2012.
Sub-basin Catchment, State Boundary: Geoscience Australia 1997

PROJECT
CENTREX ARDMORE PHOSPHATE

TITLE
REGIONAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
1782517	023	0	1

25mm IF THE MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM B0/A3



- LEGEND**
- Groundwater boreholes
 - Water Pipeline and Access Track
 - Watercourses
 - Roads
 - Start-up Operation Access Track
 - Start-up Operation Features
 - Centrex Mining Lease**
 - ML5542

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT
CENTREX PHOSPHATE PTY LTD



CONSULTANT	DD/MM/YYYY	8/24/2018
DESIGNED	HB	
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REVIEWED	DP	
APPROVED	JR	

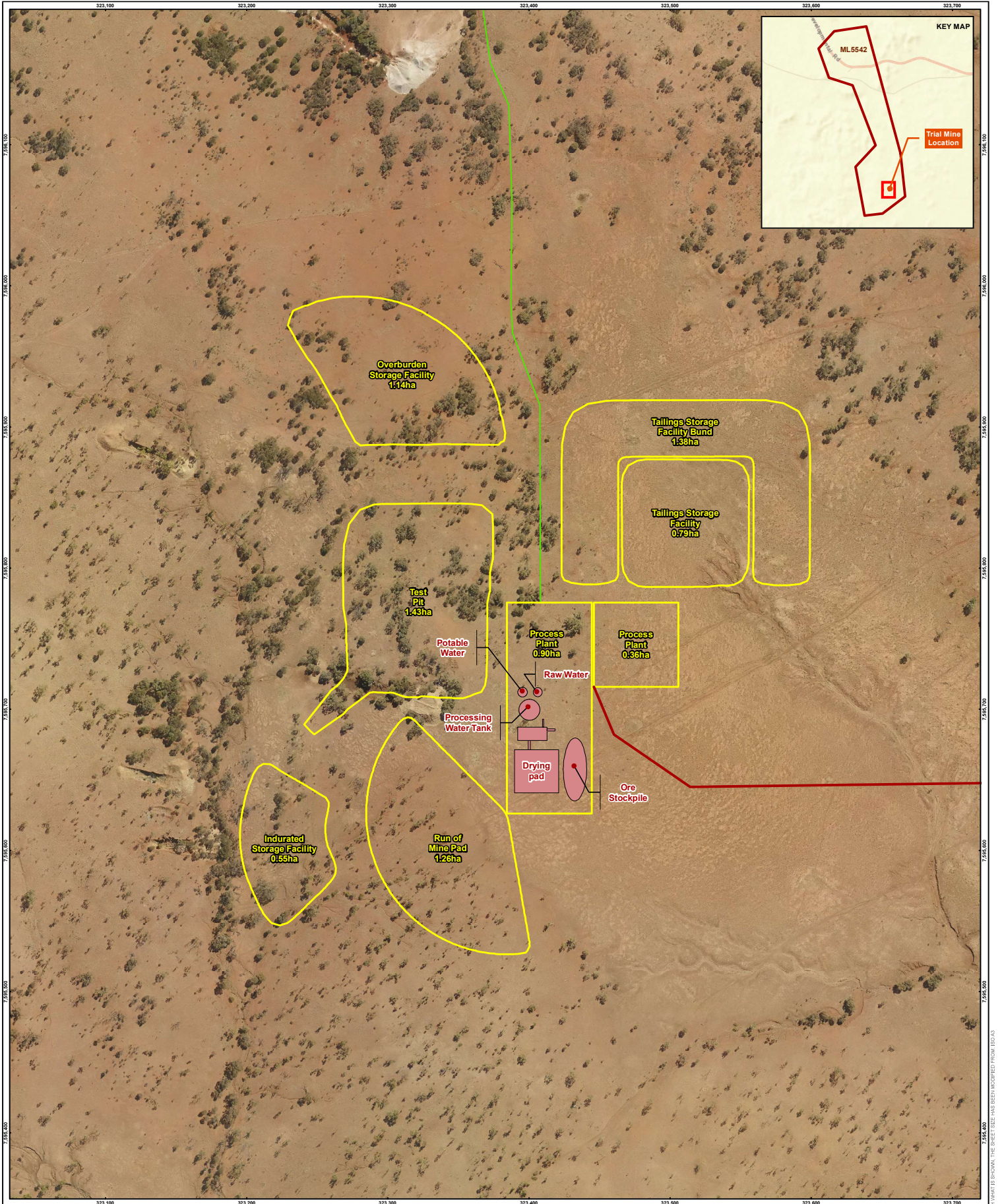
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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

REFERENCE(S)
Roads, Major Watercourses: © State of Queensland (Department of Natural Resources and Mines - DNRM) 2017
Watercourses: © Geoscience Australia 2016
Mining Lease and Exploration permit: © State of Queensland (DNRM) 2018
Access Tracks: provided by Centrex, May 2018.
Startup Operation Features: © Centrex 2018

PROJECT
CENTREX ARDMORE PHOSPHATE

TITLE
LOCAL STUDY AREA

PROJECT NO.	CONTROL	REV.	FIGURE
1782517	023	0	2



LEGEND

- Water Pipeline and Access Track
- Start-up Operation Access Track
- Processing Plant
- Start-up Operation Features
- ML5542

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

CLIENT

CENTREX PHOSPHATE PTY LTD

CONSULTANT



YYYY-MM-DD	24/08/2018
DESIGNED	DP
PREPARED	DP
REVIEWED	BM
APPROVED	BM

REFERENCE(S)

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Roads: provided by Centrex 30th April 2018.
All other data: provided by Centrex 31st May 2018.

PROJECT

CENTREX ARDMORE PHOSPHATE

TITLE

START-UP OPERATION CONCEPTUAL LAYOUT

PROJECT NO.
1782517

CONTROL
023

REV.
0

FIGURE
3

2.0 LEGISLATIVE FRAMEWORK

An overview of the Commonwealth and State regulatory framework relevant to the ecological valued components present in the ML, and planned development, are presented below.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Protection Act 1999* (EPBC Act) is administered by the Commonwealth Department of the Environment and Energy (DoEE), and protects Matters of National Environmental Significance (MNES), including nationally and internationally important flora, fauna, ecological communities and heritage places.

The MNES relevant to the Start-up Operation are:

- Listed fauna.
 - Night Parrot (*Pezoporus occidentalis*) – endangered.
 - Red Goshawk (*Erythrotriorchis radiates*) – vulnerable.
 - Painted Honeyeater (*Grantiella picta*) – vulnerable.
 - Carpentarian Antechinus (*Pseudantechinus mimulus*) – vulnerable.
 - Plains Death Adder (*Acanthopsis hawkei*) – vulnerable.
- Migratory species protected under international agreements.
 - Fork-tailed Swift (*Apus pacificus*).
 - Grey Wagtail (*Motacilla cinerea*).
 - Yellow Wagtail (*Motacilla flava*).
 - Curlew Sandpiper (*Calidris ferruginea*).
 - Oriental Plover (*Charadrius veredus*).
 - Oriental Pratincole (*Glareola maldivarum*).

Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES require approval from DoEE and the relevant Minister.

If it is determined that the proposed action will impact upon a MNES, then the action is declared a 'controlled' action and must go through an assessment and approval process. The nature, significance/intensity, and complexity of those impacts will determine the applicable level of assessment required by the Commonwealth.

The determination of the significance of the proposed action can be undertaken through a self-assessment against the DoEE impact significance criteria presented in *The Matters of National Environmental Significance: Significant Impact Guidelines Version 1.1* (the MNES guidelines) (DoE, 2013). The self-assessment can then be used by the proponent to determine if the action should be a controlled action or not. If the proposed action is not likely to be significant, the action can proceed, subject to any additional state or local government requirements.

2.2 Vegetation Management Act 1999

The Queensland *Vegetation Management Act 1999* (VM Act) is administered by the Queensland Department of Natural Resources and Mines (DNRM) and provides a framework for the management of Queensland's native vegetation and its broad-scale clearing.

The VM Act classifies vegetation communities using the regional ecosystem (RE) classification scheme. A RE refers to vegetation communities in a bioregion that are consistently associated with a combination of geology, landform and soil. The REs have been mapped by the Queensland Herbarium, and their vegetation management class and biodiversity status assigned by the DNRM:

- least concern
- of concern
- endangered.

The management class establishes the triggers for approval. The assigned classification of REs is also relevant to identifying vegetation communities classified as ESAs under the EP Reg, and potential environmental offset requirements under the Queensland environmental offsets framework.

REs relevant to the Start-up Operation are:

- RE 1.3.7b - endangered.

2.3 Environmental Protection Act 1994

Under the Queensland EP Act, an EA is required to conduct assessment of ERAs that are likely to cause environmental impacts. The Queensland Department of Environment and Science (DES) assesses applications to undertake ERAs, and issues EAs, which include conditions to protect land from environmental harm and, where applicable, to ensure that the land is rehabilitated. Environmental harm includes any adverse, or potentially adverse effect, on an environmental value.

An applicant is required under the *Environmental Protection Regulation 2008* (EP Reg) to identify ESAs within or adjacent to the proposed project site when making an application for an EA. ESAs relevant to the Start-up Operation are:

- Category B ESA (RE 1.3.7b)

2.4 Nature Conservation Act 1992

The Queensland *Nature Conservation Act 1992* (NC Act) is administered by the DES and provides for the conservation of nature, including declaration and management of protected areas, protection of wildlife and habitat, and the sustainable use of native wildlife and areas.

The *Nature Conservation (Wildlife Management) Regulation* (NCW Regulation) lists plants and animals considered or presumed extinct, endangered, vulnerable, near threatened, least concern, international and prohibited for protection. All native flora and fauna species within Queensland are protected under the NC Act, and 'permits to take' protected wildlife are required from DES.

Seven listed fauna and one flora species are considered relevant Matters of State Significance (MSES) to the Start-up Operation:

- Listed fauna:
 - Night Parrot (*Pezoporus occidentalis*) – endangered.
 - Red Goshawk (*Erythrorhynchus radiates*) - endangered.
 - Painted Honeyeater (*Grantiella picta*) – vulnerable.
 - Plains Death Adder (*Acanthopsis hawkei*) – vulnerable.
 - Grey Falcon (*Falco hypoleucos*) – vulnerable.

- Northern Leaf-nosed Bat (*Hipposideros stenotis*) – vulnerable.
- Purple-necked Rock-wallaby (*Petrogale purpureicollis*) – vulnerable.
- Short-beaked Echidna (*Tachyglossus aculea*) habitat – special least concern.
- Listed flora:
 - *Ptilotus maconochiei* – near threatened.

2.5 Queensland Environmental Offsets Framework

The Queensland environmental offsets framework includes the *Environmental Offsets Act 2014* (EO Act), the *Environmental Offsets Regulation 2014* (EO Reg), and the *Queensland Environmental Offsets Policy 2017 Version 1.4* (the Offsets Policy).

The EO Act provides the mechanisms by which unavoidable residual impacts on significant environmental matters can be compensated. Significant prescribed environmental matters can include species or ecosystems determined to be valuable, known as MSES.

Environmental offsets work by securing land elsewhere to replace those significant environmental matters which were lost, therefore, counterbalancing the impact of undertaking a prescribed activity, which are defined in Schedules 1 and 2 of the EO Reg. Prescribed activities include the clearing of native vegetation or an area of habitat (for example, foraging, roosting, nesting or breeding habitat) for an animal that is endangered, vulnerable or special least concern. This also includes causing disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of a species. Additionally, an offset may be required for significant residual impacts on habitat.

2.6 Biosecurity Act 2014

The Queensland *Biosecurity Act 2014* identifies three types of invasive plant species:

- Prohibited invasive – currently are not present in Queensland
- Restricted invasive – established in Queensland but depending on categorisation within the *Biosecurity Act 2014*, will have different restrictions.
- Invasive – species that are not listed as prohibited or restricted invasive but the species has, or is likely to have, an adverse impact on a biosecurity because of the introduction, spread or increase in population size of the species in an area.

Invasive animals are also classified under the *Biosecurity Act 2014*, and include prohibited and restricted classifications.

3.0 IMPACT ASSESSMENT METHODS

This section presents the methods used to identify and assess the potential effects and impacts to the valued components in the area of influence of the Start-up Operation. The combined LSA and RSA form the area of influence. This assessment followed a six-part process, broadly following those methods outlined in Treweek (1999), Secretariat for the CBD (2006), and Morris and Therivel (2009), and is in line with the requirements of the MNES guidelines (*viz.*, DoE, 2013), and the DES's guideline *Application requirements for activities with impacts to land* (DEHP, 2017) (the land guidelines). The process involved:

- 1) Identify key issues.
- 2) Delineate study areas/areas of interest.
- 3) Identify the timeframe for the assessment.
- 4) Describe the baseline (including current direct and indirect drivers of change to ecosystem processes and function, composition and structure, population behaviour).
- 5) Identify valued components, key questions, and indicators.
- 6) Conduct the impact assessment:
 - a) identify project interactions with the valued components
 - b) consider design and mitigation measures included in the project design
 - c) assess effects and classify direct and indirect impacts
 - d) describe the confidence in the impact predictions
 - e) determine follow-up and monitoring activities and additional mitigation measures not already considered.

The impact assessment shows clearly to the reader all the steps taken to arrive at the overall impact level score for any key issue or question. Hence, a reader should be able to use those same tools to repeat the analysis if they desired to do so.

The methods used for each of these steps are presented below.

3.1 Key Issues

Key issues in relation to the ecological values of the ML near the proposed Start-up Operation were identified through review of baseline environmental reports, and an understanding of the planned Start-up Operation.

Importantly, the baseline ecological assessments identified potential MNES and MSES, namely potential for migratory species, Category B ESAs, remnant vegetation associated with a watercourse or drainage feature, fauna listed under the EPBC or NC Acts, conservation significant flora, and State-mapped essential habitat within the ML. Based on this information, the key issues pertaining to the ecological values of the ML in the vicinity of the proposed Start-up Operation, include:

- Effect to listed fauna
 - The potential effects that the construction and operation of the Start-up Operation could have on the habitat quality of listed fauna.
 - The potential effects that the construction and operation of the Start-up Operation could have on the regional population of listed fauna.
- Effect to migratory species
 - The potential effects that the construction and operation of the Start-up Operation could have on the regional population of migratory species.
- Effects to ESAs or remnant vegetation associated with a watercourse or drainage feature.

- The potential effects that the construction and operation of the Start-up Operation could have on the regional extent of ESAs or remnant vegetation associated with a watercourse or drainage feature.
- The potential effects that the construction and operation of the Start-up Operation could have on the quality of ESAs or remnant vegetation associated with a watercourse or drainage feature.
- Effects to State-mapped essential habitat for Purple-necked Rock-wallaby.
 - The potential effects that the construction and operation of the Start-up Operation could have on the regional extent of State-mapped essential habitat for Purple-necked Rock-wallaby.
 - The potential effects that the construction and operation of the Start-up Operation could have on the quality of State-mapped essential habitat for Purple-necked Rock-wallaby.
- Effect to conservation significant flora
 - The potential effects that the construction and operation of the Start-up Operation could have on the habitat quality of conservation significant flora.
 - The potential effects that the construction and operation of the Start-up Operation could have on the regional populations of conservation significant flora.

3.2 Delineation of the Study Area

As with any environmental impact assessment, the spatial and temporal boundaries for the analysis need to be set. Spatial and temporal boundaries relative to the assessment are outlined below.

3.2.1 Spatial Boundaries

The spatial boundaries, within which potential effects arising from the Start-up Operation, could impact valued ecological components typically requires two areas of influence:

- Regional Study Area (RSA).
- Local Study Area (LSA).

For the assessment of local impacts, the area should be large enough to analyse and mitigate efficiently the potential effects from the project on the receiving environment, but not too large as to dilute or confound the potential project-related effects with other human-induced and natural influences.

The spatial bounds for each of those areas is described below:

- **Regional Study Area.** For the regional study area (RSA), a first step was to define an ecologically-relevant area of analysis surrounding, and including, the extent of the Start-up Operation's direct area of influence, including broader or regional effects from the proposed development, in association with other anthropogenic activities (such as other developments) and natural factors. These include indirect, induced and cumulative effects.

The boundaries of the RSA were devised cognisant of the need for an area where the ecological and land management issues have more in common with each other than they do with those in adjacent areas, and constitute a sensible ecological boundary.

For the intents of this impact assessment, the RSA is the Georgina River Sub-basin which encompasses the sub-catchment of the tributaries of Moonah Creek, Smoky Creek, and Sulieman Creek, and covers an area of 24,439,842 ha. The RSA is depicted in Figure 1.

- **Local Study Area.** The assessment of impacts within the local area of the Start-up Operation, that is, the local study area (LSA), is based on the spatial extent the footprint, and an associated buffer zone that includes potential immediate, direct effects on the receiving environment. It is derived as a focus for the

development of a baseline case where potential direct effects are predicted to occur. The LSA is defined as the ML area, as depicted on Figure 2.

3.2.2 Temporal Boundaries

The impact assessment considers the entire life-cycle of the proposed Start-up Operation; that is, pre-construction, construction, operation and decommissioning. The Start-up Operation will begin potentially affecting ecological values once pre-construction activities commence, and will continue to affect these at least until active rehabilitation is complete. For some values, effects may continue until vegetative succession is complete in the far future, or may be permanent.

Project effects upon ecological values are sometimes specific to a particular development phase; that is, construction (site clearing, preparation, infrastructure installation), operation (extraction and export), and decommissioning (removal of infrastructure, rehabilitation), and may change over time as the Start-up Operation advances through the various phases. These kinds of temporal variations in effects and impacts were considered in the assessment, and were described qualitatively for each valued ecological component.

For the assessment of effects and impacts from the Start-up Operation, two assessment cases were used:

a) Baseline Case

The baseline case is defined as the condition of the LSA (that is, the ML) as of April 2018. The baseline condition was estimated using data presented in Northern Resources Consultants (NRC) baseline terrestrial flora, fauna and aquatic ecology assessments (NRC, 2017, 2018a, 2018b).

b) Construction, Operation and Decommissioning Case

Due to the short timeframe for Start-up Operation activities, construction, operation and decommissioning assessments were combined. For the construction, operation and decommissioning case, the assessment describes changes from baseline conditions predicted because of the proposed construction, and ongoing operation, of the Start-up Operation, and then decommissioning and rehabilitation following completion of the Project. Currently, the anticipated timeframe for the Start-up Operation includes: four – six weeks for plant infrastructure erection and commissioning, two – three weeks for pit construction, six – eight weeks for mining, and seven - eight week processing period following plant commission. During mobilisation and set-up for mining, heavy machinery (for example, bulldozers, excavators, dump trucks and other equipment and machines) will be used during normal daytime working hours, while fixed plant (that is, the processing facility) will operate 20 hours per day. Construction and operation activity may, therefore, result in the direct destruction of ecological values within the project footprint through a change in the land surface and the direct alteration of terrestrial habitat, and, hence, ecosystem processes and functions. Decommissioning and rehabilitation activity may restore or improve ecological values within the project footprint to baseline conditions.

Direct and indirect effects to ecological values may result from the vegetation clearing, dust, noise, and light associated with construction and operation activities; although activities are limited to an area of substantial previous pastoral disturbance.

Quantitative and qualitative assessment of effects to valued components for each of the cases was based on one snapshot for each case. Snapshots are a description of the landscape at a single moment in time, permitting disturbances to be mapped and quantified. The snapshot used was a predicted maximum disturbance case for each case.

After considering effects at maximum disturbance for each case, these effects were placed in the context of mitigation measures, already proposed for the development, to establish any residual effects of the proposed development after construction, into operation, and then post decommissioning.

A cumulative effects case was also considered. Cumulative effects represent the combined impacts of all previous, existing, and reasonably foreseeable human developments and activities, along with changes due to naturally occurring factors, such as fire or erosion. The influence of existing activities within the wider area was considered when defining the effect of the proposed development on a given valued component relative to its baseline status. Of consideration was the effect of current drivers of change within the ML, specifically, pastoral use for cattle grazing.

3.3 Valued Components

To focus in on the key issues relating to the ecological values identified during the baseline studies and the potential risks posed to those values by the Project, the concept of valued components was used. Valued components are physical, biological, economic, social, cultural, and health properties of the environment that are considered important by the proponent, the public, government agencies, and/or the scientists involved in the assessment process (that is, the stakeholders) (Treweek, 1999). Those valued components identified and described during the baseline then become the focus for the impact assessment. In terms of the ecological values of the RSA, valued components are defined as those elements of the overall biodiversity that are identified as having scientific, social, cultural, economic, or aesthetic importance, and are recognised as being MNES and MSES.

Within the scope of this impact assessment, valued components were determined to be MNES and MSES (refer to Section 2.0) observed to occur or considered to have a moderate or high probability of occurring within the LSA, and be potentially impacted by the proposed Start-up Operation as identified in the baseline studies (refer to NRC, 2017, 2018a, 2018b).

3.4 Impact Assessment

The impact assessment process identifies the significance/intensity of an impact from the Start-up Operation and then compares that intensity with the sensitivity of the receiving environment to derive an overall severity for the impact. This method relies on a detailed description of both the impact and the valued component that is the receptor. The significance/intensity of an impact depends on its characteristics, which may include such factors as its magnitude, duration, reversibility, area of extent, and nature in terms of whether positive, negative, direct, indirect or cumulative.

3.4.1 Key Questions and Indicators

One of the main purposes of an impact assessment is to provide answers to questions that people, including regulators, have about how a project could affect something that matters to them, such as a valued component. These are expressed as 'key questions', and they form the basis of the investigations of potential effects and impacts of the Start-up Operation.

The following key questions were established:

- 1) **What effect could the Start-up Operation have on threatened and conservation significant fauna?**
- 2) **What effect could the Start-up Operation have on migratory species?**
- 3) **What effect could the Start-up Operation have on ESAs?**
- 4) **What effect could the Start-up Operation have on remnant vegetation associated with a watercourse or drainage feature?**
- 5) **What effect could the Start-up Operation have on State-mapped essential habitat for Purple-necked Rock-wallaby?**
- 6) **What effect could the Start-up Operation have on the near threatened *Ptilotus maconochiei*?**

Indicators for the impact assessment were selected to assess the level of potential impact. Changes to the indicators were analysed to determine the effectiveness of the applied mitigation (that is, the mitigation hierarchy incorporated into the project design), and identify constraints and opportunities for additional avoidance and mitigation. Table 1 presents the indicators, and the context for impact assessment, for the key questions and associated valued components.

Table 1: Key questions and indicators

Key Questions	Valued Component	Indicator	Context
What effect could the Start-up Operation have on threatened and conservation significant fauna?	Threatened and conservation significant fauna	Populations of threatened and conservation significant fauna in the LSA. Encounters with threatened and conservation significant fauna.	The persistence of threatened fauna in the LSA. Maintain the abundance of threatened fauna, such that self-sustaining and ecologically effective populations can be maintained in the wider regional study area.
What effect could the Start-up Operation have on migratory species?	Migratory species	Numbers of migratory species.	Maintain the current populations of migratory species utilising the LSA.
What effect could the Start-up Operation have on ESAs?	ESAs	Extent of ESA. Condition of the ESA.	The persistence of the current extent of the ESA remnant vegetation associated with a watercourse or drainage feature within the LSA.
What effect could the Start-up Operation have on remnant vegetation associated with a watercourse or drainage feature?	Remnant vegetation associated with a watercourse or drainage feature.	Extent of the remnant vegetation associated with a watercourse or drainage feature. Condition of the remnant vegetation associated with a watercourse or drainage feature.	Maintain the current condition of the ESAs and remnant vegetation associated with a watercourse or drainage feature in the LSA.
What effect could the Start-up Operation have on State-mapped essential habitat for Purple-necked Rock-wallaby.	State-mapped essential habitat for Purple-necked Rock-wallaby.	Extent of State-mapped essential habitat. Condition of State-mapped essential habitat.	The persistence of the extent of the State-mapped essential habitat in the LSA.

Key Questions	Valued Component	Indicator	Context
Purple-necked Rock-wallaby?			Maintain the current condition of the State-mapped essential habitat in the LSA, and other habitat preferred by threatened species.
What effect could the Start-up Operation have on the near threatened <i>Ptilotus maconochiei</i> ?	<i>Ptilotus maconochiei</i>	Number of <i>Ptilotus maconochiei</i> within the ML	Persistence of the population of <i>Ptilotus maconochiei</i> in the LSA

The ecological valued components were assessed in the context of maintaining the extent and condition of MNES and MSES known to occur, or potentially occurring within the LSA.

3.4.2 Impact Assessment

Key questions were answered using a two-step process. Firstly, an overall written analysis, also known as a reasoned narrative, identified the methods used for the assessment, and walks the reader through the logic of the assessment and the conclusions reached. Secondly, a formal impact classification was applied.

For a detailed explanation of the approach and method used for the reasoned narrative and the impact classifications, see Appendix A. For a detailed explanation of the sensitivity rating, see Table A3 in Appendix A, and Table A4 and A5 for the impact severity rating. Typically, for the impact severity rating, a combination of significance/intensity of the impact rated against sensitivity of the receptor, as per Table A4, was used. This presents an overall impact level as defined in Table A5 (Appendix A).

4.0 EXISTING ECOLOGICAL VALUES

Baseline terrestrial flora, fauna and aquatic ecology assessments were completed to identify ecological values within the ML (see NRC, 2017, 2018a, 2018b). Desktop and field-based assessments were conducted using methodology in accordance with best practice guidelines.

4.1 General Ecological Value

Desktop assessment identified one near threatened and one vulnerable flora species, 13 threatened fauna species, and six migratory fauna species with potential relevance to the ML (NRC, 2017). Despite targeted surveys in suitable habitat, neither of the near threatened or vulnerable flora species were recorded in the ML. The Purple-necked Rock-wallaby was the only threatened fauna species recorded within the ML. No migratory fauna species were recorded within the ML.

The desktop assessment identified that no threatened ecological communities (TEC) could potentially occur within the ML, or within a 25-km radius the ML. This was confirmed during the field-based assessment of the ML area (NRC, 2017).

Eight REs were identified during vegetation ground-truthing (NRC, 2017) (Figure 4). Aside from RE 1.3.7b, all other REs recorded and mapped within the ML have a 'least concern' status under the VM Act, and a 'no concern at present' biodiversity status. The RE 1.3.7b has an endangered biodiversity status, and, therefore, is an ESA under the EP Reg.

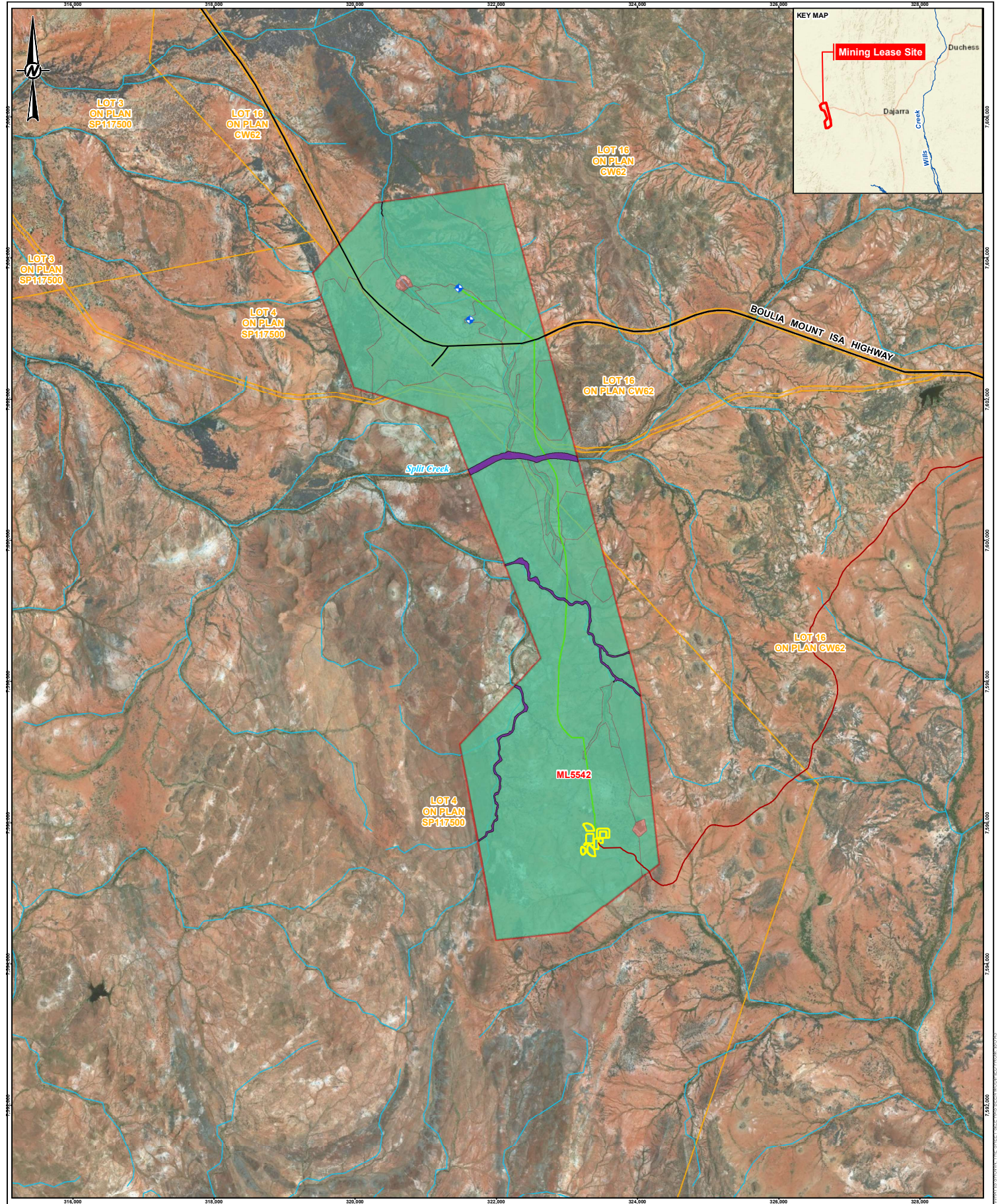
One area of remnant vegetation within the ML is mapped as essential habitat for the Purple-necked Rock Wallaby.

No wetland protection areas, wetlands of high ecological significance, or wetlands of international significance were identified during desktop or field-based assessments (NRC, 2017). The only permanent water sources identified on the ML were two stock water dams. NRC recorded 81 flora species from 31 families during vegetation surveys within the ML, all of which are considered common and widespread throughout the region within suitable habitat (NRC, 2018b). Species diversity within each unit is considered generally low. In general, floristic composition was consistent throughout the ML.

Field-based assessments identified: 20 species of mammals from 10 families; 23 species of reptiles from eight families; three species of amphibian from two families; and 64 species of birds (NRC, 2018b). It was noted that habitat suitability may vary seasonally due to highly mobile fauna species being influenced by seasonal rainfall and flowering periods (NRC, 2017). This is likely to lead to the species diversity fluctuating throughout the year.

Disturbance from cattle, particularly near the two stock water dams, was observed during the field-based assessments (NRC, 2017). These areas have low levels of vegetation cover and are virtually devoid of fauna microhabitat features resulting in low biodiversity values. Two invasive pest plant species and two pest fauna species were observed within the ML during field-based assessments (NRC, 2018b); an additional two pest fauna species (camels and goats) have been observed by Centrex personnel.

The environmental values present within the direct vicinity of the proposed start-up operation location were predominately very sparse with limited to no habitat values, on RE 14.9.12x4a/4.9.10b. Vegetation comprised a sparse ecotonal mix of *Acacia cambagei* and *Corymbia terminalis* very open woodland on skeletal soils, with large portion of the proposed start-up location containing only a sparse groundcover of *Enneapogon polyphyllus* (Plate 1 and Plate 2).



LEGEND

Groundwater boreholes

Watercourses

Water Pipeline and Access Track

Roads

Start-up Operation Access Track

Start-up Operation Features

Cadastral

Centrex Mining Lease

ML5542

Remnant Regional Ecosystem

Endangered (Dominant)

Least Concern

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994

CLINT
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CONSULTANT

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DESIGNED

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PREPARED

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REVIEWED

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APPROVED

JR

NOTE(S)
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

REFERENCE(S)
Roads, Major Watercourse, Cadastral: © State of Queensland (Department of Natural Resources and Mines - DNRM) 2017
Mining Lease: © State of Queensland (DNRM) 2018
Remnant Regional Ecosystem [Endangered (Dominant)], Regional Ecosystem Assessment, Quarterly Survey: © NRC 2018
Start-up Operations: provided by Centrex 31st May 2018

PROJECT
CENTREX ARDMORE PHOSPHATE

TITLE
REGIONAL ECOSYSTEMS (VERIFIED)

PROJECT NO.

1782517

CONTROL

023

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FIGURE

4

LIMITATIONS
The difference between the Mining Lease and Least Concern area boundaries is a result of reporting error in baseline assessments. This is not expected to affect the outcome of this assessment.



Plate 1: Current Site Condition – TSF Location facing North-West



Plate 2: Current Site Condition – Test Pit Location facing South-West

The results of sediment and surface water (where available) quality at the ML likely reflect natural conditions at the sites (NRC, 2018a). Only one site contained enough water for aquatic macroinvertebrate sampling during the field-based assessment; macroinvertebrate index scores at this site were low, despite the habitat being considered 'good' (NRC, 2018a).

Further detail on valued components is provided in the following sections.

4.2 Baseline of Valued Components

The ecological valued components, as derived from the baseline ecological studies, are summarised in the following sections. These present information on the known extent, condition, and vulnerability of those valued components, which are identified as MNES and MSES.

4.2.1 Environmentally Sensitive Areas

The RE 1.3.7b, a Category B ESA was confirmed within the ML (Figure 4) (NRC, 2017). The spatial extent of this RE within the ML (that is, 29.2 ha) was less than represented in the Queensland Herbarium RE mapping (which was 119 ha), with some areas mapped as RE 1.3.7b not supporting the River Red Gum (*Eucalyptus camaldulensis*), the defining species for this RE.

Within the ML, the River Red Gum is generally restricted to areas of sandy alluvial beds (NRC, 2017). Most drainage features and watercourses within the ML are very narrow, with River Red Gums only occasionally scattered along the beds of these features, and the watercourse vegetation communities rapidly transition to the adjacent communities of the non-riparian landscape.

The exception to this is Split Creek in the centre of the ML, which is a larger watercourse feature, with a sandy bed of approximately 40 m width (NRC, 2017). Split Creek supports a much more substantial River Red Gum community, and more distinct riparian habitat values, including hollow-bearing River Red Gums. Split Creek is the only watercourse feature considered large enough to provide corridor connectivity values at the local scale within the ML.

Significant disturbance from cattle grazing and feral animals, and the invasion of pest plant species was observed in riparian areas during field-based assessments; indeed, the criterion leading to the endangered biodiversity status for this RE is the severe degradation to this community at the regional scale as a result of agricultural land uses and invasion of exotic plant species (NRC, 2017). NRC (2017) noted that while the canopy of RE 1.3.7b remains relatively intact, the biodiversity values of the understorey layers are severely degraded.

Despite intensive searches, no distinct vegetation unit consistent with RE 2.3.18 (identified in Queensland Herbarium RE mapping during desktop assessments), which has an 'of concern' biodiversity status, was recorded during the field surveys (NRC, 2017).

4.2.2 Remnant Vegetation Associated with a Watercourse or Drainage Feature

Remnant vegetation associated with a watercourse or drainage feature is classified as a MSES. A number of watercourse and drainage features within the ML are represented on the *vegetation management watercourse and drainage feature map* (as certified under the VM Act) (NRC, 2017). The *Queensland Environmental Offsets Policy* defines the extent to which the remnant vegetation associated with the watercourse is considered a protected matter. The ML is in the non-coastal 'Northwest Highlands' bioregion; associated defining distances of the extent of MNES vegetation communities from the watercourse bank in that bioregion are presented in Table 2.

Table 2: Defining distance for regional ecosystems associated with a watercourse (non-coastal bioregions) (Queensland Environmental Offsets Policy V1.4)

Watercourse stream order	Distance from the defining bank (metres)
1 or 2 (all tributaries of Split Creek within the study area)	25
3 or 4 (Split Creek)	50
5 or greater (nil in Mining Lease)	100

4.2.3 Essential Habitat for Purple-necked Rock-wallaby

One area to the north-east of the ML is mapped as essential habitat for the State-listed vulnerable Purple-necked Rock-wallaby. Two records from 1976 and 1985 are associated with this area (NRC, 2018b). The ML boundary intersects this essential habitat, with 34.8 ha of the total mapped essential habitat area of 311.3 ha occurring within the ML.

NRC (2018b) ground-truthed habitat values within the essential habitat. No individuals were seen within the State-mapped essential habitat on the ML. The field-based assessment confirmed a lack of essential shelter habitat factors described in literature for this species within the that essential habitat on the ML. However, spinifex grasslands within the mapped essential habitat that may provide foraging habitat were observed. It was noted that suitable habitat features were identified outside the ML to the east and south that may provide shelter and breeding habitat for the Purple-necked Rock-wallaby. NRC (2018b) concluded that the State-mapped essential habitat within the ML may support Purple-necked Rock-wallaby foraging, but no favoured shelter or breeding habitat occurred within the ML. Therefore, this habitat within the ML was considered marginal.

There are also multiple records for the Purple-necked Rock-wallaby surrounding Split Creek; however, ground-truthing surveys indicate that based on habitat, these records are likely to be related to itinerant individuals. This suggests that this area may be a potential movement corridor for individuals between more suitable habitat to the west and east of the ML.

4.2.4 Threatened Fauna

One threatened species was confirmed within the ML. A population of Purple-necked Rock-wallaby was recorded from a single location on the western edge of the ML (Figure 5). This area consists of outcropping limestone, associated with a watercourse and spinifex grasslands (NRC, 2018b). The spinifex grasslands, which are a preferred food source for these rock-wallabies, extends in an approximately 200 m radius from the limestone outcrops.

Evidence of the Short-beaked Echidnas was recorded in the far south-west corner of the ML. This species is listed as 'special least concern' wildlife under the NC Act, with habitat for this species being a MSES (NRC, 2017).

Seven threatened species considered to have a moderate or high likelihood of occurring within the ML are:

- Night Parrot
- Red Goshawk
- Painted Honeyeater
- Carpentarian Antechinus
- Plains Death Adder

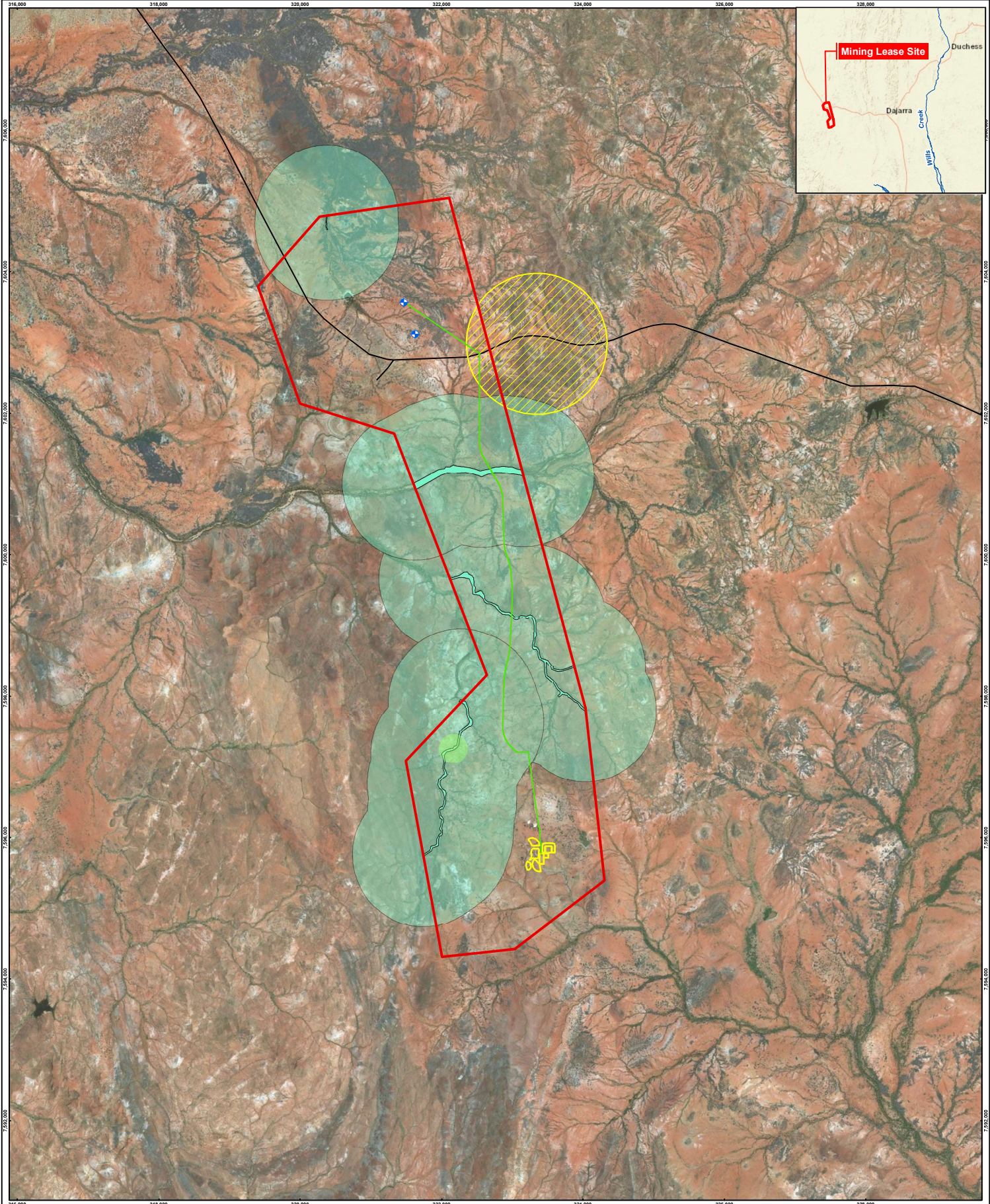
- Grey Falcon
- Northern Leaf-nosed Bat.

4.2.5 Migratory Species

Six migratory fauna could utilise the ML. None of these species were recorded during field assessments, and all are considered to have a low likelihood of occurrence within the ML. The ML supports very few resources that would be important to these species.

4.2.6 Conservation Significant Flora

No threatened or near threatened flora species were confirmed within the ML (NRC, 2017). The near threatened *Ptilotus maconochiei* could occur within the ML, within suitable habitat (NRC, 2017). The nearest record for *Ptilotus maconochiei* to the ML is approximately 100 km away. However, this species has a wide, scattered distribution in rocky habitats throughout western Queensland (NRC, 2017). Targeted surveys within suitable habitat in the ML did not detect this species, however, it could still occur.



- LEGEND**
- Groundwater boreholes
 - Water Pipeline and Access Track
 - ML5542
 - Essential Habitat
 - Ground Truthed ESAs
 - Ground Truthed ESAs 1km Buffer
 - Purple Necked Rock Wallaby Observation Buffer (200m)
 - Start-up Operation Features

Coordinate System: GDA 1994 MGA Zone 54
Projection: Transverse Mercator
Datum: GDA 1994
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PREPARED	HB			
REVIEWED	DP			
APPROVED	JR			

REFERENCE(S)

Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Ground Truthed ESAs, Purple Neck Rock Wallaby Habitat © NRC 2018.
Roads, Major Watercourse, Cadastre, Essential Habitat: © State of Queensland (Department of Natural Resources and Mines - DNRM) 2017.
Mining Lease: © State of Queensland (DNRM) 2018.
Startup Operations Features: provided by Centrex 31st May 2018

PROJECT
CENTREX ARDMORE PHOSPHATE

TITLE
AREAS OF CONCERN

PROJECT NO.	CONTROL	REV.	FIGURE
1782517	023	0	5

5.0 IMPACT ASSESSMENT

This section presents an assessment of the possible interactions, and the resulting effects and impacts, from the proposed construction, operation and decommissioning of the Start-up Operation on the valued components.

5.1 Project Interactions

Activities associated with the construction and operation of the Start-up Operation, and potential interactions with valued components, are summarised below. The identification of these activities was based on the current knowledge of the project design.

5.1.1 Project Footprint

During the construction, operations, and decommissioning of the Start-up Operation, all project features that have a physical footprint have the potential to affect valued components.

The Start-up Operation consists of a test pit, overburden storage facility, indurated storage facility, ROM pad, process plant infrastructure, TSF and associated bund (Figure 3). These components will disturb a total area of approximately 11.69 ha. Of this, 7.81 ha will be for Project infrastructure, with an additional 3.88 ha of predicted disturbance incorporating the areas around and between the open pits, including a 10-m buffer around the infrastructure (Figure 2).

A 5 m wide corridor approximately 8.5 km in length will accommodate a water pipeline from two bores in the north of the ML to the processing facilities and an accompanying single vehicle access track for pipeline maintenance. The pipeline will be temporarily laid on the surface along a route from the north to the south of the ML as shown in Figure 2, buried at a depth of 0.5 m under three creek crossings and disturbing approximately 4.3 ha of vegetation in total. An access track will be formed along-side the water pipeline for maintenance purposes. Existing access haul road tracks at the site will be upgraded and utilised to minimise additional disturbance.

The total disturbance footprint for Project and pipeline infrastructure is 15.99 ha.

During construction and operations, all Start-up Operation activities and features can create physical barriers that impede or completely obstruct movement for a range of species. Complete barriers to movement can isolate patches of fauna habitat and can also isolate a subset of a population. This is particularly the case for less mobile and fossorial species.

5.1.2 Traffic

Increased traffic levels in the ML can increase the risk of valued component mortality through direct collisions with vehicles. Additionally, increased traffic into the area could: spread or introduce pests and weeds; and cause increased dust levels in areas adjacent to roads.

5.1.3 Vegetation Clearing and Site Preparation

Vegetation clearing and site preparation has potential direct and indirect impacts to MNES and MSES, including:

- Reduction in extent of Category B ESAs within the ML.
- Reduction in extent of State-mapped essential habitat within the ML.
- Reduction in extent of habitat for threatened fauna species.
- Reduction in habitat quality associated with impacts from dust, erosion, changes to habitat suitability and quality, etc.

- Direct mortality of threatened fauna and flora.
- Fragmentation of habitats, and reduction of connectivity in remnant vegetation patches.
- Creation of edge effects, which open up habitat in areas where it was previously continuous, leading to changes in the abiotic conditions and species composition. Depending on the species, edges can have either a positive or negative effect on habitat quality and quantity.
- Creating exposed soils which can create favourable habitats for weed species. Vegetation clearing and the use of earth-moving equipment can spread exotic and/or invasive plant species if equipment is not properly cleaned prior to procurement and mobilisation to the site. It is noted that the condition of vegetation within the local study area is already substantially impacted by cattle grazing and introduced weeds.

Table 3 outlines area of clearance associated with the Start-up Operation footprint, the RE and the percentage of RE that will be impacted within the ML.

Table 3: Area of disturbance associated with Project footprint

Regional Ecosystem	Total Area within Mining Lease (ha)	Area to be disturbed (ha)	Area to be disturbed as a % of existing RE
RE 4.9.12x4a/4.9.10b	663.5*	15.99	2.4%

*Total area of mixed RE 4.9.12x4a /4.9.10b. Does not include individual RE 4.9.12x4a or 4.9.10b areas (combined total of 867.5 ha).

5.1.4 Dust and Air Emissions

Air emissions and dust created from construction and operation activities can affect habitat quantity and quality. Air emissions and dust sources include site clearing, preparation, and vehicle traffic. Dust deposition on vegetation, or in water, can reduce the quality of habitat, plant photosynthetic capacity, and food source availability and, in some cases, may degrade it to a point where it is no longer used (Gleeson and Gleeson 2012).

A detailed noise and air quality assessment (Golder, 2018a) identified that, although products of combustion will contribute to the Start-up Operation air emissions, the dominant emission during the Start-up Operation will be airborne dust from the movement of vehicles on unpaved roads, windblown dust from exposed areas and emissions from the uplift and deposit of material through bulldozer action, loaders and stockpile creation. As products of combustion emissions are considered minor, and the Start-up Operation is proposed to be operating for a relatively short time, products of combustion were not considered any further in this assessment.

At baseline, average dust concentrations were between 20 to 30 mg/m²/day, while the inferred 75th percentile concentration of PM₁₀ for the area was 19.5 µg/m³ (Golder, 2018a).

5.1.5 Sensory Disturbance

Sensory disturbances such as noise, vibration, light, and odour, have the potential to affect various species. Sensory disturbances can result in reduced use, or complete avoidance, of affected areas by some species, or, in the case of artificial lighting at night, may attract and increase use of an area by some species. The reduced use or complete avoidance of affected areas can create movement barriers, or adverse effects to reproductive success, or increase stress, leading to increased predator-prey interactions (for example, see Gleeson and Gleeson 2012).

Inferred baseline noise measurements for the ML are typical of rural areas with low background levels. Background (LA90) values of the day-time, evening, and night-time periods typically falling within a 20-dB

range (Golder 2018). Day-time background noise levels ranged from ~21 dB to 34 dB, evening noise levels ranged from 27 to 49 dB, while night-time background noise levels ranged from ~18 dB to ~38 dB (Golder, 2018). Noise sources were expected and normal for such a rural setting, and would be typically generated by wildlife and livestock. The highest levels of noise predicted to occur during construction, operation and decommissioning will occur within, and immediately adjacent to, the actual footprint of the Start-up Operation. Predicted ambient noise levels during construction, operation, and decommissioning at the boundary of the footprint will be in the range from 81 to 118 dB (L_{Aeq}) (Golder, 2018).

No specific vibration baseline data were available for the ML. Nevertheless, based on experience from similar projects, ground-based vibration levels during construction, operation, and decommissioning are predicted to be negligible. Ground vibration from heavy machinery and mining operations is not predicted to travel more than 100 m from the source (Chen *et al.* 2013).

Light disturbances will result from most Start-up Operations infrastructure because facilities and other infrastructure must be lit at night to ensure minimum health and safety standards. Interactions between nocturnal species, such as terrestrial invertebrates, birds and bats, and light disturbances are predicted to be most important at the perimeter of the footprint, where light placement may be adjacent to habitat. Lighting can decrease habitat use by species, particularly nocturnal species adapted to night-time conditions, or lead to increased mortality of individuals that may be attracted to lights. Artificial night-time light has also been attributed to species disorientation, feeding and foraging changes, and implications for reproductive success and photosynthesis (Gaston *et al.*, 2013). For various reviews and examples, see Jetz *et al.* (2003), Bruce-White and Shardlow (2011), and Gleeson and Gleeson (2012).

Odours (for example, food) can attract certain animals, or they can elicit avoidance behaviours because the odours are associated with human presence. Odours will originate from human presence, petrochemicals and other chemicals, food, and garbage and waste management. Odours are predicted to have low consequences during construction, operation, and decommissioning.

5.1.6 Surface Water Quality

Altering vegetation and surface topography has the potential to impact surface water quality including:

- Soil loss and erosion resulting in increased sediment generation, particularly following rainfall.
- Surface water yield.
- Peak surface water flow values.

These have the potential to directly affect the Category B ESAs, which are located along watercourse and drainage features in the ML.

A detailed surface water impact assessment (Golder, 2018b) concluded that the Start-up Operation will increase surface water yield and sediment generation, but have negligible impact on peak flows within the ML. The Start-up Operation has the potential to increase the presence of contaminants (associated with spills, leaks etc.) and therefore contaminant run-off, which could affect aquatic habitats.

Changes to water quality and reduction in surface water flows can result in changes in habitat quantity and quality, particularly for aquatic and semi-aquatic species (for example, frogs). Changes in surface water flows can cause changes to soil, vegetation, riparian ecosystems, and wetlands, thereby affecting habitat quantity and quality. However, any such changes in habitat quantity and quality are expected to be negligible given the very seasonal nature of the water flows in the ML, and the short duration of the Start-up Operation. Furthermore, the footprint of the Start-up Operation makes up less than 0.1% of the RSA; therefore, the impacts are minimal and manageable with appropriate erosion and sediment control measures.

5.1.7 Invasive and Pest Species

Invasive and pest species can quickly establish in disturbed areas and compete with native species. Two invasive pest plant species and two pest fauna species were observed within the ML (NRC, 2018b).

Vegetation clearing has the potential to introduce or spread species through mobilisation of equipment, which has not been properly cleaned, and by creating soil disturbance. The presence of waste may attract pest fauna species.

Pests and invasive species have the potential to impact MNES and MSES.

It is noted that the condition of vegetation within the ML is already impacted by cattle grazing and introduced weeds (NRC, 2017).

5.1.8 Major Hazards

Hazards, such as oil and chemical spills and accidents, have the potential to reduce habitat quality and quantity. However, oil and chemical handling, storage, and spill response are expected to be part of standard policies and Environmental Management Plans.

5.2 Mitigation Measures

The following section describes the mitigation measures that Ardmore will use in the design, construction, operation, and decommissioning of the Start-up Operation.

As such, in applying mitigation to the impact assessment process, it was assumed that the proposed design, construction, operation, and decommissioning of the Start-up Operation followed best practice, which included the mitigation hierarchy; that is: avoidance; minimisation; rehabilitation; and an assessment of the need for offsetting (after DEHP, 2014; CSBI, 2015). Therefore, the effects assessed here have taken into consideration those in-built mitigation measures. As such, they are all residual in the sense that they are effects that remain after the application of the mitigation hierarchy.

5.2.1 Avoidance

Avoidance measures are taken to avoid creating impacts from the commencement of a project. Avoidance measures taken as part of the Start-up Operation include:

- Locate the Start-up Operation's infrastructure away from the south-west area of the ML where Purple-necked Rock-wallaby were observed utilising rock outcrop habitats, including the associated spinifex grasslands (200 m radius). No development is planned to take place within the area where Purple-necked Rock-wallaby were observed or the associated spinifex grasslands.
- The temporary water pipeline will be laid on top of ground and placed to avoid vegetation where practicable. For the three creek crossings, it will be buried at a depth of 0.5 m, avoiding vegetation clearing, where possible.

5.2.2 Minimisation

Minimisation measures are measures taken to reduce the duration, intensity and/or extent of effects to valued components that cannot be completely avoided, as far as is practically feasible. Minimisation measures planned for the Start-up Operation include:

- Footprint and infrastructure
 - Minimising the disturbance footprint, including locating infrastructure in already disturbed and affected habitats.

- Access and road network has been planned to minimise total length and reduce the width of roads where practicable. Existing tracks will be utilised and upgraded rather than construction of new roads. Roads to be limited to 6 m wide.
- Clearly marking the boundary of areas proposed for clearing to minimise the potential for over-clearing or unnecessary habitat disturbance.
- Conduct progressive site clearing in a pattern to avoid creating habitat 'islands' within the footprint, and to allow any fauna present in the area to move to areas away from construction activities.
- Conduct site clearing so that progression of clearing moves animals towards intact habitat.
- To minimise potential interaction with nocturnal species, vegetation clearing activities will be restricted to daylight hours.
- Physical hazards
 - Restrict vehicle speeds (40 km/h on site).
 - Minimise the number of vehicles using roads where practicable (use of buses).
 - Gaps will be left between stockpiles to reduce potential physical barriers and allow fauna passage.
 - Placement of soil stockpiles and bunds to avoid drainage features.
- Soil management
 - Construction activities, including vegetation clearing and soil movement, will work from areas with fewer weed species/smaller infestations towards areas where there is a greater abundance of weeds, where practicable.
 - Inspection of vehicles and equipment brought onto site to ensure they are free of dirt and other material that may contain weed seeds.
 - Regular monitoring of disturbance sites and stockpiles for establishment of weed species. New weed species will be assessed, and appropriate control measures implemented.
- People management
 - Clearly marking the boundary of ESAs, buffer zones and essential habitat to prohibit entry and prevent unnecessary disturbance.
 - Mandatory environmental training for all workers and contractors that highlights conservation issues and species-specific sensitivities.
- Dust, light and noise
 - Water spraying on crushing plant, stockpiles, and mobile plant on-site, when appropriate, to reduce fugitive dust emissions.
 - Stripping of topsoil limited to the immediate area to be extracted.
 - Stockpiles limited to 5 m in height to reduce wind-blown dust.
 - Overburden stockpiled separately for future use.
 - Covered truck loads, and stockpiles where appropriate.
 - Assessing weather forecasts and planning disturbance activities to avoid high wind conditions, where practicable.

- Selection of equipment with lower sound power levels.
- Mobile equipment is turned off when not in use.
- Equipment maintenance in accordance with manufacturer's specifications.
- Manage light sources including using the minimum number and brightness of lights required for safety, not using bare light bulbs or any lighting pointing upward or outwards, particularly at the periphery of the Start-up Operation footprint.
- Other
 - Management measures will be put in place to minimise waste and to reduce potential attraction of fauna and pest species. Observations of pest fauna will be documented and reported to the Cloncurry Shire Council, and discussions had to determine effective future management.

5.2.3 Reclamation and Rehabilitation

Reclamation and rehabilitation measures are taken to reclaim and rehabilitate disturbed areas following exposure to impacts after decommissioning, or when an area is no longer required. Reclamation measures include:

- All disturbed areas will be returned to their original levels and stockpiled top soil spread after completion of the Start-up Operation.
- Reclamation of all disturbed areas with native species to approximate pre-existing vegetation.

5.2.4 Offsetting

Environmental offsets work by securing land elsewhere to replace those significant environmental matters which were lost, therefore, counterbalancing the impact of undertaking a prescribed activity.

No significant impacts are expected because of the Start-up Operation. Offsets are not considered to be a mitigation measure required to manage any potential impacts within the scope of the Start-up Operation.

5.3 Description of Potential Construction, Operation, and Decommissioning Phase Impacts

This section provides an assessment of the potential effects the proposed Start-up Operation could have on the valued components within the LSA and RSA, and then assigns an impact severity to those effects. The results of the impact assessment are summarised in Table 4 below and in more detail Table B1 in Appendix B.

Table 4: Summary of impact assessment considering valued components post mitigation measures

Valued component		Significance	Sensitivity	Impact Severity
Threatened Fauna	Night Parrot (MNES)	Negligible (2)	High	Minor
	Red Goshawk (MNES)	Negligible (2)	High	Minor
	Painted Honeyeater (MNES)	Negligible (2)	Medium	Minor
	Carpentarian Antechinus (MNES)	Negligible (2)	Medium	Minor
	Plains Death Adder (MNES)	Negligible (2)	Medium	Minor

Valued component		Significance	Sensitivity	Impact Severity
	Grey Falcon (MSES)	Negligible (2)	Medium	Minor
	Northern Leaf-nosed Bat (MSES)	Negligible (2)	Medium	Minor
	Purple-necked Rock-wallaby (MSES)	Negligible (10)	Medium	Minor
	Short-beaked Echidna habitat (MSES)	Negligible (8)	Medium	Minor
Migratory Species (MNES)		Negligible (2)	Medium	Minor
ESA (MSES)		Negligible (6)	High	Minor
Remnant Vegetation Associated with a Watercourse (MSES)		Negligible (6)	Medium	Minor
State-mapped Essential Habitat (MSES)		Negligible (6)	Medium	Minor
Conservation Significant Flora	<i>Ptilopus maconochiei</i> (MSES)	Negligible (4)	Medium	Minor

Due to the short timeframe for Start-up Operation activities, that is, four – six weeks plant infrastructure and commissioning, two – three weeks for pit construction, six – eight weeks for mining and a seven – eight week processing period, potential impacts associated with construction, operation and decommissioning have been considered together.

5.3.1 What effect could the proposed development have on threatened fauna?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on threatened fauna in the LSA.

5.3.1.1 Night Parrot

Generally, the impact of the proposed Start-up Operation on Night Parrot in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **high** because it is endangered MNES, resulting in **minor impact severity**. The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** it is unknown whether impacts are likely to affect individuals, although they will most likely be negligible. The Night Parrot is a highly cryptic species, and its current distribution is not known with only two areas (western Queensland and the Pilbara in Western Australia) identified where reliable records indicate that populations may persist. However, it may remain throughout its historical range from remote arid and semi-arid inland regions of Western Australia, Northern Territory, South Australia and Queensland (NRC, 2017).

Areas of RE 1.11.11 contain potentially suitable roosting, breeding and feeding habitat for the species; other REs like 1.11.10a, 1.5.6c and 1.12.3b also represent potential feeding habitat (NRC, 2017). No evidence of Night Parrots was detected within the ML despite targeted surveys for this species being undertaken in accordance with published literature (NRC, 2017).

The proposed area of disturbance for the Start-up Operation may provide very degraded feeding habitat because of the sustained grazing pressure, and does not contain potential roosting and breeding Spinifex habitats (NRC, 2017). Higher quality habitats may occur on the eastern boundary of the ML associated with hills and rock outcrops.

- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. No evidence of Night Parrots was detected within the ML, despite targeted surveys for this species being undertaken in accordance with published literature (NRC, 2017).

The proposed area of disturbance for the Start-up Operation may provide very degraded potential feeding habitat, but does not contain potential roosting and breeding habitats (NRC, 2017). Current mitigation measures include limiting clearing activities to daylight hours.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Night Parrot is a recognised endangered species. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of a population of Night Parrots; reduce the area of occupancy of Night Parrots; fragment an existing population of Night Parrots into two or more populations; adversely affect habitat critical to the survival of Night Parrots; disrupt the breeding cycle of a Night Parrot population; modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; result in invasive species that are harmful to Night Parrots becoming established in the species' habitat; introduce disease that may cause the species to decline; interfere with the recovery of the species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Night Parrot.

5.3.1.2 Red Goshawk

Generally, the impact of the proposed Start-up Operation on Red Goshawk in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **high** because it is a recognised MNES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals, with no planned disturbance to habitat. No evidence of the Red Goshawk was detected within the ML, with the nearest record over 50 km east of the ML; however, this species is sparsely distributed so it is possible that individuals may fly over the ML, or use the area as part of a much larger home range (NRC, 2017).

No habitat features unique to the ML, on which this species would rely, and the vegetation communities within the ML are characteristic of the broader landscape.

- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.

- **Improbable impacts:** impacts are not expected to occur. There are no records of the Red Goshawk in the local area, and no evidence of the Red Goshawk was detected during the field-based assessments. This species has large home ranges and the ability to readily disperse/escape potential impacts.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Red Goshawk is a recognised MNES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of an important population of Red Goshawk; reduce the area of occupancy of an important population of Red Goshawk; fragment an existing important population of Red Goshawk into two or more populations; adversely affect habitat critical to the survival of Red Goshawk; disrupt the breeding cycle of an important Red Goshawk population; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Red Goshawk is likely to decline; result in invasive species that are harmful to Red Goshawk becoming established in the species' habitat; introduce disease that may cause the species to decline; interfere substantially with the recovery of the species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Red Goshawk.

5.3.1.3 *Painted Honeyeater*

Generally, the impact of the proposed Start-up Operation on Painted Honeyeater in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MNES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts unlikely to affect individuals. The ML is outside of the known breeding range for the species; however, it supports potentially suitable foraging habitat for the post-breeding season migration period, including the River Red Gum habitat associated with Split Creek (NRC, 2017).

While it is possible this species may occur within the ML or broader locality sporadically during the post-breeding seasonal migration period, the habitats within the ML are broadly represented throughout the region, and form part of a very large area of potential non-breeding habitat for this species (NRC, 2017).
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. This species is considered uncommon and was not observed during field-based assessments. This species is highly nomadic and can readily disperse/escape potential impacts.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Painted Honeyeater is a recognised MNES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of an important population of Painted Honeyeater; reduce the area of occupancy of an important population of Painted Honeyeater; fragment an existing important population of Painted Honeyeater into two or more populations; adversely affect habitat critical to the survival of Painted Honeyeater; disrupt the breeding cycle of an important Painted Honeyeater population; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Painted Honeyeater is likely to decline; result in invasive species that are harmful to Painted Honeyeater becoming

established in the species' habitat; introduce disease that may cause the species to decline; interfere substantially with the recovery of the species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Painted Honeyeater.

5.3.1.4 *Carpentarian Antechinus*

Generally, the impact of the proposed Start-up Operation on Carpentarian Antechinus in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MNES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals, with no planned disturbance to potential habitat. No records of Carpentarian Antechinus are documented within 100 km of the ML, and no individuals were identified during the field-based assessments within the ML (NRC, 2017).

NRC (2017) noted that the ML is dominated by REs which do not represent suitable habitat for the Carpentarian Antechinus.
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. No records of the Carpentarian Antechinus were documented in the ML, and no evidence of the Carpentarian Antechinus was detected during the field-based assessments with the ML, which is dominated by REs that do not represent suitable habitat for this species.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Carpentarian Antechinus is a recognised MNES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of an important population of Carpentarian Antechinus; reduce the area of occupancy of an important population of Carpentarian Antechinus; fragment an existing important population of Carpentarian Antechinus into two or more populations; adversely affect habitat critical to the survival of Carpentarian Antechinus; disrupt the breeding cycle of an important Carpentarian Antechinus population; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Carpentarian Antechinus is likely to decline; result in invasive species that are harmful to Carpentarian Antechinus becoming established in the species' habitat; introduce disease that may cause the species to decline; interfere substantially with the recovery of the species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Carpentarian Antechinus.

5.3.1.5 *Plains Death Adder*

Generally, the impact of the proposed Start-up Operation on Plains Death Adder in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MNES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals, with no planned disturbance to habitat. The ML does not support significant areas of the Plains Death Adder's preferred habitat (flat, treeless, cracking-soil riverine floodplains) (NRC, 2017).
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phases of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Improbable impacts:** impacts are not expected to occur. There are no records of the species in the local area, and the ML does not support significant areas of the Plains Death Adder's preferred habitat (flat, treeless, cracking-soil riverine floodplains).

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Plains Death Adder is a recognised MNES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of an important population of Plains Death Adder; reduce the area of occupancy of an important population of Plains Death Adder; fragment an existing important population of Plains Death Adder into two or more populations; adversely affect habitat critical to the survival of Plains Death Adder; disrupt the breeding cycle of an important Plains Death Adder population; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Plains Death Adder is likely to decline; result in invasive species that are harmful to Plains Death Adder becoming established in the species' habitat; introduce disease that may cause the species to decline; interfere substantially with the recovery of the species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Plains Death Adder.

5.3.1.6 Grey Falcon

Generally, the impact of the proposed Start-up Operation on Grey Falcon in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals, with no planned disturbance to habitat. There are seven records of this species within 100 km.

This species is considered uncommon, and was not observed during field-based assessments, but the ML is within its known distribution (NRC, 2017). While it is possible this species may occur within the ML or broader locality, the field-based assessments identified no habitat features unique to the ML on which this species would be relying, and the vegetation communities within ML are characteristic of the broader landscape.
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Improbable impacts:** impacts are not expected to occur. This species is considered uncommon and was not observed during field-based assessments. This species has relatively large home ranges and the ability to readily disperse/escape potential impacts.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Grey Falcon is a recognised MSES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of the local population of Grey Falcon; reduce the extent of occurrence of Grey Falcon; fragment an existing population; result in genetically distinct populations forming as a result of habitat isolation; result in invasive species that are harmful to Grey Falcons becoming established in the species's habitat; introduce disease that may cause the population to decline; interfere with the recovery of the species; cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of the Grey Falcons in the wider area.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Grey Falcon.

5.3.1.7 Northern Leaf-nosed Bat

Generally, the impact of the proposed Start-up Operation on Northern Leaf-nosed Bat in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals. This species has been recorded in the Northern Territory and the Kimberly region in Western Australia, with the only records in Queensland in the Mt Isa region. It has been recorded across a wide range of habitats, and the ML may support potential foraging and roosting habitat; however, this species was not detected as part of the acoustic detection surveys during field-based assessments (NRC, 2017).
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phases of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. The species is found across a wide range of habitats and the vegetation communities and habitats found within the ML are represented across the greater region. There are no records of the species in the local area, and no evidence was detected as part of the acoustic detection surveys.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Northern Leaf-nosed Bat is a recognised MSES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of the local population of Northern Leaf-nosed Bat; reduce the extent of occurrence of Northern Leaf-nosed Bat; fragment an existing population; result in genetically distinct populations forming as a result of habitat isolation; result in invasive species that are harmful to Northern Leaf-nosed Bat becoming established in the species's habitat; introduce disease that may cause the population to decline; interfere with the recovery of the species; cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of the Northern Leaf-nosed Bat in the wider area.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Northern Leaf-nosed Bat.

5.3.1.8 *Purple-necked Rock-wallaby*

Generally, the impact of the proposed Start-up Operation on Purple-necked Rock-wallaby in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Minor impact magnitude:** impacts could affect individuals; that is, individuals may become disturbed, but not injured, with no planned disturbance to habitat proposed for the Start-up Operation. There is no planned clearing of habitat in which Purple-necked Rock-wallaby were observed, or in habitat reported in literature as shelter, breeding or foraging habitat. However, indirect impacts associated with dust, light and noise may have a minor impact on habitat quality.
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.
- **Extent limited to the local scale:** while no direct impacts are anticipated, indirect impacts have the potential to affect the local scale.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. Start-up Operation infrastructure and ground-disturbing works are not located within areas where Purple-necked Rock-wallaby were observed, or in habitat reported in literature as shelter, breeding or foraging habitat. However, indirect impacts from dust noise and light could occur; however, individuals are expected to become habituated to those disturbances, which are distant (~1.5 km) from preferred habitat within the ML.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Purple-necked Rock-wallaby is a recognised MSES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not: lead to a long-term decrease in the size of the local population of Purple-necked Rock-wallabies; reduce the extent of occurrence of Purple-necked Rock-wallabies; fragment an existing population; result in genetically distinct populations forming as a result of habitat isolation; result in invasive species that are harmful to Purple-necked Rock-wallabies becoming established in the species's habitat; introduce disease that may cause the population to decline; interfere with the recovery of the species; cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of the local Purple-necked Rock-wallabies in the ML.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on Purple-necked Rock-wallabies.

5.3.1.9 *Short-beaked Echidna Habitat*

Generally, the impact of the proposed Start-up Operation on Short-beaked Echidna in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because its habitat is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Minor impact magnitude:** impacts could affect individuals; that is, individuals may become disturbed, but not injured. Primarily these impacts may arise from sensory disturbance from light and noise, and will be very transient in nature.

Habitat proposed to be disturbed represents a small area of habitat within a vast expanse of similar habitat potentially suitable for the Short-beaked Echidna (NRC, 2017). The species is found across a

wide area and type of habitats, with field-based assessments identifying no habitat features unique to the ML on which this species would be relying, and the ML does not represent a link between other important habitat areas.

- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. While it is noted that the Short-beaked Echidna may use the habitat area to be impacted by Start-up Operation infrastructure and ground-disturbing works, proposed mitigation measures including staged clearing reduce the probability of impacts occurring.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the Short-beaked Echidna is a recognised MSES. Nevertheless, the construction, operation, and decommissioning of the Start-up Operation will not result in: a long-term decrease in the size of the local population of Short-beaked Echidna; reduce the extent of occurrence of the species; fragment the existing population in the area; result in genetically distinct population forming because of habitat isolation; disruption to ecologically significant locations (breeding, feeding or nesting sites) of Short-beaked Echidna in the ML.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the Short-beaked Echidna.

5.3.2 What effect could the proposed development have on migratory species?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on migratory species in the LSA.

Generally, the impact of the proposed Start-up Operation on migratory species in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MNES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals, with no planned disturbance to known breeding or congregatory habitat for any of the known or expected migratory species in the area. None of the six migratory-species identified as potentially occurring within the ML were recorded during field assessments. The ML does not support any critical habitat for any of these species. All habitats within the ML are common throughout the region, and are broadly represented at the local and landscape scale.
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phases of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate area of clearing associated with the proposed Start-up Operation.
- **Low probability of impacts:** impacts are expected to occur infrequently, that is, once or a limited number of times. The ML does not support critical habitat for any of the migratory species that could occur in the area.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the migratory species are recognised

MNES. The Start-up Operation will not: substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species; result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the migratory species.

5.3.3 What effect could the proposed development have on ESAs?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on ESAs in the LSA. Impacts to RE 2.3.18 are not considered because no distinct vegetation unit consistent with this RE was recorded during the field surveys (NRC, 2017).

Generally, the impact of the proposed Start-up Operation on ESAs in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **high** because it is a recognised MSES, resulting in and overall **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts unlikely to affect the extent and condition of the ESAs in the ML. No direct disturbance of Category B ESAs is planned within the Start-up Operation; however, potential indirect impacts associated with dust may occur. Nonetheless, these are expected to be negligible.

The water pipeline and maintenance access track will run through Category B ESAs from the north area of the ML to the location of Start-up Operation infrastructure in the south (Figure 2), however no vegetation is to be disturbed or cleared within the Category B ESA's with the pipeline and track to be placed in areas which do not currently contain vegetation.

Baseline surveys noted that the current condition of the Category B ESAs and remnant vegetation was compromised because of cattle grazing and invasion of exotic plant species.

- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.
- **Extent limited to the site scale:** while no direct impacts are anticipated, indirect impacts have the potential to affect the site scale.
- **Medium probability of impacts:** Impacts from dust are expected to have a medium probability of occurring from the mining and trucking activities. The ML is located within a naturally dry area, with background dust levels well below the project criterion of 120 mg/m²/day.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the ESAs within the ML have an endangered biodiversity status. Importantly, the baseline surveys identified that these ESAs within the ML are degraded due to current and historical cattle grazing, feral animal impacts, and weed species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the ESAs.

5.3.4 What effect could the proposed development have on remnant vegetation associated with a watercourse or drainage feature?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on remnant vegetation associated with a watercourse or drainage feature in the LSA.

Generally, the impact of the proposed Start-up Operation on remnant vegetation associated with a watercourse or drainage feature in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in an overall **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts unlikely to affect the extent and condition of the remnant vegetation associated with a watercourse or drainage feature. No direct disturbance of remnant vegetation associated with a watercourse or drainage feature is planned within the Start-up Operation; however, potential indirect impacts associated with dust may occur. Nonetheless, these are expected to be negligible.

The water pipeline and maintenance access track will run through and across two areas of remnant vegetation associated with a watercourse or drainage feature from the north area of the ML to the location of Start-up Operation infrastructure in the south (Figure 2), however no vegetation is to be disturbed or cleared, with the pipeline and track to be placed in areas which do not currently contain vegetation.

Baseline surveys noted that the current condition of the Category B ESAs and remnant vegetation was compromised because of cattle grazing and invasion of exotic plant species.

Transient duration: the impacts are expected to be transient, lasting throughout the construction and operation phase of four – six months.

- **Extent limited to the site scale:** while no direct impacts are anticipated, indirect impacts have the potential to affect the site scale.
- **Medium probability of impacts:** Impacts from dust are expected to have a medium probability of occurring from the mining and trucking activities. The ML is located within a naturally dry area, with background dust levels well below the project criterion of 120 mg/m²/day.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that the remnant vegetation associated with a watercourse or drainage feature within the ML are recognised MSES. Importantly, the baseline surveys identified that these vegetation communities are degraded due to current and historical cattle grazing, feral animal impacts, and weed species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on the remnant vegetation communities.

5.3.5 What effect could the proposed development have on State-mapped essential habitat?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on State-mapped essential habitat for the Purple-necked Rock-wallaby in the LSA.

Generally, the impact of the proposed Start-up Operation on State-mapped essential habitat in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts unlikely to affect the extent and condition of the essential habitat. No direct disturbance of State-mapped essential habitat is planned within the Start-up Operation; however, potential indirect impacts associated with dust may occur. Nonetheless, these are expected to be negligible
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phase of four – six months.
- **Extent limited to the local scale:** indirect impacts have the potential to affect the local scale.
- **Low probability of impacts:** No direct impacts are expected to occur, with will occur with no direct disturbance of State-mapped essential habitat planned within the Start-up Operation. Indirect impacts from dust could have a low probability of occurring. The ML is located within a naturally dry area, with background dust levels well below the planned project criterion of 120 mg/m²/day.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. In particular, the Start-up Operation will not: lead to a long-term decrease in the size of the local population of Purple-necked Rock-wallabies; reduce the extent of occurrence of Purple-necked Rock-wallabies; fragment an existing population; result in genetically distinct populations forming as a result of habitat isolation; result in invasive species that are harmful to Purple-necked Rock-wallabies becoming established in the species' habitat; introduce disease that may cause the population to decline; interfere with the recovery of the species; cause disruption to ecologically significant locations (breeding, feeding, nesting, migration or resting sites) of the local Purple-necked Rock-wallabies in the ML.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on essential habitat.

5.3.6 What effect could the proposed development have on the near threatened *Ptilotus maconochiei*?

This section presents the assessment of effects that the construction, operation, and decommissioning of the proposed Start-up Operation could have on the near threatened *Ptilotus maconochiei* in the LSA.

Generally, the impact of the proposed Start-up Operation on *Ptilotus maconochiei* in the LSA, post mitigation measures outlined in Section 5.2, will be of **negligible significance**, although the sensitivity of the receptor is **medium** because it is a recognised MSES, resulting in **minor impact severity**.

The primary reasons for this level of assessment are:

- **Negligible impact magnitude:** impacts are unlikely to affect individuals. The nearest record for *Ptilotus maconochiei* is approximately 100 km from the ML. It is typically found in rocky habitats throughout western Queensland (NRC, 2017). Targeted surveys for this species focused on suitable rocky habitat along the eastern margin of the ML but did not detect this species. The Start-up Operation will not disturb any areas of rocky habitats typical of this species. Regardless, pre-clearance surveys of the site footprint will be completed.
- **Transient duration:** the impacts are expected to be transient, lasting throughout the construction and operational phases of four – six months.
- **Extent limited to the site scale:** the impacts are restricted to the immediate disturbance footprint of the proposed Start-up Operation.

- **Low probability of impacts:** impacts are expected to be of a low probability. The nearest record for *Ptilotus maconochiei* is approximately 100 km from the ML, and targeted searches of suitable rocky habitat did not detect this species within the ML. That suitable habitat is located along the eastern margin of the ML and is not proposed to be disturbed as part of the Start-up Operation.

With a minor impact level, typically, the proposed mitigation is adequate and achievable, although monitoring may be necessary. However, this is a precautionary approach given that *Ptilotus maconochiei* is a recognised near threatened species.

The construction, operation, and decommissioning activities will, in effect, have a low to negligible effect on *Ptilotus maconochiei*.

5.3.7 Prediction Confidence

Given the information and data available on the MNES and MSES, and the precedents identified in peer-reviewed, published literature relating to potential effects of small-scale mining operations in semi-arid regions on species and habitats, there is a reasonable understanding of the potential effects to the MNES and MSES in the LSA.

5.4 Risk of Unplanned Events

The potential risk associated with unplanned events within the scope of the Start-up Operation is considered low. This is a combination of factors relating to the likelihood of an event occurring and the consequence to the receiving MNES and MSES, if an event was to occur.

There is the low likelihood of an unplanned event occurring during the Start-up Operation activates due to:

- The short timeframe (four – six month period) for Start-up Operations.
- The small spatial scale for Start-up Operation, with few potential sources of unplanned events (for example, there are few pieces of machinery proposed, which could act as sources of spills, leaks)
- The nature of the Start-up Operation means few and low volumes of hazardous materials are required.

There is a low consequence associated with an unplanned event due to:

- The small footprint of disturbance associated with proposed Start-up Operation.
- The distance to the nearest sensitive receptors (that is, ESAs, remnant vegetation associated with a watercourse or drainage feature, conservation significant fauna and flora).
- The degraded nature of the existing landscape in the area of proposed Start-up Operation activities, which has been impacted by cattle grazing and weed species invasion (refer Plate 1 and Plate 2).
- There are few existing pathways for transport of impacts to a greater area, or offsite, surrounding the proposed Start-up Operation (for example, there are no permanent waterways).

6.0 ADDITIONAL MITIGATION AND MANAGEMENT MEASURES

No additional mitigation measures outside those already planned to be implemented by Ardmore during the design, construction, operation, and decommissioning of the Start-up Operation are required. Management measures should be documented in site management plans and conveyed to all personnel involved in the Project.

Management measures should be reviewed and additional measures implemented if mitigation measures are considered to not be adequately managing potential ecological impacts associated with the Start-up Operation.

7.0 RESIDUAL IMPACTS

It is unlikely that a site disturbance caused by the development and operation of the Start-up Operation will cause any significant residual impacts to the MNES and MSES of the ML. The Start-up Operation disturbance footprint is minimal and the area is already degraded, with impacts expected to be negligible once the site is rehabilitated and revegetated.

8.0 CONCLUSIONS

The Ardmore Phosphate Rock Project Start-up Operation was considered in terms potential impacts to MNES and MSES observed to occur or considered to have a moderate or high probability of occurring within the local study area. These were identified to be valued components; specifically, these were:

- MNES
 - Threatened and conservation significant flora.
 - Migratory species.
- MSES
 - ESAs.
 - Remnant vegetation associated with a watercourse or drainage feature.
 - State-mapped essential habitat.
 - Threatened fauna and conservation significant fauna.
 - Threatened and conservation significant flora.

Baseline assessments considered that vegetation communities within the ML to be represented across the greater regional area. Significant disturbance from cattle grazing and the invasion of pest plant species was observed across the ML.

In general, potential impacts to valued components would be limited to the site scale, that is the immediate area of clearing associated with the proposed Start-up Operation, be transient, and have an improbable to low probability of occurring. Impact severity would be minor to all valued components identified.

All impacts can be managed through avoidance, minimisation or reclamation, without the need for offsets.

Overall, it is considered that the Ardmore Phosphate Rock Project Start-up Operation will not have a significant impact on MNES and MSES.

9.0 IMPORTANT INFORMATION

Your attention is drawn to the document - “Important Information Relating to this Report”, which is included as an Appendix C of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

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Signature Page

Golder Associates Pty Ltd



Brenton Laslett
Ecologist



Mervyn Mason
Principal Ecologist

BL/MCM/bl

A.B.N. 64 006 107 857

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APPENDIX A

Impact Assessment Method

Reasoned Narrative

The written analysis section for each key question first presents an outline of the methods used to estimate a change in condition for each valued component associated with that key question based around the chosen indicators. Changes in condition were defined, for example, as changes to the behaviour of individuals, or numbers of individuals, from the baseline condition. Methods to estimate change in condition included calculations, and qualitative analyses based on available information from reports, scientific literature, and expert consultation. Methods used in the analysis section were specific to valued components.

After outlining the methods, the analysis was structured using indicators. Indicators are quantifiable (that is, measurable) expressions of change to a valued component, which were used to answer the key questions. The indicators selected for a valued component (see Table 1, Section 3.4.1 of the main report) were those that helped to understand whether the fundamental properties of a valued component that should be conserved, such as self-sustaining and ecologically-effective populations, would be meaningfully affected by the development of the project. As noted in the assessment timeframe, indicators were evaluated and described for the combined construction, operation, and decommissioning case.

For each indicator, the effect attributes described below were used to guide the assessment and description of the intensity, or significance, of the impact. These included nature of change (direction), the magnitude of the change, the scale (geographic extent) of change, duration of change, and probability of occurrence. These criteria were considered together to appraise the overall significance of the effect of the proposed development on a valued component, and these effects were described using a reasoned narrative. Where possible, magnitude was quantified as a specific value, such as change in population size or number of individuals emerging.

The potential effect of the proposed development was described with respect to the known, or inferred, ability of each valued component to absorb or otherwise accommodate disturbance. The ability of a valued component to accommodate disturbance was evaluated using the concepts of ecological adaptability and ecological resilience. Adaptable valued components are those that can change their behaviour, physiology, or population characteristics (for example, birth rate) in response to a disturbance, such that the property of the valued component that should be conserved remains more or less unchanged. For example, certain animal and plant populations can accommodate loss of some individuals without a change in overall population status or trajectory (known as compensatory mortality), or can adjust their behaviour to accommodate disturbance (Cooley et al. 2009). Less adaptable valued components will be affected more than valued components with higher adaptability.

A concept closely related to ecological adaptability is ecological resilience. Ecosystems and populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe enough that the system or population changes. Adaptability influences the time it takes for this to happen, whereas resilience is the ability of a species or ecosystem to recover or bounce back from a disturbance (Mellin et al., 2014). Highly resilient valued components have the potential to recover quickly after rehabilitation, whereas valued components with low resilience will recover more slowly or may not recover at all.

At the species level, the concept of a self-sustaining, ecologically-effective population was used as a benchmark when describing level of effect. Self-sustaining populations are not populations at the brink of extirpation; they are healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Reed et al., 2003).

The level of effect to each valued component depended substantially on mitigations applied as part of the proposed project design, including the mitigation hierarchy. These mitigations were considered when

describing the effect for each development stage; that is, the combined construction, operation, and decommissioning case.

Impact Classification

A formal impact assessment rating was completed using the results described in the reasoned-narrative analysis above. The purpose of the impact classification was to provide a system for ranking the severity of impacts, based on the significance/intensity of the effect and the sensitivity of the receptor (described below), in a clear and repeatable way that permits comparison among valued components, and categorises the overall impact level for each valued component.

Severity of Impact

The first step in the impact severity classification was to determine the significance/intensity of the effect of the proposed development within the LSA and RSA on the valued components. These steps were deliberately kept transparent so that the impact assessment process can be readily understood by stakeholders.

The potential change (or impact) upon the valued components because of the proposed development was assessed by considering the following, relative to each attribute of the existing environment that has been appraised as part of the description of the baseline case:

- **Nature of Change** - The nature of the change (or impact) that is being considered may be positive, neutral or negative. For example, a gain in available habitat area for a key species would be classed as positive, whereas a habitat loss would be considered negative.
- **Magnitude of Change** – The magnitude of change (or impact) is a measure of the degree of change that will be incurred because of the proposed development, and may be classified as:
 - None/negligible
 - Minor
 - Low
 - Moderate
 - High
 - Very high/unknown.
- **Duration of Change** – The duration of change (or impact) refers to the length of time over which an environmental impact may occur. This may be categorised as:
 - Transient (less than 1 year)
 - Short-term (1 to 5 years)
 - Medium-term (5 to 15 years)
 - Long-term (greater than 15 years with impact ceasing after demolition of the development)
 - Permanent.
- **Scale (Geographic Extent) of Change** – The scale of change (or impact) refers to the area that may be affected by the proposed development, and may be classified as:
 - Site (i.e., the extent of change is restricted to areas within the boundaries of the proposed development footprint)
 - Local (i.e., affecting the greater Mining Lease area)
 - Regional (i.e., affecting greater areas that may support habitats of regional significance)
 - National
 - International.
- **Probability of Occurrence** - Probability of occurrence is a measure of the likelihood of the change (or impact) actually occurring. This may be categorised as:
 - No chance of occurrence (0% chance of change)

- Improbable (less than 5% chance)
- Low probability (5% to 40% chance)
- Medium probability (40 % to 60 % chance)
- Highly probable (most likely, 60% to 90% chance)
- Definite (impact will definitely occur).

Having assessed the attributes of change set out above, the “significance” of the change (or impact) was then appraised. This was done using a semi-quantitative scoring system based on the attributes in Table A1.

Table A1: Factors used to measure impact significance

Magnitude	Duration	Scale	Probability
10 Very high/ don't know	5 Permanent	5 International	5 Definite/don't know
8 High	4 Long-term (impact ceases after closure of activity)	4 National	4 Highly probable
6 Moderate	3 Medium-term (5 to 15 years)	3 Regional	3 Medium probability
4 Low	2 Short-term (1 to 5 years)	2 Local	2 Low probability
2 Minor	1 Transient	1 Site only	1 Improbable
1 None/Negligible			0 No chance of occurrence

The significance of the change (impact) was determined as:

$$\text{SP (Significance Points)} = (\text{Magnitude} + \text{Duration} + \text{Scale}) \times \text{Probability}$$

The relative significance of the change (or impact) was typically ranked in accordance to Table A2.

Table A2: Significance categories (High, moderate, low, negligible and positive)

Value	Significance	Implications for the Project
SP >75 (4)	Indicates high environmental and/or social significance	The degree of change (or impact) that the proposed development may have upon the valued component is unacceptably high. It is unlikely that an impact of this magnitude can be satisfactorily mitigated. If this impact cannot be avoided, the proposed development is unlikely to be permitted for development.
SP 30 – 75 (3)	Indicates moderate environmental and/or social significance	The degree of change (or impact) that the proposed development may have upon the valued component is high. The development may be compromised if this impact cannot be avoided or mitigated (i.e., to reduce the significance of the impact).
SP 10 – 30 (2)	Indicates low environmental and/or social significance	The degree of change (or impact) that the proposed development may have upon the valued component is relatively low. Opportunities to avoid or mitigate the impact should be considered, however, this should not compromise the viability of the development.
SP <10	Indicates negligible environmental and/or social significance	The degree of change (or impact) that the proposed development may have upon the valued component is negligible.

Value	Significance	Implications for the Project
+	Positive impact	The changes will have a positive benefit upon the valued component.

Adopting this approach, where it is deemed that the significance points of the proposed development exceeding a value of 30, the design should be reviewed so as to mitigate the potential impact that the development will have upon the valued component. This will involve the modification of the design to avoid sensitive areas of the site, and/or to incorporate additional measures that will reduce the resulting significance of the change.

Sensitivity of Receptor

To derive an overall level of impact severity, which also reflected the expected conservation outcome for the valued component in a national and global context (*sensu* EPBC Act), the predicted effect significance/intensity was combined with a sensitivity value for the valued component.

For the intents of this impact assessment, sensitivity represents the valued component's irreplaceability and vulnerability. It was based on, amongst other aspects, the valued components resilience, as well as national and global conservation status. As such, sensitivity was based on scientific principles of biodiversity conservation and human values regarding valued components associated with ecosystem services.

Sensitivity for each valued component ranged from very low to high according to increasing level of threat (Table A3).

Table A3: Sensitivity assessment rating scale

Criterion	Rating scales
Negligible 1	<ul style="list-style-type: none"> None of the below.
Low 2	<ul style="list-style-type: none"> Where natural recovery of the impacted area to the baseline or pre-project condition is expected in the short-term (1-5 years), or where the potentially impacted area is already disturbed by non-project related activities occurring on a scale similar to or larger than the proposed activity. At baseline, ecosystem's or species's distribution significantly reduced from historical extent, but is currently stable.
Medium 3	<ul style="list-style-type: none"> Where natural recovery to the baseline condition is expected in the medium term (5-15 years), and where marginal disturbance or modification of the receiving environment by existing activities is present. State/national/IUCN status of Vulnerable, Near Threatened, or Data Deficient. At baseline, ecosystem's and/or species's distribution fragmented and/or under stress.
High 4	<ul style="list-style-type: none"> Where natural recovery of the receiving environment is expected in the long-term (>15 years) or cannot be readily predicted due to uncertainty over the nature of the potential impact, and where unique or highly valued ecological, social or cultural resources could be adversely affected. State/national/IUCN status of Critically Endangered or Endangered. Local temporal concentrations of individuals significant to global population At baseline, a much reduced and/or highly fragmented ecosystem and/or species distribution compared to historical extent.

Impact Severity

Sensitivity was combined with the RSA-level significance/intensity classification to obtain an overall impact severity using the matrix presented in Table A4. Overall impact severities were classified for the construction, operation, and decommissioning cases. Descriptors of the impact severity levels are presented in Table A5.

Table A4: Determination of impact severity

			Sensitivity of receptor			
			Negligible	Low	Medium	High
			1	2	3	4
Significance/Intensity of Impact	Positive/Negligible	1	1 Negligible	2 Minor	3 Minor	4 Minor
	Low	2	2 Minor	4 Minor	6 Moderate	8 Moderate
	Moderate	3	3 Minor	6 Moderate	9 Moderate	12 Major
	High	4	4 Minor	8 Moderate	12 Major	16 Major

Table A5: Overall impact level

Attribute	Definition
Negligible	<ul style="list-style-type: none"> No adverse impacts to valued components from the proposed development.
Minor	<ul style="list-style-type: none"> Impact level is acceptable to viability or integrity of valued components. Mitigation is adequate and achievable and monitoring may be necessary.
Moderate	<ul style="list-style-type: none"> Impact level requires follow up action, including the possibility of compensation. Monitoring necessary to evaluate continued viability or integrity of valued components and provide opportunities for adaptive management
Major	<ul style="list-style-type: none"> Impact level is unacceptable. Depending on valued component, impact level requires careful, specific, higher-level mitigation design (e.g., compensation). Resilience of valued components stressed to the extent that recovery may not be considered possible Exceedance of legal standards and widely-accepted conservation good practice. Implies proximity to, and uncertain risk of exceedance of, design thresholds.

Prediction Confidence

Although not explicitly included in the criteria tables, there is uncertainty associated with the information and methods used in an impact assessment because of its predictive nature. The certainty with which an impact analysis can be completed depends on many factors including:

- degree of understanding of project activities and other human activities, such as:
 - How well do we understand when, where, and how project activities will occur?
 - When, where, and how did, or will, other human activities occur?
 - How will these activities interact with the project's activities?
- quality of data about the environment (that is, how accurate is the data used in the analysis?)
- variability of the data (that is, how consistent is the data?)

- degree of errors in handling data (that is, what is the potential for generating errors?)
- capability of models to predict (that is, how accurately does the model predict effects?)
- degree of understanding of ecological processes (that is, how well do we understand what is happening to the valued component?)
- success of proposed mitigation (including any offsets) and optimisation (that is, how likely is the proposed mitigation to be effective?)

Prediction confidence influences the possibility of error in the effects prediction, and is addressed in the impact assessment by taking a precautionary approach. Each impact prediction provides a discussion of the prediction certainty (using a scale of low, moderate, high), and how to deal with any issues of uncertainty.

The level of prediction confidence for an impact analysis is discussed when there are questions about the factors reviewed above. Assumptions used when predicting confidence are clearly stated. Where the level of prediction confidence makes a prediction of the impact problematic, a subjective assessment is made based on the available information, the applicability of information on surrogates, and on professional opinion.

The level of prediction confidence may be sufficiently low in some cases that an estimate of impact levels cannot be made with a sufficient degree of confidence. Impact levels with low prediction confidence are accompanied by recommendations for research or monitoring to provide more data in the future.

APPENDIX B

Impact Assessment

Table B1: Impact assessment considering valued components post mitigation measures

Valued component		Nature of Change	Magnitude (/10)	Duration (/5)	Scale (/5)	Probability (/5)	Significance / (/100)	Sensitivity	Impact Severity
Threatened Fauna	Night Parrot (MNES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	High	Minor
	Red Goshawk (MNES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	High	Minor
	Painted Honeyeater (MNES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
	Carpenterian Antechinus (MNES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
	Plains Death Adder (MNES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
	Grey Falcon (MSES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
	Northern Leaf-nosed Bat (MSES)	Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
	Purple-necked Rock-wallaby (MSES)	Negative	Minor (2)	Transient (1)	Local (2)	Low (2)	Negligible (10)	Medium	Minor
	Echidna (MSES)	Negative	Minor (2)	Transient (1)	Site (1)	Low (2)	Negligible (8)	Medium	Minor
		Negative	Negligible (0)	Transient (1)	Site (1)	Improbable (1)	Negligible (2)	Medium	Minor
Migratory Species (MNES)		Negative	Negligible (0)	Transient (1)	Site (1)	Medium (3)	Negligible (6)	High	Minor
ESA (MSES)		Negative	Negligible (0)	Transient (1)	Site (1)	Medium (3)	Negligible (6)	Medium	Minor
Remnant Vegetation Associated with a Watercourse (MSES)		Negative	Negligible (0)	Transient (1)	Site (1)	Low (2)	Negligible (6)	Medium	Minor
State-mapped Essential Habitat (MSES)		Negative	Negligible (0)	Transient (1)	Local (2)	Low (2)	Negligible (6)	Medium	Minor
Conservation Significant Flora	<i>Ptilotus maconochiei</i> (MSES)	Negative	Negligible (0)	Transient (1)	Site (1)	Low (2)	Negligible (4)	Medium	Minor

APPENDIX C

**Important Information
Relating to this Report**

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification



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