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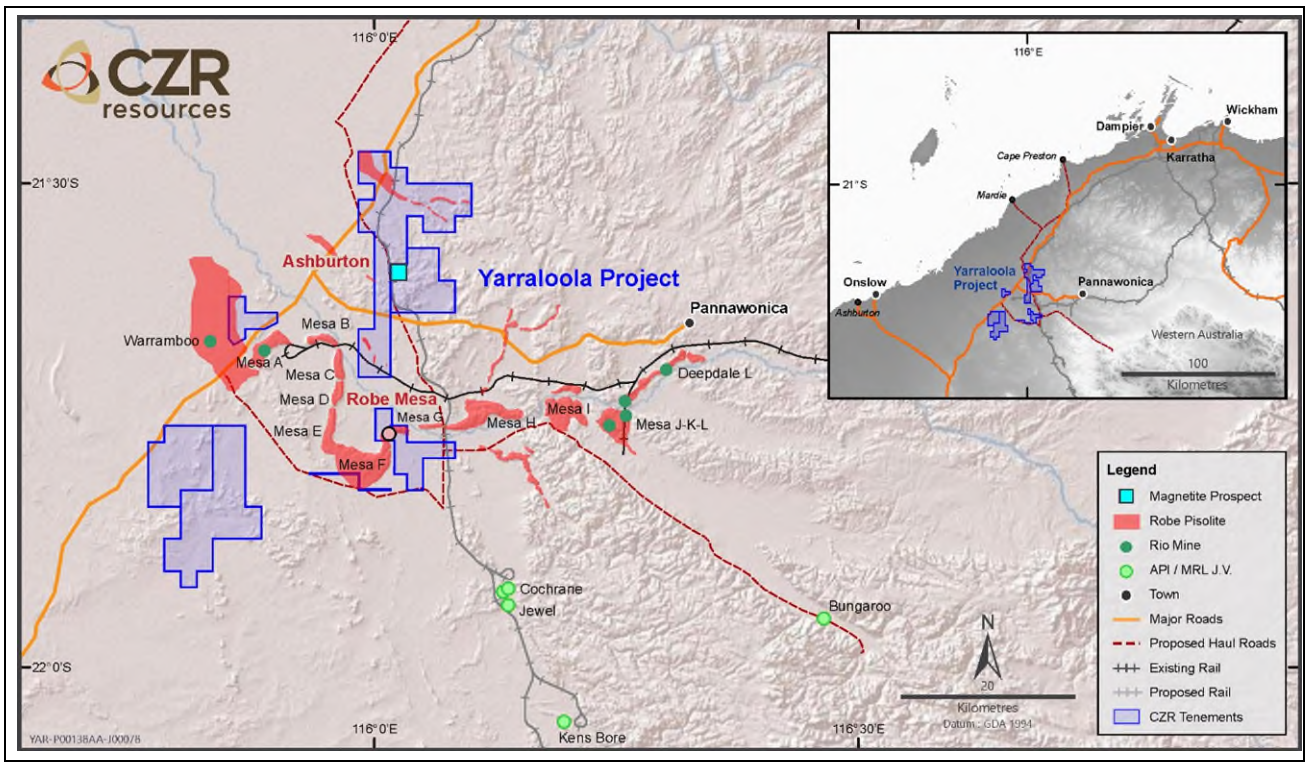
1. Introduction

1.1 Project Description

The Robe Mesa Iron Ore project (hereafter 'the project') is located within the Robe River valley channel iron deposits (CID), adjoining Rio Tinto's Mesa F deposit, in the west Pilbara region of Western Australia, within the Shire of Ashburton, approximately 200 km by road from the City of Karratha and 180 km by road from the town of Onslow (Figure 1.1 and Figure 1.2).

Figure 1.1: Project location.



The project is part of a larger Yarraloola Iron Ore Project, whose ownership is a joint venture between Zanthus Resources Ltd (Zanthus), a wholly owned subsidiary of CZR Resources Ltd (CZR), which holds 85%, and ZanF Pty Ltd (ZanF) which holds 15%. Zanthus is the operator of the Robe Mesa Project.

CZR recognises the Robe River Kuruma (RRK) People as the traditional owners of the land that Robe Mesa is located on, and the importance to the RRK People of leaving country as close as possible to the way that it was found. Working collaboratively, CZR and RRK signed the Robe Mesa Native Title Agreement on 21 December 2022 which includes a 'live' Cultural Heritage Management Plan to ensure the parties continue to work together to develop appropriate protection and management actions for the places it contains.

CZR acknowledges that within the vicinity of the project tenements there are many significant cultural places of great importance to RRK People. CZR and RRK have agreed the Productive Mining area boundaries and identified No-Go-Areas which must not be entered or impacted by CZR. The area of the Robe Mesa that has been identified for Productive Mining provides for a set back from the mesa edge or buffer that must not be entered or impacted. Additionally, northern aspects of the Robe Mesa and other selected areas off the mesa, also contain No-Go-Areas.

Mining of the Robe Mesa is all above the water table. CZR will not conduct any mining below the water table. Mine waste will remain on top of the Mesa. No external waste dumps will be left upon closure, with the pit progressively backfilled with waste.

These commitments of:

- maintaining a mesa edge buffer zone (Figure 1.2);
- enforcing No-Go-Areas (Figure 1.3);
- backfilling of pits with waste material;
- only undertaking mining above the water table; and
- on-going collaborative engagement with the RRK people,

will ensure that the project proactively manages environmental and cultural priorities, through an avoidance approach, consistent with best practice impact mitigation (Government of Western Australia 2014).

Mining will occur on top of the mesa only, utilising conventional drill and blast, truck, and shovel (excavator) open pit mining practises, with the mesa edge buffer zone being undisturbed. Mining will be focused on a low strip ratio, 24 hour – 7 days a week operation. The ROM pad will be off the mesa, feeding a dry processing plant (crush, screen and stack) that produces fines only product. No wet processing will occur and no tailings storage facility is required. Product will be stacked in a post-crusher stockyard with stockpiles built to product specification at the mine to minimise blending required at the port.

CZR personnel will provide overall supervision and management of a predominantly contractor operation. Contracts will be in place for mining, process plant, laboratory, haulage, power supply, village management and people logistics. Mine infrastructure will include offices, administration, workshops, laydown areas, roads, bore field, communication tower, ANFO storage facilities, power generation, a 120-person village and a general waste facility. A mine site laboratory will analyse grade control, process plant and TSV shipment samples.

Final product will be hauled by road trains to a Pre-shipment Stockyard (PSS) along Onslow Road, and also directly hauled to the road train unloading facility and storage shed at the Port of Ashburton. A 12 kt Transhipment Vessel (TSV) will be directly loaded, via covered conveyors, from the road train unloading facility and by front end loaders (FELs) from within the storage shed. The TSV will travel ~18 nautical miles west of Thevenard Island, to load a 180 kt Ocean Going Vessel (OGV) bulk ore carrier, cycling around 15 times over and approximately 10-day period, prior to the OGV departing for export to international markets. When the TSV is not at berth, road trains will deliver product into the Port shed in preparation for the next berthing.

With a relatively simple mine site operation, the main early works include development of the mine access road, and construction of the village and port unloading facility. Regulatory approvals will determine start dates for these tasks but, with an overall construction period of less than 12 months, an early works target of Q2 2025 would enable mine operations to commence in Q1 2026, with first shipment approximately 1-2 months later.

1.2 Purpose of this Environmental Management Plan

This Environmental Management Plan (EMP) documents environmental outcomes and management actions to be implemented to achieve these during the construction and operation of the project. This includes:

- management actions to avoid, reduce and minimise any potential environmental impacts of the project on key environmental values;
- specifying timing for implementation of these management actions; and
- specifying monitoring and reporting procedures to provide for continuous improvement, consistent with an adaptive management approach.

This EMP has been prepared to support the project's Mining Proposal, which will be submitted to the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) in accordance with the *Mining Act 1978*. The structure of this EMP, while not fully conforming with the templated format, has been prepared in consideration of the Environmental Protection Authority's (EPA) guidance on preparing EMPs (EPA 2021), particularly in regard to setting environmental outcomes to be achieved through the implementation of management actions.

Figure 1.2: Project indicative footprint (light blue) and development envelope (yellow).

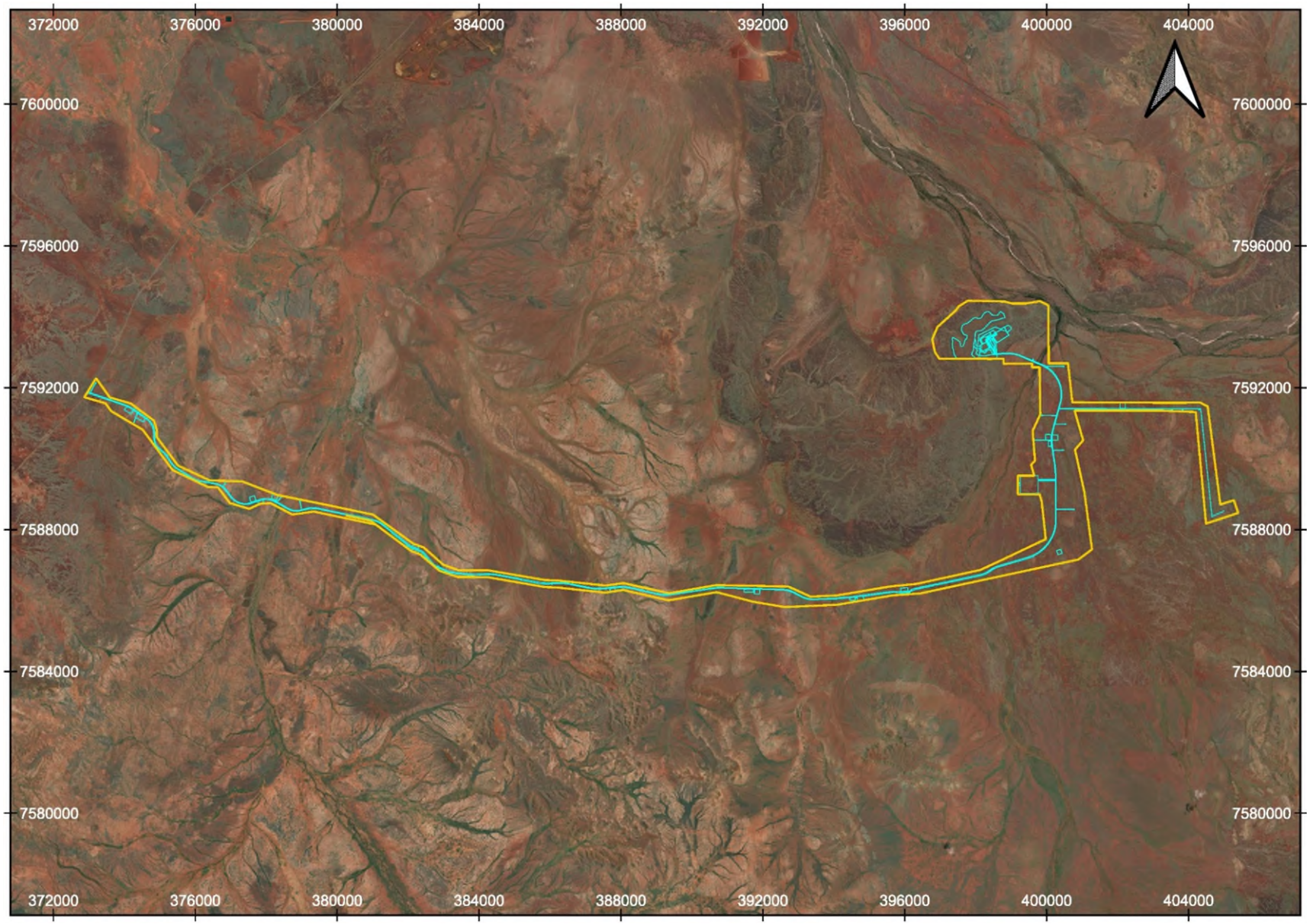
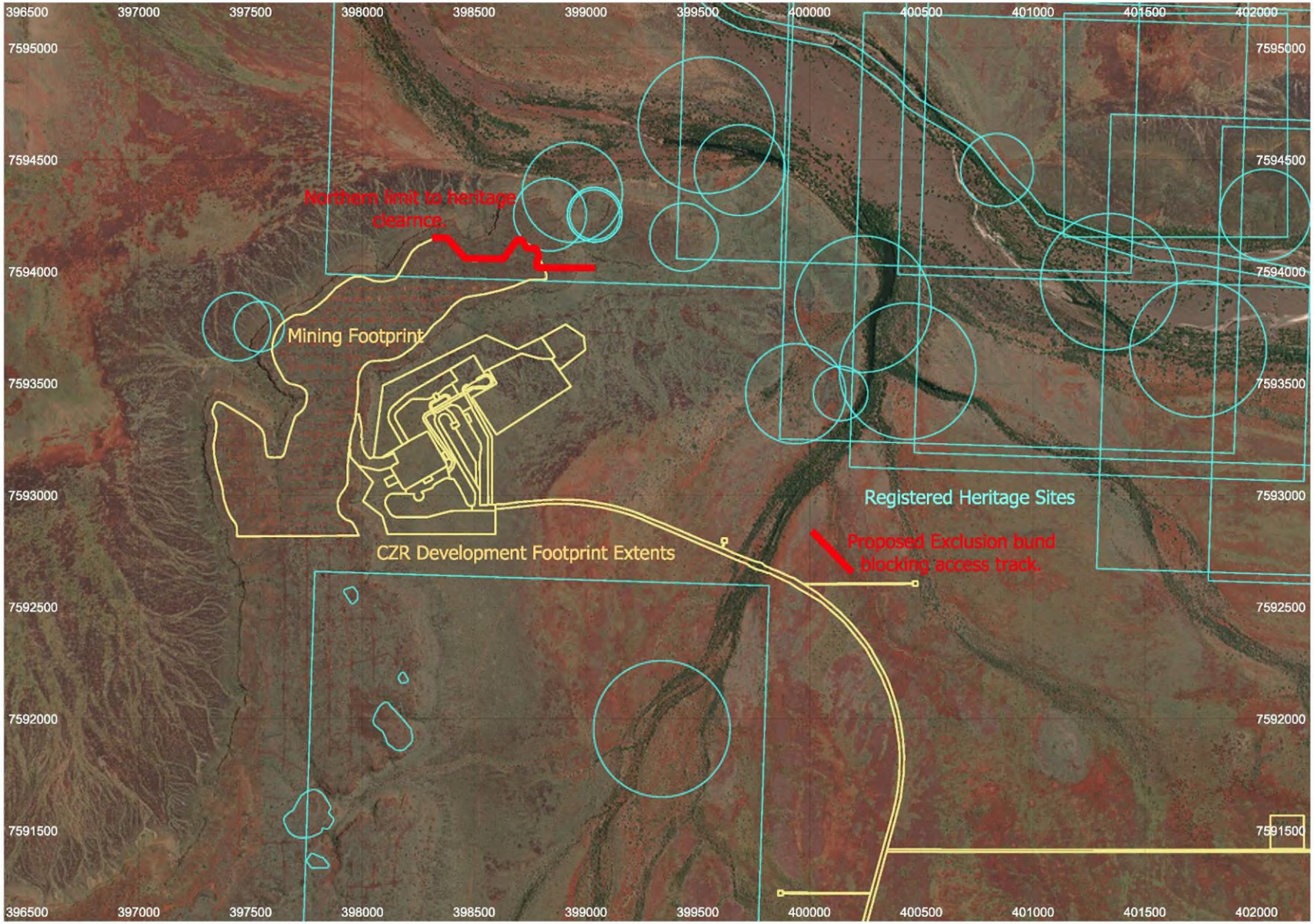


Figure 1.3 Mine and Infrastructure footprint (yellow) with 'no go' areas (red) and associated Registered Heritage Sites (light blue)



1.3 Relationship of this Environmental Management Plan to other Plans

While this EMP is the primary document setting out environmental outcomes for the project, and how these will be achieved, two related matters are addressed in other CZR documents:

1. Cultural heritage protection - Cultural Heritage Management Plan (RRKAC and CZR Resources 2023).
2. Project closure and rehabilitation – Mine Closure Plan (CZR Resources 2023b).

1.4 Key Environmental Values

CZR has conducted various studies extending over a period of approximately two years with the objective of providing sufficient data to obtain statutory approval to mine. The studies includes infill drilling and a variety of resource delineation studies, as well as environmental surveys (flora and vegetation, terrestrial fauna and subterranean fauna), surface and groundwater studies for environmental assessment and process water supply, together with consultation with relevant stakeholders, and discussions with the Local, State and Commonwealth Government authorities to obtain the needed licences and permits to operate a mine.

Given the volume and scope of work complete, CZR has identified the key environmental values present in the project area and the potential impact pathways of the planned operation. The key environmental values of the project area comprise:

- Subterranean Fauna – a Priority Ecological Community (PEC) of troglofauna (air-breathing animals occurring between the water table and ground surface), with at least 10 individual troglofauna species recorded;
- Significant terrestrial fauna – The project area recorded Threatened species Northern Quoll, Ghost Bat and Pilbara Leaf-nosed Bat, in addition to Priority fauna species (Western Pebble-mound Mouse and Gane's Blind Snake). Note, Pilbara Olive Python was not recorded but is also considered in this plan;
- Priority flora – three species, all of which are widespread in the region; and
- Sites of cultural heritage importance – primarily associated with the mesa edge and the adjacent Robe River.

While the above values represent the key potential impact receptors that this EMP has been prepared to address, the management actions committed to will also serve to mitigate potential impacts on all ecological and cultural values of the project area and adjoining landscape.

1.5 Potential Impact Sources and Pathways

The potential impact sources and pathways associated with the elements of the project are typical of above water table iron ore mining operations, as summarised in Table 1-1.

Table 1-1: Project potential impact sources and pathways.

Impact Source: / Impact Pathway	Mine pit	Stockpiles	Haul Road	Processing	Other Infrastructure
Ground disturbance	✓	✓	✓	✓	✓
Noise	✓	✓	-	✓	✓
Vibration	✓	✓	-	✓	-
Dust	✓	✓	✓	✓	-
Light spill	✓	✓	-	✓	✓
Linear infrastructure	-	-	✓	-	✓
Human habitation	-	-	-	-	✓
Changed fire regimes	-	-	✓	-	✓
Increase in introduced fauna	-	-	-	-	✓
Increase in environmental weeds	-	-	✓	-	✓

2. Receiving Environment and Potential Impacts

2.1 Terrestrial Fauna

2.1.1 Overview of Receiving Environment

An overall total of 147 vertebrate fauna species were recorded in the project area across all field surveys (May and October 2021, and July and September 2022) (Bamford Consulting Ecologists 2022).

Two species of frog are present, largely confined to low points in the landscape, with breeding taking place in pools and claypans. Adults will disperse widely and individuals are likely to move across the project area. At least one species may be moderately abundant in the project area, particularly along the mesa edge, and may breed in ephemeral pools adjoining the mesa.

The reptile assemblage of the project area comprises 43 species spread across the landscape, with differing suites of species and abundance in different habitats (Bamford Consulting Ecologists 2022). The mesa top supports a limited number of species at low levels of abundance due to shallow soils and few microhabitats compared with the mesa edge and slopes. It is unlikely that any species are locally-confined to the mesa top, whereas there are very likely to be species limited to the other habitats present (mesa edge, sandy flats and forests along drainage lines; Bamford Consulting Ecologists 2022).

The avifauna of the project area is rich at 80 species, but again; the mesa top supports a very limited number of species at low levels of abundance due to a lack of habitat structural complexity (Bamford Consulting Ecologists 2022). No bird species are likely to be confined to the mesa top, but the tall, thick spinifex and woodlands on the lower slopes and outwash of the mesa may be locally important with higher levels of abundance of many species (Bamford Consulting Ecologists 2022).

The mammal fauna of the project area comprises 13 native species. The mesa edge is notable for a rich assemblage including several species of conservation significance (Section 2.1.2). Mammal diversity and abundance on the mesa top is much lower due to the structural simplicity of the habitat. Some mesa edge species may forage across the mesa top, but rely more heavily on dense vegetation of lower slopes for foraging (Bamford Consulting Ecologists 2022).

2.1.2 Significant Terrestrial Fauna

Three species listed as Threatened under both the State *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occur in the project area:

- Northern Quoll (*Dasyurus hallucatus*);
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*); and
- Ghost Bat (*Macroderma gigas*) (Bamford Consulting Ecologists 2022).

Although the listed Pilbara Olive Python (*Liasis olivaceus barroni*) was not detected during field investigations, which is understandable they are highly cryptic, DBCA deem that they are almost certainly present within the area, with recent records less than 1km from the mine pit (Bamford Consulting Ecologists 2024a).

All three recorded species and the Pilbara Olive Python are strongly associated with the mesa edge as core habitat, both for denning and roosting opportunities, and foraging resources. None of the species are restricted to the project area and all three recorded species are routinely recorded in the Robe River valley. No known maternity roosts for either bat species are present in the project area, and the Northern Quoll is present in relatively small numbers, typical of similar habitat in the locality (Bamford Consulting Ecologists 2022). The

temporary bat roosts that are present are associated with the mesa edge and are located within the project No-Go-Areas.

Local watercourses such as Mungarathoona Creek, just east of the mine area, and Warramboo Creek at the southern haul road route, also provide suitable habitat for all four listed species, with rocky areas including mesas may be used for shelter during the cooler months (Bamford Consulting Ecologists 2024a).

A list of all 28 conservation significant vertebrate species expected within the project area is provided in Appendix 1. Information on the conservation status, distribution and habitat, salient ecology, records in the project area (where applicable) and expected occurrence is provided for those species expected to occur at least as irregular visitors is provided in Appendix 2. Species expected only as vagrants are not discussed as the project area is of no conservation value for them.

2.1.3 Potentials Impact on Terrestrial Fauna

The project's impact pathways relevant to terrestrial fauna, and the ultimate potential impacts on receptor species and communities, are summarised in Table 2-1.

Table 2-1: Potential impacts on terrestrial fauna.

Impact Pathway (Source)	Potential Impacts
Ground disturbance (Mine pit, stockpiles, haul road, processing, infrastructure)	• Direct impacts on individuals (plant and equipment) • Habitat loss beyond approved limit (population decline and fragmentation) • Habitat degradation (altered surface hydrology)
Noise and Vibration (Mine pit, stockpiles, haul road, processing, infrastructure)	• Behavioural changes (disturbance response) • Habitat degradation (structurally altered)
Light spill (Mine pit, stockpiles, processing, infrastructure)	• Behavioural changes (altered foraging)
Linear infrastructure (Haul road, infrastructure)	• Individual mortality (vehicle interaction) • Habitat degradation (altered surface hydrology)
Human habitation (Infrastructure)	• Behavioural changes (altered foraging) • Individual mortality (human interaction)
Changed fire regimes (Haul road, infrastructure)	• Individual mortality (increased fire frequency) • Habitat degradation (increased fire frequency)
Increase in introduced fauna (Infrastructure)	• Increased predation and/or competition
Increase in environmental weeds (Haul road, infrastructure)	• Habitat degradation (altered vegetation structure)

2.1.4 Environmental Outcomes

Through implementation of this EMP, CZR will ensure the following outcomes are achieved for terrestrial fauna:

1. Project ground disturbance will not exceed 270 ha.
2. No loss of habitat critical to significant fauna species due to the project.
3. No loss of fauna habitat outside of the project development envelope.
4. No introduction or spread of introduced fauna due to the project.
5. No introduction or spread of environmental weeds due to the project.
6. No significant decline in habitat condition outside of the project development envelope.

Management actions that will be implemented to achieve these objectives are detailed in Section 3.

2.2 Subterranean Fauna

2.2.1 Overview of Receiving Environment

Three phases of sampling for troglofauna have been completed in the CID mesa landform of the project area, with at least 13 species from seven orders recorded (Biota 2023a and 2024). All species recorded are endemic to the mesa and do not occur in other mesa landforms in the Robe River locality or wider west Pilbara. None of the species present are formally listed as significant under either the BC Act or the EPBC Act, but all are of conservation significance due to their extreme short-range endemism, significance as relictual fauna and as they form part of a PEC (Section 2.2.2).

Eight of the 13 species have thus far only been recorded within the project mine pit (Biota 2023a and 2024). However, both geological modelling (CZR Resources 2023a) and extensive subterranean fauna research completed elsewhere in the locality (Biota 2023a and 2024), indicate that it is highly likely the CID troglofauna habitat is connected across the extent of the mesa landform and the species are similarly distributed.

2.2.2 Priority Ecological Community

The project area mesa forms part of the State-listed *'Subterranean invertebrate communities of mesas in the Robe Valley region'* PEC.

The PEC is categorised by the Department of Biodiversity, Conservation and Attractions (DBCA) as Priority One: "Poorly-known ecological communities, which are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within active mineral leases) or for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range".

2.2.3 Potentials Impact on Subterranean Fauna

The project's impact pathways relevant to subterranean fauna, and the ultimate potential impacts on receptor species and communities, are summarised in Table 2-2.

Table 2-2: Potential impacts on subterranean fauna.

Impact Pathway (Source)	Potential Impacts
Ground disturbance (Mine pit, stockpiles)	• Loss of subterranean fauna habitat beyond approved limit • Habitat degradation (altered surface hydrology)
Vibration (Mine pit, infrastructure)	• Habitat degradation

2.2.4 Environmental Outcomes

Through implementation of this EMP, CZR will ensure the following outcomes are achieved for subterranean fauna:

1. Mine pit ground disturbance will not exceed 68 ha.
2. Mine pit depth to target the Upper CID unit, and limit access to the Lower CID unit to small pockets.
3. No significant decline in subterranean fauna habitat condition outside of the mine pit.

4. No loss of subterranean fauna habitat outside of the project development envelope.

Management actions that will be implemented to achieve these objectives are detailed in Section 3.

2.3 Flora and Vegetation

2.3.1 Overview of Receiving Environment

Flora and vegetation surveys of the project area (Biota 2023b) have delineated four broad vegetation types:

- Mesa tops - *Acacia arida* Mid Sparse Shrubland over *Triodia wiseana* Hummock Grassland;
- Mesa breakaways and gorges - *Eucalyptus leucophloia* Low Isolated Clumps of Trees over *Acacia arida* Isolated Clumps of Shrubs over *Triodia wiseana* and *T. pisoliticola* Sparse Hummock Grassland;
- Mesa footslopes - *Corymbia hamersleyana* Low Isolated Trees over *Acacia inaequilatera* Mid to Tall Sparse Shrubland over *Triodia epactia* Hummock Grassland; and
- *Triodia epactia* hummock grasslands (sparse shrub steppe over hard spinifex).

All of the vegetation types are widespread in the project area locality and the wider west Pilbara (Biota 2023b).

2.3.2 Significant Flora

Three state-listed Priority flora species have been recorded from the project area:

- *Eragrostis crateriformis* (P3) – recorded from 73 locations along the haul road (Biota 2023b) and also within the mine infrastructure area (RPS 2021);
- *Triodia pisoliticola (P3)* – recorded from 412 locations along the mesa edge (RPS 2021);
- *Goodenia nuda (P4)* – recorded from 26 locations near the village and the mine infrastructure areas (RPS 2021).

All three species are widespread in the west Pilbara (RPS 2021, Biota 2023b).

2.3.3 Potentials Impact on Flora and vegetation

The project's impact pathways relevant to flora and vegetation, and the ultimate potential impacts on receptor species and communities, are summarised in Table 2-3.

Table 2-3: Potential impacts on flora and vegetation.

Impact Pathway (Source)	Potential Impacts
Ground disturbance (Mine pit, stockpiles, haul road, infrastructure)	• Direct impacts on individuals (plant and equipment) • Loss of vegetation types beyond approved limit
Dust (Mine pit, haul roads, infrastructure)	• Vegetation degradation (shading, altered transpiration)
Linear infrastructure (Haul road, infrastructure)	• Vegetation degradation (altered surface hydrology)
Changed fire regimes (Haul road, infrastructure)	• Vegetation degradation (increased fire frequency)
Increase in environmental weeds (Haul road, infrastructure)	• Vegetation degradation

2.3.4 Environmental Outcomes

Through implementation of this EMP, CZR will ensure the following outcomes are achieved for flora and vegetation:

1. Project ground disturbance will not exceed 270 ha.
2. No loss of significant flora species due to the project.
3. No loss of flora and vegetation outside of the project development envelope.
4. No introduction or spread of environmental weeds due to the project.
5. No significant decline in vegetation condition outside of the project development envelope.

Management actions that will be implemented to achieve these objectives are detailed in Section 3.

2.4 Cultural Heritage Values

2.4.1 Overview of Receiving Environment

CZR has undertaken extensive consultation with the RRK People, who have identified areas of cultural significance within the project area. This is documented in the project's Cultural Heritage Management Plan (RRKAC and CZR Resources 2023).

2.4.2 Potentials Impact on Cultural Heritage Values

The project's impact pathways relevant to cultural heritage, and the ultimate potential impacts on sites of significance, are summarised in Table 2-4.

Table 2-4 : Potential impacts on cultural heritage values.

Impact Pathway (Source)	Potential Impacts
Ground disturbance (Mine pit, stockpiles, haul road, infrastructure)	• Direct disturbance
Noise and Vibration (Mine pit, stockpiles, haul roads, infrastructure)	• Site degradation (structurally altered) • Reduced amenity
Access to sensitive areas (river pools) (Mine pit, stockpiles, haul road, infrastructure)	• Site disturbance and cultural insensitivity at heritage sites

2.4.3 Environmental Outcomes

Through implementation of this EMP, and the project Cultural Heritage Management Plan, CZR will ensure the following outcomes are achieved for cultural heritage values:

1. No direct disturbance of sites of cultural heritage significance.
2. No degradation or reduction in amenity of sites of cultural heritage significance.
3. Access to sites of cultural heritage significance is prohibited by all CZR employees and contractors, unless approval has been sought (monitoring etc.)

Management actions that will be implemented to achieve these objectives are detailed in Section 3 and the project Cultural Heritage Management Plan.

3. Management Actions

3.1 Management Framework

The project management actions that CZR will implement throughout the life of the project are set out in Table 3-1, along with risk-based prioritisation and timing.

Note that Table 3-1, treats the likelihood of a potential impact occurring as the unmitigated probability; i.e. the likelihood if no management actions were taken. This best informs the management prioritisation, to clearly identify the most important management actions that need to be central to project implementation (Table 3-1).

As some impact pathways, particularly ground disturbance, could affect more than one of the environmental receptors discussed in Section 2, the potential impacts in Table 3-1 have been consolidated into a single item where the same management actions will avoid or mitigate more than one potential impact.

Weed management is an important part of maintaining healthy vegetation and fauna habitats, and as such, a summary of key actions for weed management is provided in Table 3-2. These actions form the basis of CZRs Weed Hygiene and Control Procedure.

3.2 Implementation Responsibility

While CZR has ultimate responsibility for project implementation, much of the day-to-day delivery and operation of the project will be undertaken by contractors.

CZR will ensure that all services contracts for the project are binding on all contractors in regard to implementing the content of this EMP as relevant to their activities onsite. Compliance reporting will also be contractually required, to enable CZR to consolidate environmental management data into annual reporting (see Section 5).

Table 3-1 : Risk-based prioritisation of management actions.

Item	Potential Impact	Unmitigated Likelihood	Management Priority	Management Actions	Project Timing
1.	Loss of fauna habitat, vegetation or sites of cultural significance beyond approved ground disturbance limits	Very likely	High	1. Final mine pit design to be spatially limited to observe the mesa edge buffer and No-Go Areas.	Pre-construction
				2. Final design of project footprint to reduce extent of habitat cleared, including utilising existing tracks and co-locating infrastructure, where feasible.	Pre-construction
				3. Develop and implement ground disturbance approval procedures, requiring supervisor approval prior to proceeding.	Construction
				4. Approved clearing limits to be delineated on ground and spatially managed via GPS technology.	Construction
				5. Implement rehabilitation procedures for decommissioned areas of the project footprint, in accordance with the project's Mine Closure Plan (CZR Resources 2023b).	Post-operations
2.	Loss of subterranean fauna habitat beyond approved limits	Very likely	High	1. Final mine pit design to be spatially limited to observe the mesa edge buffer and No-Go Areas, and pit depth to be limited to the upper and lower CID units.	Pre-construction, Operations
3.	Direct impacts on significant terrestrial fauna and flora	Very likely	High	1. Final design of mine pit and associated infrastructure footprint to observe mesa edge buffer and No-Go Areas.	Pre-construction
				2. Final alignment of project haul road and any associated materials sourcing areas to avoid known locations of Priority fauna and flora.	Pre-construction
				3. Drill and blast activities to be constrained to the approved mine pit boundaries.	Operations
				4. Culverts under roads and directional fencing should be established to facilitate movement around the project area. Steep batters may also help to guide animals to the entrance).	Construction, Operations
4.	Altered surface hydrology, degrading fauna habitat and vegetation	Very likely	High	1. Incorporate culverting or other appropriate drainage treatments into the final design of the haul road at locations where it crosses significant drainage lines, to ensure no backwater upstream of the crossing point or reduction in natural hydrology downstream.	Pre-construction
				2. Ensure run-off from active mining areas, including the mine pit and any temporary stockpiles, is managed by bunding, diversion drains, or other appropriate drainage treatments to minimise sediment transport from areas of ground disturbance.	Operations
5.	Increased feral fauna distribution and	Very likely	High	1. Best practice waste management procedures and facilities, particularly for food waste.	Construction, Operations

Item	Potential Impact	Unmitigated Likelihood	Management Priority	Management Actions	Project Timing
	abundance, increasing predation pressure			2. Prohibiting all personnel from feeding of fauna or disposal of food outside of allocated disposal points.	Construction, Operations
				3. Maintain a register to record the presence of feral animals on site.	Construction, Operations
				4. Implement annual targeted feral fauna control across the broader project area, including high risk areas such as around the camp mess and crib rooms, as well as the infrastructure sites and haul road. Regular inspections of the area and reporting of opportunities sightings will guide annual control event target sites and timing.	Construction, Operations
6.	Altered surface hydrology, degrading subterranean fauna habitat	Likely	Moderate	1. Direct return of waste material in-pit, minimising any temporary stockpiling time, with materials strategically deployed directly against undisturbed subterranean fauna habitat within the mesa edge buffer.	Operations
				2. Ensure earthworks and roads minimise any obstruction to natural surface water flow.	Construction
7.	Weed introduction and spread, degrading fauna habitat and vegetation	Likely	Moderate	1. Implement Weed Hygiene and Control Procedure, including awareness training, the use of Weed Hygiene Certificates and implementing weed control measures.	Construction, Operations
				2. Weed monitoring to record changes in target weed populations, their location, extent and the effect of any control methods.	Operations, Closure
8.	Noise, light spill, and vibration, changing fauna foraging behaviour	Possible	Low	1. Design of site lighting to incorporate light sources with little or no short wavelength (blue and ultraviolet) light and motion-sensitive activation and deactivation where safety considerations permit.	Pre-construction
				2. Lighting to be directed to required areas only and incorporate shielding to reduce unneeded light spill into natural areas.	Construction, Operations
				3. Lighting should not be directed into natural areas and should use non insect-attracting fittings	Planning, Construction, Operations
				4. Blasting limited to daylight hours and will avoid the any nominated exclusion zones	Operations
				5. Drill and blast practices will be modified near the pit edge if rock shelters are identified along the mesa escarpment. If any rock shelter found sits within the minimum distance for 95% probability of compliance with 20 mm/sec vibration, no blasting will occur, with only dozer rip and excavator free-dig activities performed.	Construction, Operations

Item	Potential Impact	Unmitigated Likelihood	Management Priority	Management Actions	Project Timing
				6. Plant, vehicles, and generators will be maintained according to manufacturer specifications.	Construction, Operations
				7. Vehicle and machinery traffic will be confined to defined roads and tracks where practicable.	Construction, Operations
				8. Vehicle speed limits shall be imposed and enforced on all roads and tracks.	Construction, Operations
9.	Changed fire regimes, degrading fauna habitats and vegetation	Possible	Low	1. Implementation of a hot works permitting system to control any works where sparks or other potential ignition sources are generated, such that there is no risk of adjacent intact vegetation being ignited.	Construction, Operations
				2. Ensure adequate firefighting equipment and personnel are available on site.	Construction, Operations
				3. Development and readiness resourcing for fire emergency response procedures.	Construction, Operations
				4. Liaise with DBCA during their controlled burning season and ensure they are aware of the need to protect sensitive habitat around the project area (i.e. riparian vegetation).	Construction, Operations
10.	Other general construction and operations impacts	Possible	Low	1. Implement dust monitoring management procedure to track and minimise dust emissions across project area	Construction, Operations
				2. Site induction for all personnel to specify environmental management requirements and conservation significant values	Construction, Operations
				3. Implement Ground disturbance approval procedure.	Construction
				4. Pre-clearing checks across potential habitats (i.e. creek lines and mesa edge/ramp), including trapping for Northern Quoll and Pilbara Olive Python immediately prior to clearing. Maintain watch at the commencement of disturbance	Construction
				5. Fire prevention and emergency response procedures.	Construction, Operations
				6. Onsite speed limits, with speed restrictions of 60 km/hr implemented within key habitat locations (e.g. creek locations and the mesa edge)	Construction, Operations
				7. Establish wildlife crossing signs, with speed limits clearly signposted at key locations (e.g. creek locations and the mesa edge) on the road network	Construction

Item	Potential Impact	Unmitigated Likelihood	Management Priority	Management Actions	Project Timing
				8. Prohibit off-road driving over uncleared fauna habitat and vegetation, unless authorised by environmental personnel.	Construction, Operations
				9. Minimise the use of barbed wire fencing (in consultation with land managers).	Construction, Operations
				10. Implement reporting protocols for any fauna roadkill,	Construction, Operations

Table 3-2 : Weed Management – summary of key actions.

Item	Phase	Management Actions	Project Timing
1	Planning	1. A list of weed species known to occur or likely to occur on site shall be complied and their priority for control and eradication determined. In determining their priority for control, consider their existing occurrence across the Pilbara and their expected impact on Pilbara ecosystems or pastoral enterprises.	All stages
		2. Weed information shall be incorporated into site maps on the CZR GIS system and shall be considered in the preparation and assessment of any ground disturbance permitting (GDP) process.	All stages
		3. Areas containing weeds or likely to contain weed seeds shall be designated "Weed Risk Areas". Weed Risk Areas shall be identified and the location(s) recorded within the site GIS. Advice of any new Weed Risk Areas shall be given to relevant personnel.	Planning
		4. Planning of construction works should enable the works to progress from Clean Areas to Weed Risk Areas.	Annually
		5. Weed spraying (or other suitable control mechanisms) requirements should be identified for significant infestations.	All stages
2	Management	1. Facilities shall be provided at appropriate locations for the cleaning of ground engaging equipment, light and heavy vehicles.	Construction and Operations
		2. The number of entry and exit points for work sites and washdown areas shall be minimised.	Construction and Operations
		3. All earthmoving equipment, drill rigs and vehicles coming to site shall be free of seeds or material that may contain seeds (e.g. dried mud). The CZR Site Manager may refuse entry to any vehicle presenting to site that is not free of seeds - to be cleaned down at an appropriate facility.	All stages
		4. A Weed Hygiene Certificate shall be submitted prior to equipment arriving to site. Once on site, movement within the site is unrestricted unless moving from a Weed Risk Area (see below).	All stages

Item	Phase	Management Actions	Project Timing
		5. All earthmoving equipment, drill rigs and vehicles moving from a Weed Risk Area shall be cleaned down in a manner that captures and controls material likely to contain weed seeds.	All stages
		6. Material that may contain weed seeds shall be disposed of on the advice of Environmental personnel.	All stages
		7. Driving through Weed Risk Areas particularly at high risk times (such as when weeds are in seed) should be avoided. Nomination of high risk times shall be made by Environmental personnel.	Construction and Operations
		8. In cases where topsoil is significantly contaminated with weeds, topsoil salvage may be abandoned and the material removed and disposed according to the directions of the CZR Environmental personnel (who may seek advice or consult with regulators).	Construction and Operations
		10. Weed management occurring on tenure that is not exclusive to CZR shall be communicated and coordinated with the relevant landholder.	Construction and Operations
		11. Seed for use in rehabilitation shall be free of weed seeds. If necessary a certification of weed free status shall be obtained.	Construction and Operations
3	Monitoring and Reporting	1. Weed management shall be included in annual reporting to the statutory authorities.	Construction and Operations
		2. Occurrences of Declared Plants under the Agriculture and Related Resources Protection Act 1976 shall be reported to the Department of Agriculture and Food.	Construction and Operations
		3. The number of weed hygiene certificates received and issued shall be reported each month.	Construction and Operations
4	Performance Indicators	1. Number of weed species in the project area.	Construction and Operations
		2. Reduction or no change in the abundance or area of weeds in the project area.	Construction and Operations

4. Monitoring

CZR will implement monitoring to measure the effectiveness of the management actions in achieving the project's environmental outcomes, and to identify when additional mitigation or contingency responses may be needed.

Table 5-1 sets out the monitoring needed to measure the effectiveness of the management actions in meeting their related targets.

5. Reporting

An Annual Environmental Report (AER) will be prepared and submitted to DEMIRS. The AER will be structured and include required content as defined in DEMIRS (2022).

In relation to this EMP, the AER will contain:

- Information demonstrating compliance with the content of this EMP;
- Results of monitoring and performance reviews associated with the implementation of the EMP; and
- Any improvements to management actions and planned revisions to this EMP (Section 6).

Table 5-1 : Monitoring frequency and reporting.

Item	Environmental Outcomes	Monitoring	Timing/Frequency	Reporting
1	• Project ground disturbance will not exceed 270 ha. • No loss of fauna habitat outside of the project development envelope. • No loss of flora and vegetation outside of the project development envelope. • No loss of habitat critical to significant fauna species due to the project. • No loss of significant flora species due to the project. • No direct disturbance of sites of cultural heritage significance.	1. Cumulative ground disturbance extents captured and tracked via GPS technology or regular aerial imagery and GIS capture. 2. Verification of onsite ground disturbance against final project design.	• Quarterly during construction and operations.	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.
2	• Mine pit ground disturbance will not exceed 68 ha. • No loss of subterranean fauna habitat outside of the project development envelope.	1. Pit shell extent monitoring and volume tracking during active mining.	• Monthly during operations.	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.
3	• No significant decline in habitat condition outside of the project development envelope. • No significant decline in vegetation condition outside of the project development envelope.	1. Establish and monitor representative vegetation condition sites around the periphery of the mesa footslopes.	• Annually during operations	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.
4	• No significant decline in subterranean fauna habitat condition outside of the mine pit.	1. Monitor microclimate within the mesa edge buffer.	• Ongoing during operations.	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.
5	• No introduction or spread of introduced fauna due to the project.	1. Waste management procedure compliance records. 2. Monitor/inspect for the presence of feral fauna at higher risk areas, including camp, crib, infrastructure sites and haul roads.	• Quarterly inspections during construction and operations. • Annual control measures implemented, with timing and location dependant on	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.

Item	Environmental Outcomes	Monitoring	Timing/Frequency	Reporting
		3. Records of engaging appropriately licensed feral fauna control contractor and scope of activities.	outcomes of the prior inspections. Frequency of control measures will in part be guided by licenced feral fauna control contractor.	
6	• No introduction or spread of environmental weeds due to the project.	1. Inspection and auditing of clean down point facilities and cleaned equipment. 2. Targeted weed monitoring at higher risk locations and current earthworks areas. 3. Targeted weed monitoring on completion of works.	• Quarterly review of clean down records. • Quarterly weed monitoring during construction and annual weed monitoring during operation.	• Annual environmental reporting. • Review management actions (and revise if required). • Reporting on the review and revision of management actions.
7	• Minimise impacts on conservation significant fauna from noise, light and vibration	1. Monitoring the activity for conservation significant fauna during key phases over the life of the project 2. Visual inspections of light spill during works 3. Vehicle and equipment maintenance records 4. Blast plans and records	• Fauna monitoring during key stages of the project (construction, initial blast, regular operations, closure etc.) • Annual inspections during operational phase for all other records and inspections	• Incident reporting • Equipment and vehicle inspection and maintenance records • Annual environmental reporting

6. Adaptive Management and Review

CZR recognises that incremental knowledge gain over time, and the evolving nature of project implementation, may lead to varying risk profiles for potential impacts over the duration of the project.

An adaptive management approach will therefore be adopted for the implementation of this EMP, involving:

- Developing and implementing additional mitigation actions (should these become necessary);
- Monitoring and evaluating data in comparison to management targets and environmental criteria, noting that these targets and criteria will be developed based on future monitoring data specific to the development envelope; and
- Systematically adapting, as necessary, management and mitigation actions and monitoring to meet the environmental objectives.

This will be supported by the implementation of an Environmental Management System (EMS) for the project and associated procedures, to ensure that management actions contained in this EMP are embedded in all work practices.

Revision of this EMP will be undertaken on an as-needs basis following annual review and reporting of relevant monitoring data and the adequacy with which existing management actions are achieving the intended environmental outcomes.

7. References

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Government of Western Australia (2014). *WA Environmental Offsets Guidelines*. Environmental Protection Authority, Western Australia.

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8. Appendix

Appendix 1 – Conservation significant fauna species expected to occur and confirmed present (bold).

Species are listed in taxonomic order. CS1, CS2, CS3 = (summary) levels of conservation significance.
EPBC Act listings: E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine.
WA *Biodiversity Conservation Act 2016* listings: S1 to S7 = Schedules 1 to 7.
DBCA Priority species: P1 to P4 = Priority 1 to 4.

Species	Common name	Status	Expected occurrence	Confirmed			
				May 2021	Oct 2021	July 2022	Sept 2022
Leiopotherapon aheneus	Fortescue Grunter	CS2 (P4)	**Resident**	X	X		
Ophisternon candidum	Blind Cave Eel	CS1 (V, S3)	Resident				
Notoscincus butleri	Lined Soil-Crevice Skink	CS2 (P4)	Resident				
Anilios ganei	Gane's Blind Snake	CS2 (P1)	**Resident**			X	
Liasis olivaceus barroni	Pilbara Olive Python	CS1 (V, S3)	Resident				
Elanus scriptus	Letter-winged Kite	CS2 (P4)	Vagrant				
Erythrotriorchis radiatus	Red Goshawk	CS1 (V, S3)	Vagrant				
Apus pacificus	Fork-tailed Swift	CS1 (M, S5)	Irregular Visitor				
Falco peregrinus	Peregrine Falcon	CS1 (OS, S7)	Resident				
Falco hypoleucos	Grey Falcon	CS1 (V, S3)	Regular Visitor				
Burhinus grallarius	Bush Stone-curlew	CS3	**Resident**				X
Tringa glareola	Wood Sandpiper	CS1 (M, S5)	Irregular Visitor				
Actitis hypoleucos	Common Sandpiper	CS1 (M, S5)	Irregular Visitor				
Calidris acuminata	Sharp-tailed Sandpiper	CS1 (M, S5)	Irregular Visitor				
Glareola maldivarum	Oriental Pratincole	CS1 (M, S5)	Irregular Visitor				
Pezoporus occidentalis	Night Parrot	CS1 (C, S1)	Vagrant				
Stipiturus ruficeps	Rufous-crowned Emu-wren	CS3	**Resident**	X		X	X
Amytornis striatus	Striated Grasswren	CS3	**Resident**	X	X		
Neochmia ruficauda	Star Finch	CS3	**Resident**	X	X		
Dasyurus hallucatus	Northern Quoll	CS1 (E, S2)	**Resident**	X	X	X	X

Species	Common name	Status	Expected occurrence	Confirmed			
				May 2021	Oct 2021	July 2022	Sept 2022
Sminthopsis longicaudata	Long-tailed Dunnart	CS2 (P4)	Resident				
Trichosurus velpecula	Brushtail Possum	CS3	**Resident**			X	
Petrogale lateralis	Black-flanked Rock-Wallaby	CS1 (V, S3)	Vagrant				
Petrogale rothschildi	Rothschild's Rock-Wallaby	CS3	**Resident**	X	X		
Leggadina lakedownensis	Short-tailed Mouse	CS2, (P4)	Resident				
Pseudomys chapmani	Ngadji or Western Pebble-mound Mouse	CS2 (P4)	**Resident**			X	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	CS1 (V, S3)	**Resident**	X			
Macroderma gigas	Ghost Bat	CS1 (V, S3)	**Resident**	X	X		

Appendix 2 – Information on conservation significant species

Blind Cave Eel (*Ophisternon candidum*)	**CS1 (V, S3)**
Conservation status:	Vulnerable under the EBPC Act and Schedule 3 under the BC Act. The key threats to the Blind Cave Eel are sedimentation from mining and construction, canal development, water abstraction, point source pollution from sewage, landfill, dumping and mining, and diffuse pollution from urban development (TSSC 2008).
Distribution and habitat:	Populations were thought to have existed only on Cape Range however discoveries along Robe River and Barrow Island in recent years have expanded its known distribution (Moore *et al.* 2018). Genetic analysis suggest that the three populations are isolated and unlikely to mix (MWA 2018). This species persists in stratified waters ranging from freshwater at the surface to seawater salinities at depth and is known to traverse this range (TSSC 2008). These waters lack surface connection to the sea.
Ecology:	This species is one of only three vertebrate animals known from Australia that are restricted to subterranean waters and caves. It is a predator of small invertebrates but little is known of its biology.

Expected occurrence:	Resident. Nine records lie within the vicinity of the project area, the closest of which is 12 km to the east. Five records are from the DBCA threatened species search and four from a biological survey undertaken for Rio Tinto for the assessment of Mesa H (Rio Tinto 2019). All records span an area in the Robe River north and east of Mesa J and along Jimmawurrada creek, which supports the likelihood of habitat connectivity and features between the creek/river systems. The subterranean water of the Robe River and Mungarathoona Creek within the project area is likely to connect with the aquifers only 12 km to the east therefore this species is highly likely to be present.

Pilbara Olive Python (*Liasis olivaceus barroni*)	**CS1 (V,S3)**
Conservation status:	Vulnerable under the EBPC Act and Schedule 3 under the BC Act.
Distribution and habitat:	This species occurs in the Hamersley Ranges, Dampier Archipelago, Pannawonica, Millstream, Tom Price and Burrup Peninsula as scattered populations within the Pilbara region, and has been recorded east to near Marble Bar and Nifty on the edge of the Great Sandy Desert (M. Bamford pers obs.). It is found in rocky areas with a preference for deep gorges with streams and permanent pools (Pearson 1993, Burbidge 2004). Waterholes are an important feature for this species as they wait there to ambush prey (Pearson 2006). In the warmer months there is a preference for riparian habitats while in the cooler times, Olive Pythons utilise rocky habitats such as escarpments, mesas, caves and gorges (Doughty *et al.* 2011).
Ecology:	Usually found in proximity to water, although breeding males and juveniles may disperse widely (Burbidge 2004). Males can travel distances of up to 4 km during the breeding season (June to August) to locate females (Pearson 1993). An ambush predator that feeds predominately on mammals and birds (Burbidge 2004). There may be seasonal movement between watercourses and upland rocky landscapes (Doughty *et al.* 2011).

Expected occurrence:	Resident. The DBCA threatened database search identified 24 records within the surrounding area. The majority of these records lie further east along the Robe River with the nearest being 5km from the project area. The Rio Tinto Mesa H report (2019) documented an additional six along the Robe Valley including one record at the northern stretch of Mungarathoona Creek at a permanent waterhole which is located within 300 metres of the project area. Biological surveys undertaken by environmental consultants have recent records within the vicinity at Mesa H (Astron 2016), Bungaroo (Astron 2016a) Middle Robe/East Deepdale (Astron 2016b) and Yarraloola (Biologic 2014). While the species was not detected during field investigations, the species is almost certainly present as a resident. The major watercourses (such as Mungarathoona Creek just east of the mine area and Warramboo Creek at the southern haul road route) provide suitable habitat, and rocky areas including the mesa of the mine area may be used for shelter during the cooler months.

Fork-tailed Swift (*Apus pacificus*)	**CS1 (M,S5)**
Conservation status:	Migratory under the EPBC Act and Schedule 5 under the BC Act.
Distribution and habitat:	The swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (Higgins 1999; DAWE 2021a). Aerial, usually flying in excess of 300 m above the ground but sometimes almost at ground level.
Ecology:	A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (Higgins 1999; DAWE 2021a). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.
Expected occurrence:	Irregular visitor. Likely to be occasionally and unpredictably present within the region and to pass over the project area on an occasional basis.
Grey Falcon (*Falco hypoleucos*)	CS1 (V, S3)

Conservation status:	Vulnerable under the EPBC Act and Schedule 3 under the BC Act.
Distribution and habitat:	Sparsely distributed through central, northern and north-western Australia, this species appears to have a distribution that is centred around wooded ephemeral or permanent drainage lines (Menkhorst *et al.* 2017).
Ecology:	An aerial, diurnal predator that predominantly forages on pigeons and parrots, although may also take invertebrates, reptiles and small mammals (Debus 2019). Sedentary when seasonal conditions are favourable, nomadic in times of drought (Debus 2019).
Expected occurrence:	Regular visitor. Given the proximity of the Robe River valley and associated riparian woodlands, the species is expected to be at least a regular visitor to the northern part of the project area and could also forage along Warramboo Creek. It was not recorded during field investigations and is usually quite conspicuous, but may still be present regularly. Records on Birdlife Birdata website show the nearest sightings 37 km north and 40 km south-west along the North-West Coastal Highway.
Peregrine Falcon (*Falco peregrinus*)	CS1 (S7)
Conservation status:	Schedule 7 under the BC Act.
Distribution and habitat:	More or less cosmopolitan and occurs throughout Australia (Menkhorst *et al.* 2017). This species occurs in a variety of environments but is usually reliant on cliff faces or tall trees for nesting (Debus 2019).
Ecology:	A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus 2019). Mostly diurnal or crepuscular.
Expected occurrence:	Resident. The project area is likely to be within the home range of a pair, and cliff faces in the project area provide suitable nest sites for breeding. The Peregrine Falcon have been recorded 37 and 47 km south-east in the Hamersley ranges in gorge habitats through the DBCA threatened species search. The study area may provide suitable habitat for breeding and foraging given the likely presence of cliffs and large trees.
Migratory waders (shorebirds) (at least four species)	**CS1 (M, S5 [C, S2,S3])**

Conservation status:	Migratory under the EPBC Act and Schedule 5 under the BC Act, with some species also listed as Schedule 2 or 3 under the BC Act.
Distribution and habitat:	Migratory wader species that may occur in any areas of suitable habitat throughout Australia, including wetlands, coasts, rivers, lakes, mudflats, mangal and man-made water bodies (e.g. salt ponds and sewage ponds), although some species (e.g. pratincoles, Little Curlew) also utilise dryland habitats (Hayman *et al.* 1991). These species are not just reliant on permanent water bodies and will also regularly use ephemeral wetlands and drainages when suitable conditions prevail (Hayman *et al.* 1991).
Ecology:	Migratory waders generally forage diurnally for aquatic invertebrates from wetland substrates and, within the group, have a diverse range of foraging strategies and body forms (e.g. bill morphology) to reflect specialisations towards specific foraging niches (Hayman *et al.* 1991; Rogers *et al.* 2003). These species breed in the higher latitudes of the northern hemisphere and migrate south (including Australia) for the non-breeding season (Hayman *et al.* 1991; Rogers *et al.* 2003). While some species make this journey almost non-stop, most require stopover points along the route to 'refuel' and internationally important staging sites have been identified by Bamford *et al.* (2008). Migratory waders are most abundant in Australia in the non-breeding season (the austral summer) but some birds may be present at any time of year (especially in northern Australia).
Expected occurrence:	Irregular visitors. The project area provides little habitat for these species, but small number may occasionally visit drainage systems, and temporary flooding of claypans may also provide small areas of habitat for brief periods. The Oriental Pratincole can appear in large numbers for short periods of time to catch flying insects.
<u>Night Parrot</u> (*Pezoporus occidentalis*)	CS1 (E,S1)
Conservation status:	Endangered under the EBPC Act and Schedule 1 under the BC Act.
Distribution and habitat:	Highly elusive and known from only a very small number of records, it is difficult to ascertain the distribution and habitat of this species. DAWE (2021k) lists central Western Australia, north-eastern South Australia and south-western Queensland as 'core' areas, although the Night Parrot may occur throughout any part of inland Australia. Habitat associations are also tenuous but the species may occur in areas of spinifex grassland and/or chenopod shrublands, or in areas of shrubby samphire (TSSC 2016c). DBCA (2024), while including the Hamersley bioregion as a 'high priority survey area' for the species, also notes that "At the landscape scale, Night Parrots require two distinct habitats: 1. patches of low, dense vegetation in which they roost during the day [typically long-unburnt spinifex]; and 2. nearby floodplains or other low-lying areas supporting diverse assemblages of native grasses and herbs in which to feed at night."

Ecology:	The Night Parrot was recorded more or less regularly through the late 19th Century but appeared to decline early in the 20th Century, with a lack of reliable records from the 1930s to the end of the century leading to some speculation that it was extinct. In the early 20th Century, however, there have been multiple records including in the eastern Pilbara, northern Murchison and western deserts of Western Australia (Davis and Metcalf 2008; Hamilton *et al.* 2017; Jackett *et al.* 2017), and a population has been studied in south-western Queensland since 2013 (DAWE 2021k). The species has been mired in controversy due to the implications of records close to development proposals, and after researchers falsified recordings and subsequently retracted recent Night Parrot records from South Australia (Jones *et al.* 2019). It is likely to be predominantly nocturnal and granivorous.
Expected occurrence:	Vagrant. While the project area does support spinifex, including areas that are long-unburnt, there is no favoured suitable foraging habitat (floodplains or other low-lying areas supporting diverse assemblages of native grasses and herbs) as described by DBCA (2024). The species could still occur as a vagrant, but it would effectively be undetectable even if present as dispersing individuals. BCE described a Vagrant as 'a species that occurs within the project area unpredictably, in small numbers and/or for very brief periods.' There are no recent records in the western Pilbara despite increased survey effort. DBCA (2024) guidelines describes at length the need for roosting and foraging habitat. Roosting habitat (spinifex; often long unburnt) was present and widespread, with some areas long unburnt, but such an environment can be found across vast tracts of the region. Foraging habitat is more likely to be limited, and consists of species-rich grasslands and herbfields often associated with paleo-drainage systems. Such landscapes do not occur in the project area or nearby. This is not to say the Night Parrot could never be present, hence the conclusion that it might occur as a vagrant. The definition of 'vagrant' used by BCE is a 'species that occurs within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species'.

Northern Quoll (*Dasyurus hallucatus*)	**CS1 (E,S2)**
Conservation status:	Endangered under the EBPC Act and Schedule 2 under the BC Act. With a former range from The Pilbara and the Kimberley across to south-eastern Queensland, the species has suffered a large population decline due to many factors, but most recently linked to the spread of the introduced Cane Toad. The Pilbara population is considered to have been declining since the mid-1980s with the precise causes unknown (DAWE 2021c).

Distribution and habitat:	In Western Australia this species is often associated with rocky areas in the Pilbara (but also occurs along watercourses and beaches) and occurs through forests, savannahs and dissected rocky environments in the Kimberley (Van Dyck and Strahan 2008; DAWE 2021c). It also occurs, patchily, across northern Australia to Queeensland (Van Dyck and Strahan 2008; DAWE 2021c). The Pilbara population inhabits complex, rocky areas across the north, central and west Pilbara, and with recent records from the far eastern Pilbara (Turpin and Bamford 2015). According to Nature Map location records (Cramer *et al.*, 2016), it is less common through the south and east of the Hamersley Ranges than elsewhere in the Pilbara. High quality habitat is considered to be rugged, rocky areas associated with ironstone ridges, basalt mesas and gorges generally in close association with permanent water (Begg 1981; Schmitt *et al.* 1989; Braithwaite and Griffiths 1994; Oakwood 1997). Northern Quoll den sites are often in rock crevices, with surrounding vegetated habitats used for foraging and dispersal (TSSC 2005). Den sites may also include tree hollows, logs, termite mounds and goanna burrows, but these are used less frequently than rocky habitats. Rocky areas also provide refuge from feral cats, fire and livestock. The region around the project area is a stronghold for this species with the DBCA search documenting 502 records within a 50km radius. Previous surveys as part of a biological survey west of Mesa H (10-15 km E) recorded Northern Quoll on 27 occasions (Astron 2016). The majority of records were found in the breakaway habitat with some records in the riverine and gorge habitats. There appears to be a significant population along the western edge of Mesa H with several dozen recorded on the DBCA threatened species search.
Ecology:	A predominantly nocturnal predator of invertebrates, amphibians, reptiles, birds and small mammals (Van Dyck and Strahan 2008). Northern Quoll may be both terrestrial and arboreal (Van Dyck and Strahan 2008). This species undergoes a post-breeding male-die off (semelparity), with most individuals (including females) only surviving for one or two breeding seasons (Van Dyck and Strahan 2008). Home ranges are overlapping; on average 35 ha for females and 100 ha for males (Oakwood 2008; Hernandez-Santin *et al.* 2021).

Expected occurrence:	Resident. The project area lies in a region where the Northern Quoll has been consistently recorded and is widespread and abundant. In addition to the large number of records across the region, there have been several recent nearby records including Mesa A (Biota 2005) (12km NW) and North of Red Hill (Biota 2009) (7km S). During field investigations, the Northern Quoll was recorded on all field trips on cameras (23 locations), and with secondary evidence in the form of tracks and scats being widespread. Records were on the mesa edge, on top of the mesa, on an isolated rocky hill near Transect 1 (Plate 1), along drainage lines (including Warramboo Creek along the southern haul road route; Plate 2) and even on sandy flats several hundred metres from rocky landscapes. The major rocky landscapes were clearly the focus of the population, with the majority of cameras set around the mesa edge recording the species, but drainage lines were also supporting the species, and individuals were moving across the plains. The top of the mesa was a sparse environment but likely to be used for movement and some foraging. The lower slopes of the mesa, plains and drainage lines are likely to be important for dispersal and foraging.

Plate 1. Northern Quoll caught on camera (rocky hill near Transect 1) in September 2022.

Plate 2. Sandy bank of Warramboo Creek near the southern haul road route showing multiple Northern Quoll tracks (July 2022).

Ghost Bat (*Macroderma gigas*)	**CS1 (V, S3)**
Conservation status:	Vulnerable under the EPBC Act and Schedule 3 under the BC Act. The major threat to Ghost Bat populations are habitat loss and degradation due to mining activities (TSSC 2016a). Ghost Bats are easily disturbed when roosting and disturbance threatens the viability of roosts with unregulated human visitation. The Cane Toad is also a threat and there are anecdotal reports of Ghost Bats disappearing from the eastern Kimberley following arrival of the Cane Toad. The Pilbara Ghost bat population is estimated at 1500-2000 individuals (Bat Call 2017; TSSC 2016a). Current population estimates in the Hamersley and Chichester subregions are approximately 350 and 1500 respectively. The current Pilbara population is discontinuous, with geographically disjunct colonies occurring. The Pilbara population has decreased by at least 30% and a future estimated decline of 30% over the next 20 years with a decrease in range expected, particularly in the central and eastern Hamersley Range (TSSC 2016).

Distribution and habitat:	Occurs in discontinuous populations through northern Australia, including a Pilbara population and a Kimberley-Northern Territory population (Van Dyck and Strahan 2008; Churchill 2009; TSSC 2016). The Ghost Bat occurs in a broad range of environments including grasslands, forests, open woodlands and rainforests (Churchill 2009; TSSC 2016). Ghost Bats require foraging habitat and suitable roosting opportunities. There are two types of roosts: maternity roosts that may be permanent and support breeding, and non-breeding roosts roost that may be permanent or semi-permanent and support non-breeding animals. A key feature of maternity roosts is an interior chamber that is rising toward the rear thereby trapping warmer and more humid air at the top, allowing suitable conditions to form when reproductive females and pups are present (Armstrong and Anstee 2000; Churchill 1991; Churchill and Helman 1990). For a population to persist, Bat Call WA (2017) describes the requirement for an "apartment block" of roosting opportunities, with at least one deep cave that has characteristics of a maternity roost, multiple caves/shelters and overhangs in close proximity offering nocturnal feeding and refuge opportunities, a productive set of gullies and gorges locally, a productive foraging area within 5-10 km radius, usually including a good quality riparian line or ephemeral fresh water, and appropriate protection from human interference. Bullen *et al.* (2023) reported that the species will forage widely over open woodland and at an average distance of 8.5km (maximum 17.7km) from the roost.
Ecology:	A nocturnal predator of vertebrates including frogs, reptiles, birds and mammals, including other bats (Van Dyck and Strahan 2008; Churchill 2009; Claramunt *et al.* 2019). Ghost Bats may also take large invertebrates (TSSC 2016b). Unlike other microchiropteran bats, the Ghost Bat hunts visually (rather than using echolocation continuously) and may either perch in vegetation and ambush prey, or glean prey off 'surfaces' such as the ground (Van Dyck and Strahan 2008; TSSC 2016b). Ghost bats use daytime roosts in caves, rock crevices and old mines with a relatively stable temperature of 23°−28°C and a moderate to high relative humidity (Churchill 2009; TSSC 2016b).

Expected occurrence:	Resident. There are multiple existing records of the Ghost Bat in the region (75 records within 50km in the DBCA threatened fauna database), and these records include at least one confirmed maternity roost in a gully on the mesa about 650m south of the project area. This roost supported about 70 animals in 2017 (Bat Call WA 2017). Two further possible maternity roosts are known from nearby (Astron 2017), and a recent population estimate suggested the lower to mid Robe Valley supports about 150 Ghost Bats (Bat Call 2017; TSSC 2016). In May 2021 there were 16 primary records of Ghost Bats (observed; other records were of scats at the entrance to caves), with most of these being animals observed along the mesa edge but one over the camp on the plain. The highest count was of seven animals emerging from the known maternity roost area south of the project area (27/05/21), while the highest count within the project area was of three animals (28/05/21). These animals in the project area emerged from caves in the gully on the western side of the mesa, but there were also records from the east of the mesa. There were two records (three animals) from the evening bat-watch along the west side of the mesa in October 2021, while no Ghost Bats were seen during evening watches on two evenings in September 2022. This included one evening observing the known maternity roost, and while observations were made on only one night at this location, results suggest that the maternity roost was not in use in that year. Ghost Bat records were scattered around the margins of the mesa in the project area, but numbers seen were always low. There were no aggregations of Ghost Bat droppings that suggest use by large numbers of animals, only scattered and small numbers (<10) of droppings near the entrance of the largest caves in the western valley. Evening bat-watches took place in the breeding season in 2021 and 2022, and result suggest that the caves along the mesa edge in the project area are used by small numbers of non-breeding animals. This is consistent with the structure of the caves, which were generally shallow, going back up to about 10m but lacking the vertical interior chamber and deep recesses with high humidity and stable temperatures suggested to be important for maternity roosts. The structure of the cliff line is such that between larger caves there are many small crevices, overhangs, nooks and crannies, and the bats appear to be making use of a variety of shelter locations. A total count could not be made across the project area, but across three evenings and in different locations in May 2021, eight Ghost Bats were counted.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara))	**CS1 (V,S3)**
Conservation status:	Vulnerable under the EBPC Act and Schedule 3 under the BC Act. The Pilbara Leaf-nosed Bat is under threat due to expanding mining activities in the Pilbara and future collapse of mine adits currently used for roosting (Cramer *et al*. 2016; TSSC 2016b). Most of the known natural roosting sites coincide with areas of current or future interest for mining development; hence mining activities are an identified threat to Pilbara populations of the species (DotEE 2017b).
Distribution and habitat:	The Pilbara Leaf-nosed Bat occurs within the Pilbara where it is limited in distribution by the availability of very hot (28-32 °C) and very humid (96-100%) roost sites in caves and/or abandoned mine voids (Armstrong 2001; Van Dyck and Strahan 2008). These are

especially important as maternity roosts. Populations of the Pilbara Leaf-nosed Bat are found in three distinct areas: in the mines of the eastern Pilbara, scattered throughout the Hamersley Range in small colonies, and in sandstone formations south of the Hamersley Range (Armstrong 2001). Bat Call WA (2021) has identified 48 known category 1 (proven maternity roots) and 2 roosts (continuously used but breeding not confirmed), with the majority of these in the Hamersley Range, at least two within 20km of the Mesa F project area. There are also populations of the non-Pilbara form of the Orange Leaf-nosed Bat (*R. aurantia*) in the Kimberley and Northern Territory (Van Dyck and Strahan 2008).

Ecology: A nocturnal, aerial insectivore (DAWE 2021d). Populations spread from diurnal roosts to satellite roosts when wet season conditions allow, to then consolidate back to permanent sites during dry periods (Bat Call 2013). Foraging habitat is diverse and includes riparian vegetation, hummock grassland, and sparse tree and shrub savannah (Duncan, Baker and Montgomery 1999). It is known to have a usual foraging range up to 20 km from its primary roost caves but appears to require a permanent water site within 5 km (Bat Call 2013).

Expected occurrence: The Pilbara Leaf-nosed Bat has been recorded 119 times across the Robe Valley according to DBCA threatened species search and Rio Tinto database (Rio Tinto 2019). The records are concentrated around areas of significant roost sites, often associated with disused mine infrastructure. Within the vicinity of the project area there are four records, one along Mungarathoona Creek (just south of Robe Pool) and three records within 1 km of the project area: one along the Robe River to the north and two on Mesa F. The Rio Tinto report (Rio Tinto 2019) states that Mesa F was surveyed for potential roosts and no Pilbara Leaf-nosed Bat roosts were discovered.

Useful data on the species were collected from detectors in from May 2021 (outside breeding season) and September 2022 (breeding season). During the May 2021 survey, five of the ten bat detectors recorded Pilbara Leaf-nosed Bat calls). Three records were on the margins of the mesa (both east and west), while one was detected over camp and one at the known Ghost Bat maternity roost site south of the project area. Most of the records were late at night, but one record in the western valley was at 0630hrs (28/05/2021) suggesting an animal possibly preparing to roost in that area.

In September 2022, the species was recorded at three of the five locations sampled, and was recorded most often along a eucalypt-lined creek near a stock well about 1km east of camp. It was also recorded over the camp. The earliest of the records at the stock well were 39 minutes after sunset and 17 minutes after last light, suggesting a roost within a few kilometres. The last records were consistently between 02:30 and 03:30 hours. The stock well is alongside a tree-lined creek and possibly the bats were following this line of vegetation. Other records at other locations, including on Mesa F, were late at night. Given the consistent lack of large numbers of records in the mesa area and the time of year, this observation at the stock well suggests that there may be a maternity roost to the south or south-east of the stock well location. There are some existing records to the south and many to the east.

<u>Cave assessment:</u>

As with the Ghost Bat, the cave structures within Mesa F appeared suitable for seasonal roosting Pilbara Leaf-nosed Bats, but were probably not suitable for maternity roosts. They thus align most closely with category 3 and 4 roosts as defined by Bat Call WA (2021), which are roosts used only seasonally and not for breeding. Category 3 roosts are

diurnal (thus provide shelter during daylight) and are considered critical habitat. Category 4 roosts are used intermittently at night for shelter and are supporting habitat. Cave structure did not appear to include the deep recesses needed by the species for the favoured high humidity and near-constant, high temperature; the caves were open and shallow, and much of the cliffline was a complex of caves, overhangs and shallow shelters. The cliffline was highest and caves most clearly formed in the west and north, particularly in the western valley. Even caves in this area, while large, were shallow and did not extend more than 5-10 back from the cliff face. Bat Call WA (2021) describes known category 1 and 2 roosts, and they are deep and often with narrow sections connecting chambers. Pilbara Leaf-nosed Bat records were generally made late at night or about an hour before sunrise, suggesting the animals had travelled some distance from a roost site before they were detected. It therefore appears that they were not roosting regularly on the mesa edge at the time studies were undertaken. The western valley is where the caves with the most potential for category 3 and 4 roosts are located.

Overall, the pattern of bat records suggests low levels of usage (thus the categorisation) of priority 4 roosts, with possible/probably priority 3 roosts in caves in the western valley and perhaps along the western and northern mesa edge). Both flanks of this western valley were cliffs with caves at the base of the cliff (see Plate 6 which illustrates the complex nature of the breakaway). These caves were mostly only a few metres deep but with narrow recesses that could not be entered. The base of the cliff was considered an overhang with multiple recesses of varying depth, but with no deep chambers of the sort favoured by these bat species for major roosts.

The lack of large aggregations of bat droppings at the entrances, and the low number of actual bat records, further suggests that at least at the time of the surveys, large numbers of bats were not present. This scarcity of records suggests the caves do not have the features favoured as significant roosts.

This does not mean the mesa is not important for the bats, but that it appears to support bats only for part of the year and in small numbers. The structure of the landscape and the bat records suggest this. The bats do need this sort of landscape for dispersal and to forage widely, and therefore the mesa edge is valuable, and usage should be monitored. Note that the most important observation on bats was probably of PLnB moving along a drainage line shortly after sunset in September 2022, suggesting a maternity roost located to the south.

Although caves were assessed around the mesa but were not assigned categories as outlined in the DCCEEW conservation advice on the species (Threatened Species Scientific Committee (2016). The mesa landscape did not lend itself to the use of such categories as the mesa edge was a breakaway with more or less continuous overhangs, depressions, undercuts and shallow caves. It was thus difficult to recognise discrete locations. It was noted, however, that there was a large valley in the west with several probably interconnected caves, and that the western and northern mesa edge was a higher breakaway with more crevices than the eastern/southern edge. ARUs were deployed in May 2021 (10 locations), October/November 2021 (10 locations), July 2022 (4 locations) and September 2022 (5 locations). However, devices either failed or recorded no significant bat species in October/November 2021 and July 2022. Thus, useful data only from May 2021 (outside breeding season) and September 2022 (breeding season). Locations in these two surveys were around the mesa, close to pools along drainage lines, at isolated rocky hills, on the plains and alongside a tree-lined dry creekbed. Very

few records were obtained even when units were placed to a previously recorded maternity roost site, but this probably reflects annual variation in the use of that site.
In May 2021, there were single records on the flats, near a drainage line (upper end of Mungarathoona Creek), on both eastern and western sides of Mesa F, and outside a cave system previously identified as a maternity roost site. It was concluded that 'the cave structures within Mesa F appeared suitable for seasonal roosting Pilbara Leaf-nosed Bats, but were probably not suitable for maternity roosts. Pilbara Leaf-nosed Bat records were generally made late at night or about an hour before sunrise, suggesting the animals had travelled some distance from a roost site before they were detected'. Such usage would be consistent with the caves of the mesa serving as temporary nocturnal roosts outside the breeding season for the PLnB (nocturnal refuge – priority 4), although they may also be used by small numbers of animals as diurnal roosts (priority 3). The most likely location of priority 3 roosts would be in the western valley.
In September 2022 (Table 25), there were no records around the mesa, a single record along Mungarathoona Creek, and multiple records around the camp and particularly at the tree-lined dry creekbed in the south (Figure 32 of the report). The timing of recordings at the creekbed (within 17 minutes of last light) suggests a moderately large roost (probably a maternity roost), probably in hills to the south (indicated by the lack of large numbers of records elsewhere in the project area at the time). An ARU set at the large valley in the east of the mesa detected no PLnB, and nor did an ARU set on an isolated hill nearby. While not conclusive, this suggests limited roosting activity during the breeding season in Mesa F at least at the time of the surveys. Thus, the caves may have limited value as impermanent roosts during the breeding season.
As noted, the caves appeared to be shallow and to lack the depth and high humidity favoured by the species.
Overall, it would appear the PLnB roosts nearby and enters the project area to forage, and probably occasionally to roost in small numbers, particularly outside the breeding season. There will be buffer zones to protect the mesa edge and major drainage systems, and hydrological impacts will be minimised, but monitoring is recommended.