Lynas Find Project - Preliminary Documentation

EPBC Act Referral 2023/09471

Prepared for Pilbara Minerals Limited

25 November 2024

Project Number: TE23060

DOCUMENT CONTROL

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2.0	Updated following Pilbara Minerals Review	07/11/2023	AJ	GB	AJ
3.0	Updated following DCCEW RFI	07/06/2024	AJ	GB	AJ
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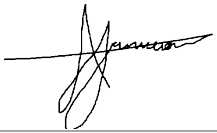
5.0	Updated following resolution of bat offsets	25/11/2024	AJ	GB	AJ

Approval for Release

Name	Position	File Reference
Ami Jamieson	Senior Environmental Consultant	TE23060_Lynas Find Preliminary Documentation_5.0_tracked
Signature		

Executive Summary

Pilbara Minerals Ltd (PLS) operates the Pilgangoora Project, located approximately 80 km SSE of Port Hedland in the Pilbara region of Western Australia. The Pilgangoora ore bodies form one of the largest hard rock lithium deposits in the world and is considered strategically important within the global lithium supply chain.

The Lynas Find Project (the Proposed Action) is a proposed open pit mine and waste rock landform (WRL) located to the north of the current operations, as well as miscellaneous supporting infrastructure including transport corridors and topsoil stockpiles. Ore removed from the Lynas Find pit will be processed at the current Pilgangoora site.

Implementation of the Proposed Action will require vegetation clearing of the proposed areas, as well as removal of a portion of rocky ridge that represents fauna habitat for the Northern Quoll. The Northern Quoll is listed as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Proposed Action was referred by the proponent on the basis of potential impacts resulting from a loss of habitat.

The Proposed Action is located within 2.2 km from the East Turner River - Birthday Gift Roost. In accordance with Batcall (2021) this roost is categorized as a level 2 but was abandoned somewhere between 2018 and 2019. A Conservation Significant Bat Management Plan (CSBMP), which includes monitoring of conservation significant bats, has been developed.

The Proposed Action is located within 2.2 km from the East Turner River - Birthday Gift Roost. Although this roost is categorized as a level 1 or 2 roosts, it was found to be abandoned somewhere between 2018 and 2019.

This Preliminary Documentation has been prepared to provide an outline of the potential impacts of the Proposed Action, as well as the proposed mitigation strategies PLS intends to implement to minimise the impact. This will be submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for assessment.

Persons involved in the preparation of the Preliminary Documentation include:

- Ami Jamieson – Senior Environmental Consultant – Talis Consultants;
- Dr Greg Barrett – Principal Environmental Consultant – Talis Consultants;
- Erin Jackson – Spatial Consultant; and
- Eulogio Almanza – Manager of Environment – Pilbara Minerals.

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1 Introduction

1.1 Description of the Action

1.1.1 Summary of Proposed Action Components

The Proposed Action is a component of a larger project – the Pilgangoora Project, operated by PLS since 2018. The Proposed Action includes construction of an open pit mine (Lynas Find Pit) and WRL (Lynas Find WRL) to the north of the current Pilgangoora operations, as well as necessary supporting infrastructure including access and haul roads, laydown areas, and topsoil stockpiles as required. A layout plan has been provided as Figure 1-1, and includes the infrastructure to be constructed for the Proposed Action, as well as information on the surrounding areas that may be impacted through implementation of the Proposed Action.

1.1.2 Activities and Operational Requirements

Mining of the Proposed Action area will be undertaken using routine open pit mining methods, including:

- Land clearing and site preparation (including stockpiling of topsoils);
- Drill and blast activities;
- Excavation and haulage of material; and
- Closure and rehabilitation activities.

The development of the Lynas Find Pit is planned in two stages: Stage 1 – developing the pit to a maximum depth of 190 mAHD for the purpose of providing a direct ship ore product. Stage 2 progresses to 110 mAHD. Stage 1, to 190 mAHD, does not progress below the prevailing water table at the site and therefore is not anticipated to have any significant impacts on the local groundwater environment (GRM, 2017). Stage 2, however, is anticipated to extend up to 80 m below the prevailing water table and require dewatering (GRM, 2017).

Waste rock will be transported by haul truck to the Lynas Find WRL, which may also be used to store waste rock from other locations in the broader project area.

Ore will be transported to an existing process plant where it will be crushed and processed to produce lithium and tantalite concentrates for export.

Due to the short life of the Proposed Action, no maintenance works are expected to be required.

1.1.3 Location

The current Pilgangoora operations are located approximately 80 km SSE of Port Hedland in the Pilbara region of Western Australia, and the Lynas Find deposit is located approximately 5 km to the north of the existing operations. A locality map has been provided as Figure 1-2.

The Proposed Action includes a Development Envelope of 394.86 ha, of which 26.32 ha will comprise of open pit disturbance, and 61.02 ha of disturbance for the WRL, totalling 87.34 ha of total disturbance. Included in the proposed disturbance footprint is a buffer of approximately 23 ha, which allows peripheral disturbance for low impact associated infrastructure such as access roads and topsoil stockpiles.

Within the Development Envelope, 37.54 ha will be classified as an avoidance area, which will not be disturbed by PLS mining activities. This area includes rocky ridges that have the potential to be utilised as denning habitat for the Northern Quoll, and as such, all efforts will be taken to preserve this habitat.

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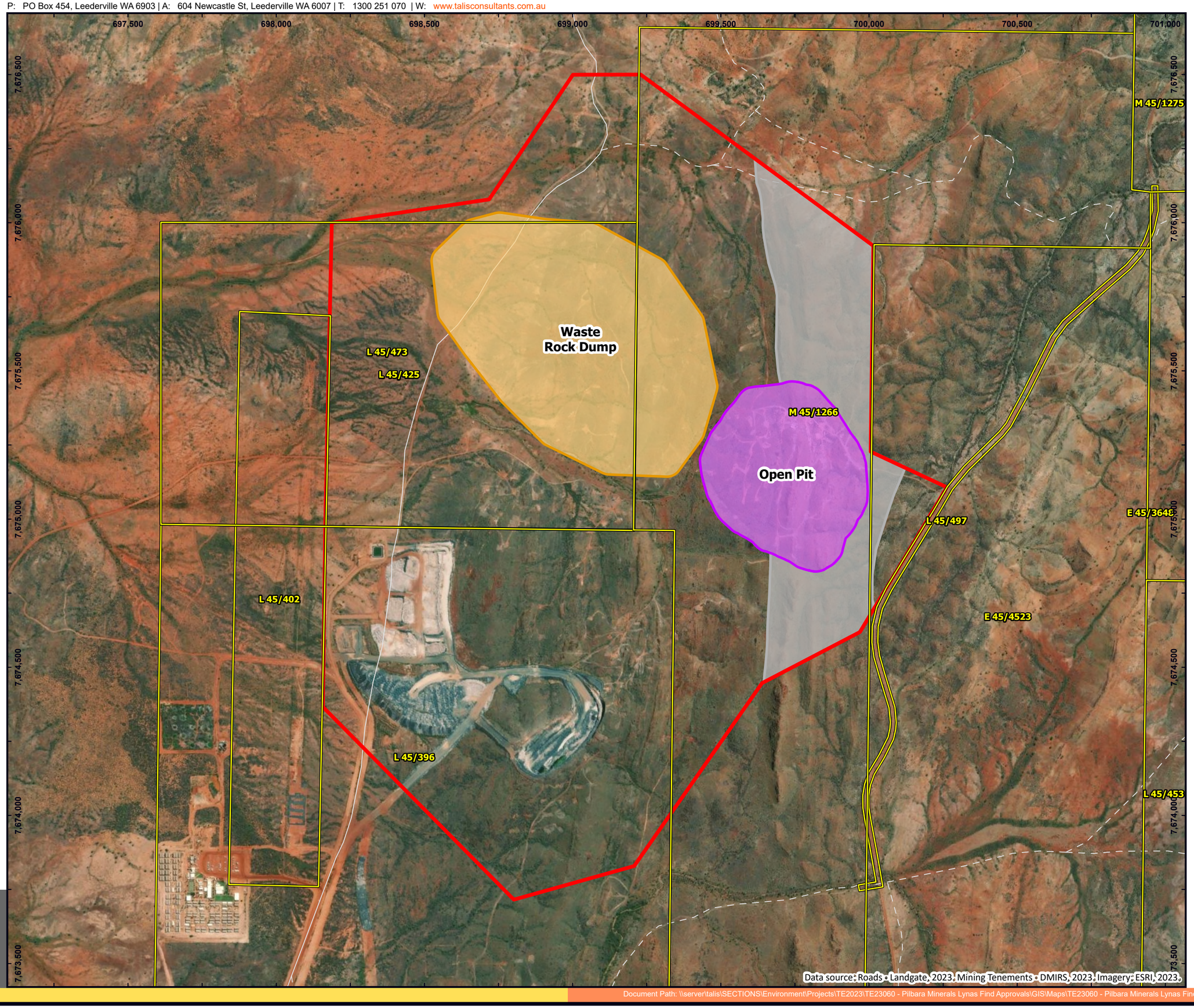

LEGEND

- Lynas Find Mine Development Envelope
- Mining Tenements

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

Western Australian Roads

- Minor Road
- Other

LOCALITY

0 200 400 600 800 1,000 km

SITE LAYOUT

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 1-1

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660,000 680,000 700,000 720,000 740,000 760,000 780,000 800,000

7,760,000 7,740,000 7,720,000 7,700,000 7,680,000 7,660,000

IBRA REGION: DAMPIERLAND

IBRA Sub-Region: Pindanland

IBRA REGION: GREAT SANDY DESERT

IBRA Sub-Region: McLarty

IBRA Sub-Region: Roebourne

Port Hedland

South Hedland

Marble Bar Rd

Great Northern Hwy

IBRA REGION: PILBARA

IBRA Sub-Region: Chichester

Marble Bar

Data source: Roads, Rail - Landgate, 2023. IBRA Regions - Department of Environment, 2023. Imagery: ESRI, 2023.

LEGEND

- Lynas Find Mine Development Envelope

IBRA Sub-Regions

- Chichester
- McLarty
- Pindanland
- Roebourne

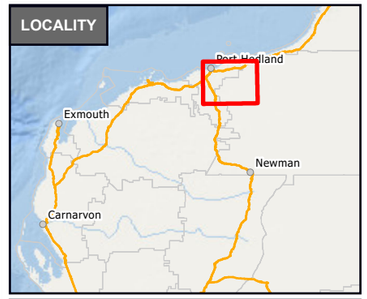
Rail Network

- Railway Stations
- Railway Lines

Western Australian Roads

- Freeway / Highway
- Main Road

LOCALITY



0 200 400 600 800 1,000 km

SITE LOCALITY

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 5 10 15 20 Km

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:500,000

Prepared: E Jackson	Date: 20/09/2023
Reviewed: A Jamieson	Revision: A
Project: TE23060	

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Figure 1-2

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1.1.4 Timing

Mining of the Lynas Find Project is expected to take place over three years, from 2025 to 2027. At the completion of mining, waste rock from future pit operations will be used to backfill the open pit and the surface will be rehabilitated. Rehabilitation of the WRL will be undertaken following final construction, currently expected to be in 2027. Initial rehabilitation works are estimated to take approximately one year, with substantial completion expected in 2028. Monitoring of rehabilitation will be ongoing and will inform the need for any further rehabilitation works required.

1.1.5 Rehabilitation

The Proposed Action will be rehabilitated in line with an approved Mine Closure Plan, which will be submitted to the WA Department of Energy Mines, Industry Regulation and Safety (DEMIRS) prior to commencement of the Proposed Action.

Following operation of the Lynas Find pit, waste rock from adjacent operations within the Pilgangoora Project will be used to backfill the pit. Abandonment bunds will also be constructed where required.

The WRL will be profiled to a slope of 18°, with berms, erosion control structures and water management infrastructure installed as required.

Following final earthworks, the surface will then be rehabilitated, including:

- Application of topsoil to the final landform where available;
- Deep ripping of slopes along the contour; and
- Seeding with local provenance seed.

1.1.6 Details of the Person Proposing to Take the Action

The person proposing to take the action is Pilbara Minerals Ltd (ABN 95 112 425 788). PLS have a satisfactory record of responsible environmental management.

Pilbara Minerals Ltd has not been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources. The proposed action will be undertaken in accordance with their Environmental Policy.

The Environment Policy (Appendix A) governs all PLS mining activities. The Policy includes commitments to “make environmental protection an integral part of business operations and of equal importance with other key operational and strategic business objectives” and to “ensure we are always compliant with all applicable environmental laws and regulations”.

Environmental management is integrated into the normal work practices at PLS by setting clear objectives and targets, having sound systems and controls, ongoing data collection and regular environmental monitoring and reporting.

Since the commencement of the Pilgangoora Project, PLS have embraced the expanded environmental responsibility and continue to meet or exceed statutory requirements. Risks associated with environmental incidents are managed through risk assessments, introduction of preventative measures, ongoing review and monitoring, and where necessary, effective and efficient mitigation actions.

1.1.7 Alternatives Considered

The location of the Lynas Find Project is based on the mineralisation of the ore. This means that the location of the open pit is fixed.

The location of the WRL was originally planned to be located to the south of the pit to reduce haulage distance from the existing Pilgangoora operations. However following the outcome of fauna surveys, the WRL was relocated away from Northern Quoll habitat. The new location of the WRL avoids Northern Quoll denning habitat and is not located adjacent to any major creeks or waterways. This location was chosen to minimise the environmental impact on the landform.

2 Description of the Environment and Matters of National Environmental Significance

The sections below provide an outline of the baseline environment of the Proposed Action, including an assessment of the Matters of National Environmental Significance (MNES) that are known to occur within the Proposed Action area.

Detailed information is provided relating to listed threatened species that occur in the area, as the Proposed Action is likely to have a significant impact on these species.

A brief assessment of other potential MNES and the relation to the Proposed Action has also been provided.

2.1 Baseline Environmental Quality

2.1.1 Current Land Use

The Proposed Action area has been affected by mining and mineral exploration activities, and by cattle grazing. Field survey investigations reported that "Vegetation is predominantly in very good condition with the main disturbances being low to moderate cattle grazing and vegetation clearing for mining activity" (Animal Plant Mineral 2022). The areas proposed for disturbance relating to this Proposed Action have existing mining, mineral exploration and cattle grazing disturbance.

There are no nearby towns with Port Hedland being the closest at approximately 80 km north-northwest of the proposed action. Wallareenya Station homestead is approximately 30 km north-northwest of the proposed action. Indee Station is more than 30 km northwest, Woodgina Camp is more than 30 km southwest, Yandeyarra community is more than 50 km southwest, and South Hedland is more than 75 km north.

2.1.2 Topography

The topography of the general area features a ridgeline to the east of the Proposed Action area, with generally flat land surrounding this topographic feature.

The area of the open pit features a crest of approximately 230 m AHD. The crest is associated with a ridgeline running in a north-south direction. Elevation decreases either side of the ridgeline with the waste rock landform occurring on land with a current elevation of approximately 200 m AHD, declining further to the west (Figure 2-1).

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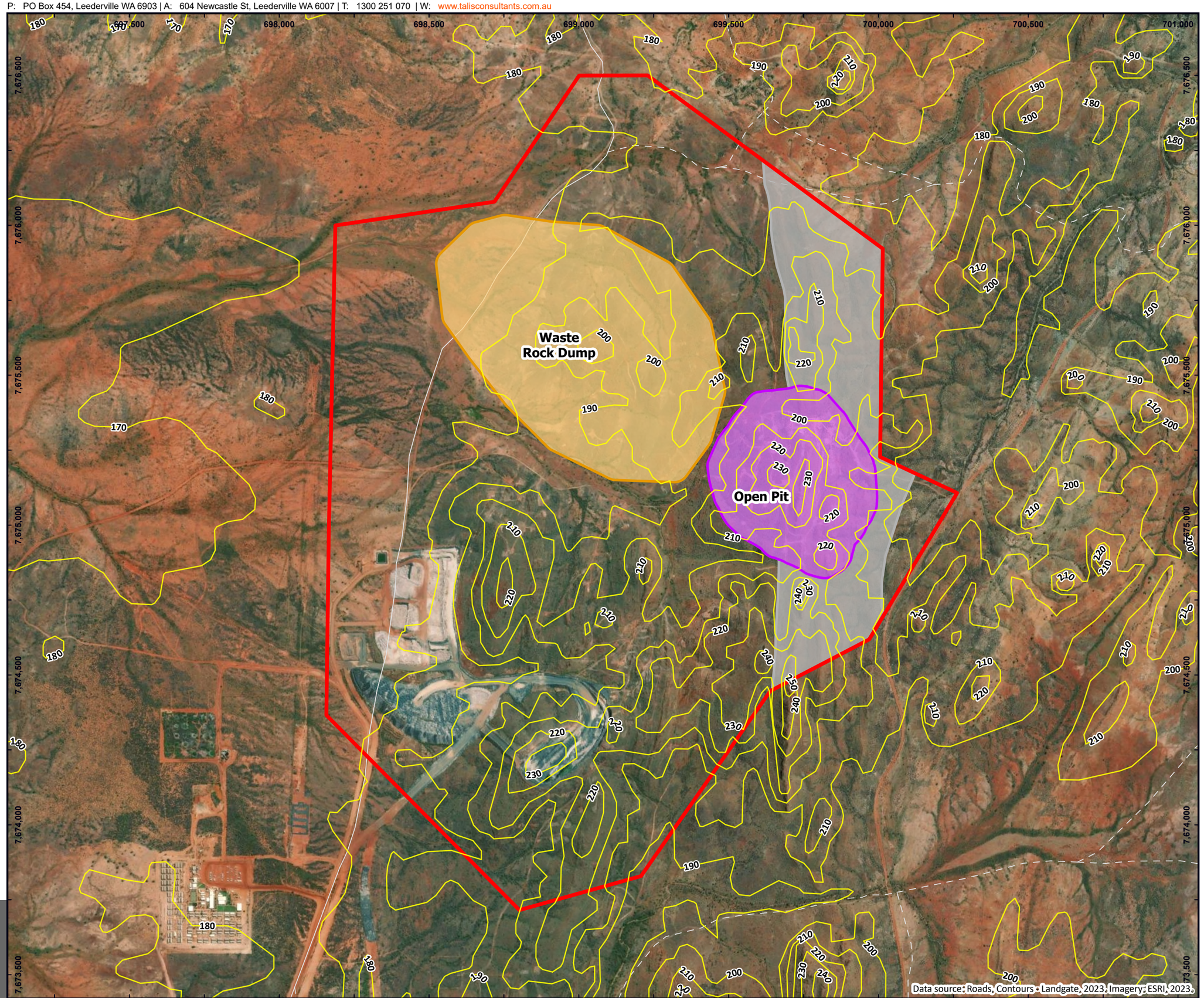


LEGEND

- Lynas Find Mine Development Envelope
- Elevation (m AHD)

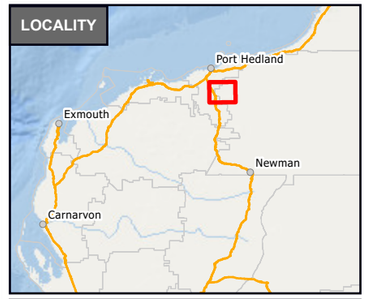
Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

Western Australian Roads

- Minor Road
- Other

LOCALITY



0 200 400 600 800 1,000 km

TOPOGRAPHY

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 2-1

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2.1.3 Water

2.1.3.1 Surface Water

The site lies on the Eastern side of the Turner catchment, near the Strelly River catchment boundary, and within the catchment for Chinnamon Creek.

A hydrological and hydrogeological review was undertaken for the Proposed Action (Pentium Water 2022; Appendix B). The hydrological investigation noted that the proposed pit is at the top of regional catchment boundaries and there will be no natural flow into or around the pit, meaning the pits will only be influenced by direct rainfall. Similarly, the waste rock landform is also near the top of the catchment boundary with minimal upstream flows affecting it. The study recommended bunding of the landform to prevent loss of sediment to local creek systems. PLS will adopt this measure.

2.1.3.2 Groundwater

Testing undertaken at Lynas Find indicates that the water table is between 21 and 35 metres below ground level (mbgl). Groundwater is recharged by direct rainfall or stream flow during episodic high rainfall events, mainly along drainage lines. The general hydrogeology of the area suggests an east to west draining system, with a groundwater divide reflecting the catchment divides.

While no water quality data for the Lynas Find area is available as there are no monitoring bores installed, the groundwater across the Pilgangoora site is likely to be representative of the Lynas Find area. This groundwater is generally neutral to slightly alkaline, fresh to slightly brackish with a sodium chloride type water.

A dewatering assessment was completed, showing that pit inflows are likely to be limited, however installation of an abstraction bore is anticipated to be required when mining at increased depths. Groundwater drawdown is likely to also be limited to areas in close proximity to the pit, meaning that there will be no nearby groundwater dependent ecosystems or groundwater users that may be detrimentally impacted by dewatering at Lynas Find.

Monitoring to better understand dewatering requirements has been recommended and will be adopted. Baseline data for water quality and groundwater level will be collected for at least two years before commencement of dewatering.

2.1.3.3 AMD Potential

In 2023, Mine Waste Management (MWM) completed a report on the environmental geochemistry hazards from waste rock for the Lynas Find Pit.

The MWM report found that risk of acid and metalliferous drainage (AMD) developing is low, with only one sample receiving an AMD classification of ‘uncertain’. This sample is not located within the proposed Lynas Find pit shell, and all other samples were classified as non-acid forming (NAF). Highly negative Net Acid Producing Potential (NAPP) values for some samples indicate that there may actually be net acid consuming material. There were no sulfidic/acid forming minerals identified in the samples tested with some carbonate buffering associated with calcite and dolomite found for basalt, mafic volcanic and ultramafic lithotypes.

There is the potential for saline drainage which may contain potentially elevated levels of Aluminium, Arsenic, Chromium, Nickel and Sulfate. Elements of possible concern identified from the DI (deionised water) leach tests include: Aluminium, Chromium, Copper, Nickel and Zinc. Sulfate was also found to

be elevated in one mafic volcanic and one ultra mafic sample, which could further indicate a risk of saline drainage (MWM, 2023). However, the nature of mineralisation within the Pilgangoora deposits is not one where the 'trace-sulphides' are well endowed with chalcophyles that are soluble at circum-neutral pH. Therefore, mobilisation of metals and subsequent generation of metalliferous drainage is not expected to occur.

No specific mitigation measures are considered necessary for AMD management. Should any PAF samples be encountered in the future, management measures such as encapsulation will be implemented.

2.1.4 Flora and Vegetation

A biological survey (Animal Plant Mineral 2022; Appendix C) was undertaken over the Lynas Find Project area by Ecotec in 2022. This survey recorded nine vegetation types within the area of the Proposed Action (Figure 2-2).

The ridgeline featured vegetation type 10a, described as "Tall, isolated shrubs of *Acacia inaequilatera*, *Atalaya hemiglauca* and *Acacia colei* over a low sparse shrubland of *Hibiscus sturtii*, *Acacia acradenia*, **Aerva javanica*, and *Triodia wiseana*, *Triodia brizoides* and *Triodia chichesterensis* mid open hummock grassland" and covered an area of 10.15 ha. The adjoining hills featured vegetation types 11a and 11b covering a combined area of 125.02 ha consisting of Acacia shrubs over a hummock grassland.

The remaining six vegetation types occurred on minor creek lines or the surrounding plains. Of the overall area of 393.8 ha, 73 ha (18.5%) was already disturbed (inclusive of rehabilitated areas where revegetation has not yet re-established).

One vegetation type (6a) is synonymous with a vegetation type recorded in earlier baseline surveys for the Pilgangoora Project, the remaining eight are different from previously described.

Across the Proposed Action area, 64.6% supported native vegetation in very good condition (254.48 ha). A further 16.9% of the vegetation was recorded as in good condition while 18.5% is degraded (disturbed) (Figure 2-3).

No Weeds of National Significance were recorded. Three weed species were recorded- *Cenchrus ciliaris* (buffel grass), *Cenchrus setiger* (birdwood grass) and *Aerva javanica* (kapok). All three are common throughout the Pilbara region.

Overall, the vegetation is broadly reflective of that encountered elsewhere in the Pilbara with the vegetation being predominantly in very good condition.

2.1.5 Conservation Significant Flora

2.1.6 Fauna Habitat

The Proposed Action area has been identified as potential habitat for a number of threatened fauna species. Six fauna habitats are described for the Study Area (APM, 2022) (Figure 2-4):

- FH1- Boulder rock outcrops (4%)
- FH2- Platy rock outcrops (1%)
- FH3- Low hills (54%)

- FH4- Sandy plains (3%)
- FH5- Stony gullies (2%)
- FH6- Stony plains (17%).

Of these, FH1 was identified as key critical habitat for the Northern Quoll, in line with the referral guidelines on the Northern Quoll with other habitats potentially used by a number of threatened species for foraging. Fauna and fauna habitats are discussed in further detail in section 4.1. An earlier targeted survey confirmed the presence of the Northern Quoll across the ridgeline on which the Lynas Find open pit is proposed (Terrestrial Ecosystems, 2020).

2.1.7 Conservation Significant Fauna

A Biodiversity survey was completed over the area (APM, 2022) which concluded that there were several species of conservation significance potentially occurring in the Proposed Action area. The only threatened species confirmed as present during field surveys within the Proposed Action area were the Northern Quoll and the Pilbara leaf-nosed bat.

Occurrence data from field surveys undertaken over the Proposed Action area have been included as Appendix E.

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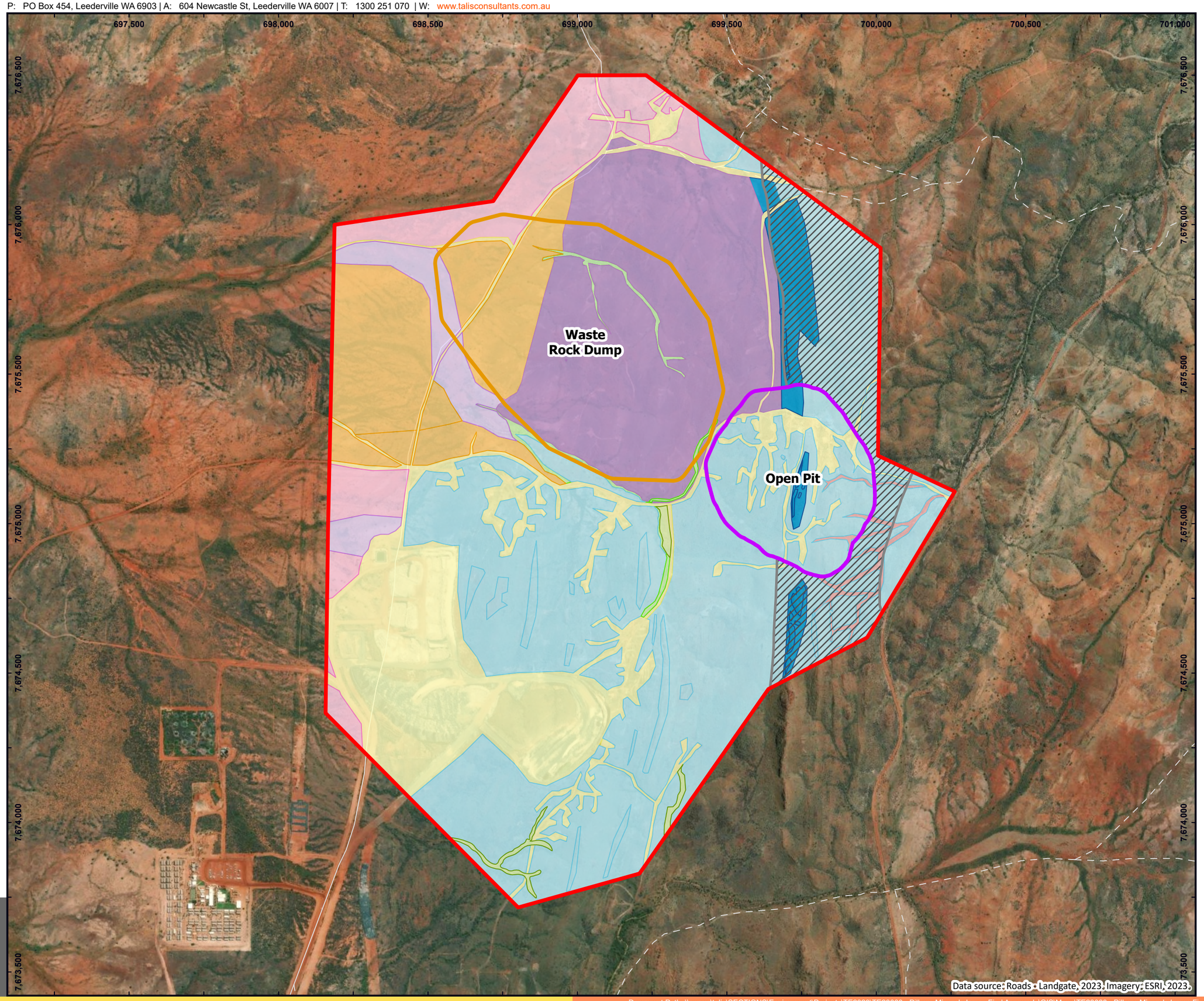


LEGEND

- Lynas Find Mine Development Envelope

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

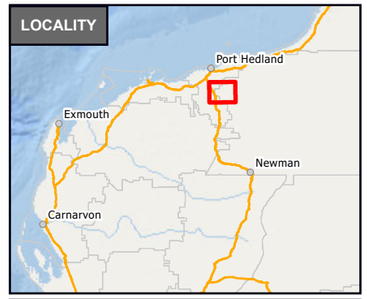
Vegetation

- D
- 9b
- 9a
- 8b
- 8a
- 7a
- 6a
- 11b
- 11a
- 10a

Western Australian Roads

- Minor Road
- Other

LOCALITY



0 200 400 600 800 1,000 km

VEGETATION TYPES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 2-2

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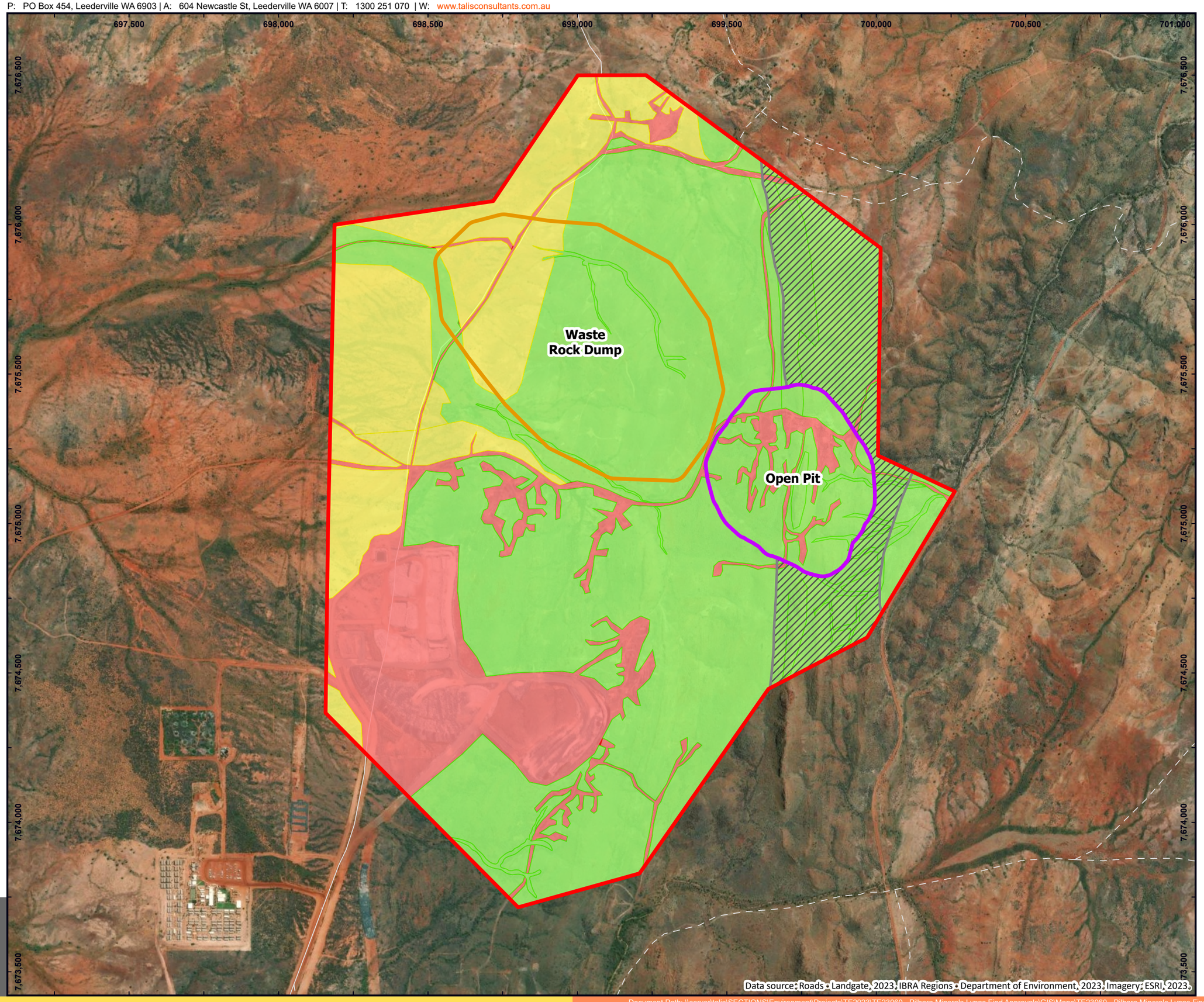


LEGEND

- Lynas Find Mine Development Envelope

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

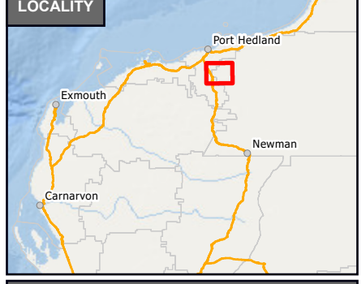
Vegetation Condition

- Completely Degraded
- Good
- Very Good

Western Australian Roads

- Minor Road
- Other

LOCALITY



0 200 400 600 800 1,000 km

VEGETATION CONDITION

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 2-3

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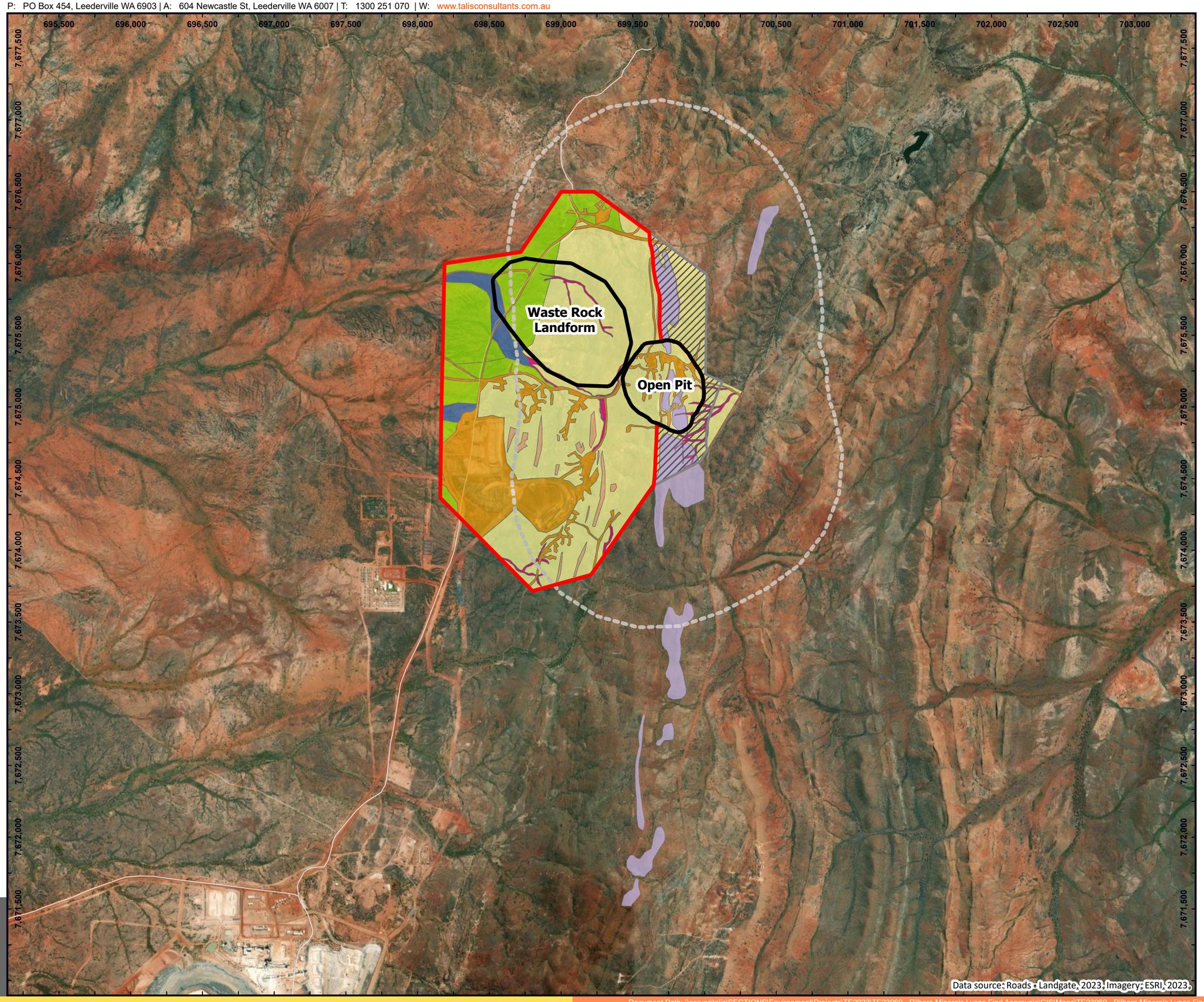


LEGEND

- Lynas Find Mine Development Envelope
- Site Layout
- Proposed Avoidance Area

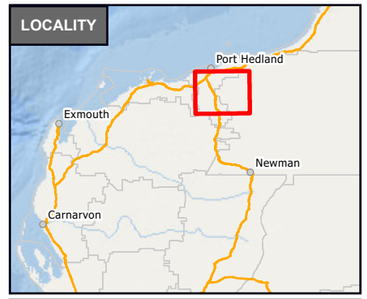
Fauna Habitat Types

- 1 km northern quoll critical habitat buffer
- D
- FH1
- FH2
- FH3
- FH4
- FH5
- FH6

Western Australian Roads

- Minor Road

LOCALITY



0 200 400 600 800 1,000 km

FAUNA HABITAT TYPES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 200 400 600 800 1,000 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:25,000

Prepared:	E Jackson	Date:	6/05/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 2-4

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2.2 Listed Threatened Species

2.2.1 Northern Quoll

2.2.1.1 Surveys

The 2022 APM survey concluded that Northern Quolls were present within the Proposed Action location. Desktop surveys and field surveys that captured the Northern Quoll on camera confirmed the species presence, and Northern Quoll scats provided further evidence of habitation within the area.

A targeted survey has also been completed in November 2019 for the Northern Quoll (Terrestrial Ecosystems, 2020), which confirmed the presence of the Northern Quoll within the rocky ridges in the Lynas Find area. This survey also confirmed the status of the rocky ridges as critical habitat for the Northern Quoll. No Northern Quolls were recorded in any other fauna habitat type as part of this survey.

The biodiversity survey was completed in accordance with the WA EPA Technical guidance for Terrestrial Vertebrate Fauna Surveys (2020) and the targeted survey was completed in line with survey recommendations outlined in the EPBC Act referral guideline for Northern Quoll (DCCEEW, 2016). These surveys are considered adequate for determining the risk to the Northern Quoll in the Proposed Action area.

2.2.1.2 Ecology

Northern Quolls are sedentary, nocturnal, generally carnivorous mammals (DCCEEW, 2023). They are predators of invertebrates; however they will also eat small mammals, reptiles, birds and fruit.

They reproduce annually, with broods of up to eight young. They have a relatively short lifespan, with females only surviving for one or two breeding seasons, while males almost completely die off annually due to the intense physical effort expended in roving during breeding season. This makes the Northern Quoll particularly susceptible to local extinction (DCCEEW, 2016).

Threats to Northern Quoll populations include cane toad toxins, predation by feral cats, fire and habitat fragmentation and degradation.

2.2.1.3 Abundance, Distribution and Habitat

The Northern Quoll is found in the northern half of Australia, including the Pilbara and Kimberley regions in Western Australia. It has been suggested that they are most abundant in broken country, rocky areas, and open eucalypt forest within 150 km of the coast (Oakwood, 2008), however there is no overall population size data available (Hill B.M and Ward S.J, 2010).

They often occur in small, fragmented populations in habitat that includes rugged rocky areas that follow waterways, ironstone ranges, and uprisings of survey granite outcrops (Molloy et al 2017). The rocky habitat provides denning sites, refuge from fire, increased food resources, and is typically not used for livestock grazing purposes (Moro et al 2019). Individual home ranges for Northern Quolls are approximately 35 ha, with an increase of up to 100 ha for males during breeding seasons.

In the Pilbara, the geographic distribution of Northern Quolls is considered fragmented, with its numbers in decline, potentially due to cattle grazing and exotic disease (Braithwaite and Griffiths,

1994), as well as predation and altered fire regimes (Moore et al 2019). Given that the Pilbara habitat is free of cane toads, the populations within the area are likely to be considered important for the long-term survival of the Northern Quoll.

Given the sporadic nature of the sampling undertaken at the Lynas Find Proposed Action area it has not been possible to determine local population numbers. However, it is clear that there are multiple individuals of both sexes present based on camera spotting results (Terrestrial Ecosystems, 2020). Recent overall population of Northern Quoll estimates approximately 100,000 individuals; however, this number is generally considered to be in decline (Terrain, 2022).

2.2.1.4 Habitat Impacts

Within the Proposed Action area 19.83 ha of rocky hills habitat has been mapped with a further 36.21 ha mapped outside the proposed DE to the north and south. These areas constitute critical habitat for the Northern Quoll, and accounts for all the Northern Quoll sightings within the Proposed Action area, other than one historical record to the southwest of the DE. (Figure 2-4). The Proposed Action will impact a maximum of 4.62 ha of this critical habitat, corresponding to 25% of the surveyed habitat. The remaining area of this habitat type within the Proposed Action Development Envelope will be classified as an avoidance zone, to ensure no further disturbance occurs in these areas as a result of Project implementation. These areas are all shown on Figure 2-4.

Additionally, the Project will include disturbance of up to 82.72 ha of potential foraging Northern Quoll habitat. The potential foraging habitat mainly consists of low hills and stony plains, in good and very good condition.

Although the rocky hills habitat impacted by the Proposed Action is likely to be important for the local Northern Quoll population, the reduced extent of impact, as well as the avoidance of the surrounding similar habitat areas will ensure that the Northern Quoll population is still able to inhabit the area. The supporting habitat types that will be impacted are widespread within the surrounding areas.

Indirect impacts to Northern Quoll habitat may include light impacts, dust generation, potential for increase in weed or feral animal species, and an increase in the frequency of fires in the area.

2.2.1.5 Assessment Against Significant Impact Criteria

The Significant Impact Guidelines – Matters of National Environmental Significance 1.1 provide a number of criteria to determine whether an action is likely to have a significant impact on the species, based on the conservation classification.

Table 2-1 provides an assessment of the Proposed Action impacts against the significant impact criteria for Endangered species, including the Northern Quoll.

In accordance with referral guidelines, DCCEEW considers that the Proposed Action may have a significant impact on the local Northern Quoll population, given the reduction in the area of occupancy of the species and the possibility of adverse impacts to habitat critical to the survival of the species.

Table 2-1: Significance of Impacts to Northern Quoll

Criteria	Impact Assessment
Possibility that the activity leads to a long-term decrease in the size of a population.	The potential impact to the Northern Quoll denning habitat may result in a localised decrease in Northern Quoll population numbers. However given the proposed avoidance, mitigation and rehabilitation measures, any decrease in numbers is unlikely to be material in the long-term.
Possibility that the activity reduces the area of occupancy of the species.	The area of available denning habitat will be reduced through implementation of the Proposed Action. This denning habitat is considered to be of a type that is critical to the survival of the species, and therefore the removal of this habitat as part of the Proposed Action will reduce the area of occupancy by up to 4.62 ha.
Possibility that the activity fragments an existing population into two or more populations.	The avoidance area located to the east of the proposed pit will act as a habitat corridor for Northern Quoll individuals, reducing the likelihood of fragmentation of populations. Although the denning habitat that runs north to south will be interrupted by the construction of the pit, dispersal of individuals between remaining denning habitat will still be possible through the proposed avoidance area. The distance between remaining sections of denning habitat is under 1 km, which is well within the limits of Northern Quoll dispersal. This is further discussed in Section 3.1.2. Additionally the surrounding supporting habitat types are generally widespread, and the Proposed Action will not cause significant fragmentation of supporting habitat.
Possibility that the activity adversely affects habitat critical to the survival of a species.	The Proposed Action will impact on Northern Quoll denning habitat, which is a habitat type critical to the survival of the species. Up to 4.62 ha of this habitat type will be impacted. Surveys show that up to 49 ha of this habitat type will remain in the area, and all remaining denning habitat will be encompassed within an avoidance zone to ensure no further impacts to this habitat type.
Possibility that the activity disrupts the breeding cycle of a population.	Northern Quoll breed once per year, generally in a two week period falling between June and August. Young are weaned by 6 months of age, where they generally disperse to other areas (DCCEEW, 2023). To ensure the breeding cycle is not interrupted, initial clearing of the Proposed Action area will be undertaken between February and May.
Possibility that the activity modifies destroys, removes, isolates or decreases the availability or quality of habitat to the extent that the species is likely to decline.	The Proposed Action will result in the removal of 4.62 ha of denning habitat and 82.72 ha of supporting habitat within the range of the species. Given the remaining habitat availability and the commitments to protect all remaining denning habitat as part of the avoidance area, the Proposed Action is unlikely to result in a significant decline in the Northern Quoll species.

Criteria	Impact Assessment
Possibility that the activity results in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat.	The most detrimental invasive species to the Northern Quoll population is the cane toad, which is not currently located in the Proposed Action area. The lack of permanent water resources in the area is also likely to prevent the cane toad from colonising the area. However feral cats and foxes may also predate on young Northern Quoll, and other feral animals may compete with Northern Quoll for resources. However, implementation of the mitigation strategies outlined in Section 3.1.3 will ensure invasive species numbers do not increase and become harmful to the Northern Quoll population. Invasive weed species may also be detrimental to Northern Quoll through habitat degradation. The Proposed weed management actions will ensure that the spread of weeds in the Proposed Action area remains minimal and does not result in any significant change to the Northern Quoll supporting habitat.
Possibility that the activity introduces disease that may cause the species to decline.	The Proposed Action is unlikely to introduce any disease that may cause the Northen Quoll to decline. Mitigation actions controlling the feral animal populations in the area will also act to minimise the spread of any disease that may take hold in these animals to the local Northern Quoll population.
Possibility that the activity interferes with the recovery of the species.	The overall objective of the Northern Quoll Recovery Plan (Hill & Ward, 2010) is to minimise the rate of decline of the Northern Quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future. Specific objectives relevant to the population in the Lynas Find area include halting Northern Quoll declines in areas not yet colonised by cane toads, and reducing the potential impact of feral predators on Northern Quolls. The Proposed Action is unlikely to result in a significant decline in Northern Quoll numbers or health, and the proposed mitigation techniques for feral animal control are consistent with the objective of reducing the impact of feral predators on Northern Quolls. Additionally, a number of actions proposed within the recovery plan include increasing monitoring of Northern Quoll populations. The proposed monitoring to be undertaken as part of this Proposed Action and the associated EMP will further increase the availability of data on Northern Quoll distribution.

2.2.2 Pilbara Leaf-Nosed Bat

2.2.2.1 Surveys

The 2022 Biological Survey (APM, 2022) included a desktop assessment of previous surveys, as well as field surveys including recording of bat calls within the Proposed Action area. A field survey conducted in August 2022 recorded five call sequences of the PLNB over 51 recording nights, from four bat detector units. All call sequences were recorded well after sunset and therefore when the individual was out foraging, rather than near diurnal roosts.

A review of Pilbara leaf-nosed bat ecology, threats and survey requirements by Batcall (2021), identified that the Pilbara leaf-nosed bat (PLNB) roost located at The East Turner River Roost – Birthday Gift was abandoned between 2018 and 2019.

A targeted PLNB survey conducted in 2015 also confirmed that the species are present.

The field survey as part of the biological assessment found that the habitat rating of areas within the Proposed Action boundary were scored from low to moderate, and the area did not contain any roosting habitat for the PLNB. Previous surveys have determined the nearest roosting area is located approximately 2.2 km to the north east of the Proposed Action boundary (Figure 2-5). This roost was identified by Batcall (2021) as abandoned.

Survey techniques were appropriate for determining the presence of PLNB roosting and foraging habitat within the Proposed Action boundary. Targeted surveys have been completed to establish the extent of the potential impacts to the PLNB as a result of Proposed Action implementation.

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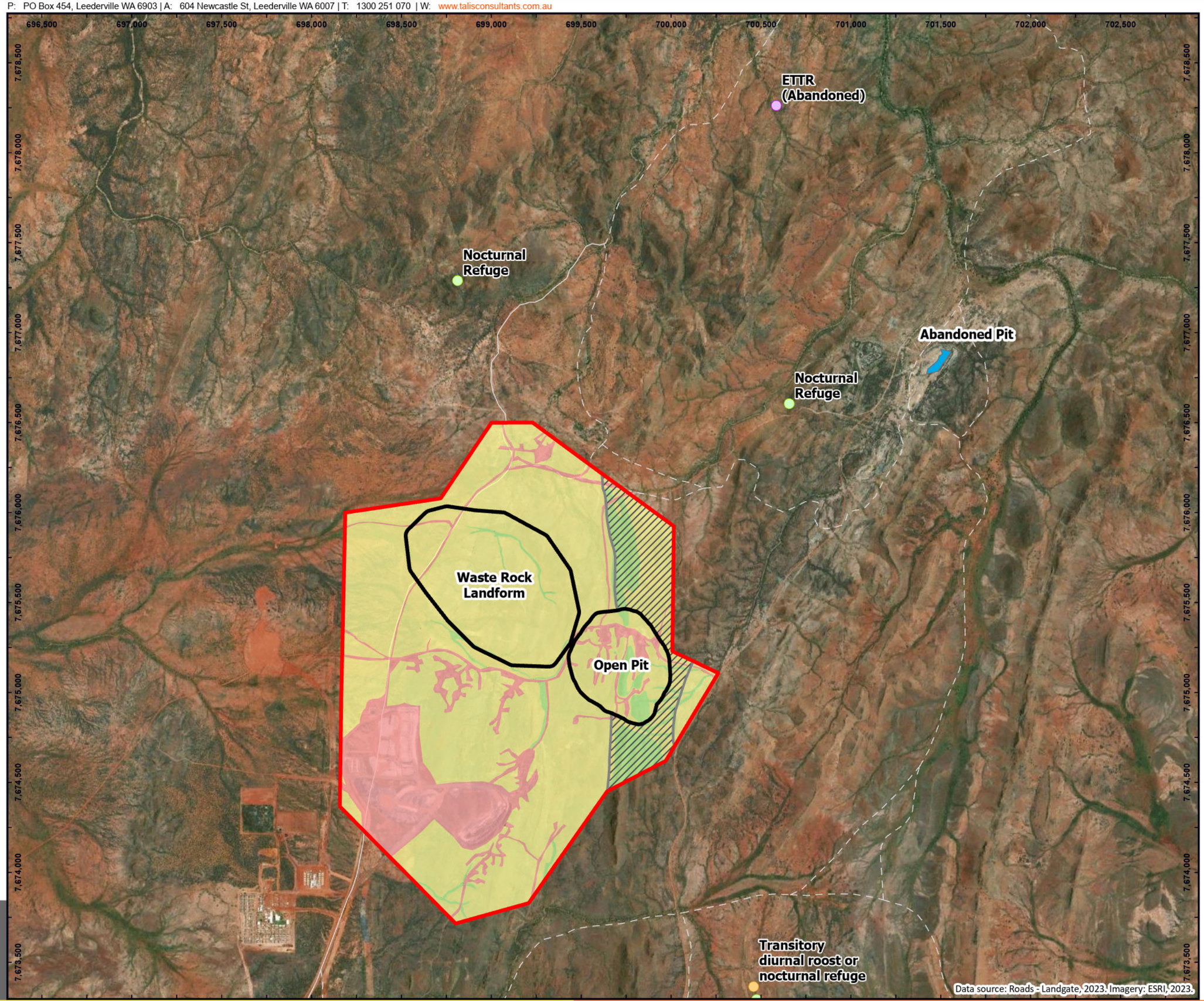

LEGEND

- Lynas Find Mine Development Envelope
- Site Layout
- Proposed Avoidance Area

Fauna Habitat Rating

- HR0 - Degraded
- HR1 - Low Habitat Rating
- HR2 - Moderate Habitat Rating

Western Australian Roads

- Minor Road
- Other

LOCALITY

0 200 400 600 800 1,000 km

FAUNA HABITAT TYPES

Lynas Find Mine Site
EPBC Referral

Pilbara Minerals Limited

N
0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:20,000

Prepared:	E Jackson	Date:	18/11/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

talis consultants

Figure 2-5

Document Path: C:\Users\ami.jamieson\Documents\ArcGIS\Lynas Find\Lynas Find_Templates.aprx

2.2.2.2 Ecology

The PLNB is a small nocturnal bat with a distinctive fleshy, diamond-shaped noseleaf surrounding the nostrils. They use echolocation in predation of invertebrates, and their call is highly distinctive and can be used for species identification (DCCEEW, 2023a).

Little is known on the breeding cycle of the PLNB, although it is assumed to be similar to that of the Orange leaf-nosed bat. Breeding is thought to take place in roosts where bats are present year-round. Life expectancy is unknown but is estimated to be approximately 10 years (Wilkinson & South 2002).

Threats to the PLNB include habitat destruction, interruption of breeding activity, vehicle strike and natural and introduced predators. Additionally, as old mining shafts are often used as habitat, rehabilitation of sites can detrimentally impact the PLNB.

2.2.2.3 Abundance, Distribution and Habitat

The PLNB is an endemic species, restricted to the Pilbara of WA. Records show distribution across the area, although they are generally located in rocky areas that provide adequate roosting habitat, or in abandoned mines (Armstrong 2006).

The PLNB roosts deep in natural or man-made caves that provide stable temperatures and higher humidity, where they tend to aggregate on the ceiling in a cluster. They are rarely seen as they are sensitive to human presence and will flee, and as such either remote video or acoustic monitoring are the preferred methods to survey PLNB populations. Given the broad habitats of the PLNB and the low frequency of encounters during field sampling of the Proposed Action area, it has not been possible to determine the local population numbers (DCCEEW, 2023a).

Populations of PLNB can be difficult to quantify, as colonies can range in size from several dozen up to a few hundred individuals, with one instance of a very large colony in the Hamersley Range estimated to house several thousand bats (DCCEEW, 2023a).

PLNB are generally encountered within 20 km of their diurnal roosting area, however where climatic conditions are more suited they can be encountered further afield (Bullen, 2013). Foraging activity is widespread throughout the broader Pilgangoora area.

2.2.2.4 Habitat Impacts

Due to the lack of PLNB roosting habitat within the Proposed Action area, habitat impacts are expected to be minimal. Foraging habitat is abundant within the broader Pilgangoora area, and the only potential foraging habitat within the Proposed Action area has been scored as low to moderate.

The Proposed Action is within 20 km of a PLNB roost, and as such impacts to the surrounding area have been considered. Up to 82.72 ha of foraging habitat may be disturbed as part of the Proposed Action, which consists mainly of good and very good condition vegetation over low hills. In accordance with Batcall (2021) foraging habitat types and rating scale, two fauna habitat types are considered to be of moderate value (Habitat rating 2), while the rest of the habitat within the Proposed Action area is considered to have low or poor value (Habitat rating 0-1). Approximately 5.56 ha of PLNB habitat with moderate value is proposed to be cleared as part of the Proposed Action. This habitat type is widespread within the area and the proposed disturbance is unlikely to impact significantly on PLNB populations.

Indirect impacts on the PLNB may include impacts from light and noise resulting from the Proposed Action implementation. As the nearest roost is located over 2 km from the Proposed Action, significant

impacts are unlikely, however changes to foraging patterns over the Proposed Action area may occur. Additional indirect impacts to PLNB habitat may include dust generation, potential for increase in weed or feral animal species, and an increase in the frequency of fires in the area.

2.2.2.5 Assessment Against Significant Impact Criteria

Table 2-2 provides an assessment of the Proposed Action impacts against the significant impact criteria for Vulnerable species, including the Pilbara leaf-nosed bat.

Following assessment against the Significant Impact Guidelines (Department of the Environment, 2013) and guidance provided by DCCEEW (Bat Call WA, 2021), only minimal residual impacts to the Pilbara leaf-nosed bat are likely to result from the implementation of the Proposed Action.

Table 2-2: Significance of Impacts to the Pilbara leaf-nosed bat

Criteria	Impact Assessment
Possibility that the activity leads to a long-term decrease in the size of an important population of a species.	The population of Pilbara leaf-nosed bats in proximity to the Proposed Action has not been identified as an important population, as it is not clear that it is a key source population for breeding or dispersal to maintain genetic diversity, and it is not located near the limit of the species range. No Pilbara leaf-nosed bat roosts will be impacted by the proposal, and the supporting habitat that will be impacted by the Proposed Action consists of habitat types that are widespread throughout the local area. Direct mortalities may result through vehicle strike, entrapment, or altered fire regimes, however with implementation of the proposed mitigation strategies, the Proposed Action is very unlikely to lead to a long-term decrease in the population of the Pilbara leaf-nosed bat.
Possibility that the activity reduces the area of occupancy of an important population.	The area of occupancy is defined as 'the smallest area essential at any stage to the survival of existing populations of a taxon' (IUCN 2001), and current guidelines only include the total area of roost sites for calculations of the area of occupancy, specifically excluding foraging habitat area. As there are no Pilbara leaf-nosed bat roosts located within the Proposed Action area, the activity will not reduce the area of occupancy for the species.
Possibility that the activity fragments an existing important population into two or more populations.	No PLNB roosts are located within the Proposed Action area. Pilbara leaf-nosed bats are capable of dispersal over several kilometres, and are very unlikely to be fragmented as a result of the Proposed Action.

Criteria	Impact Assessment
Possibility that the activity adversely affects habitat critical to the survival of a species.	The Bat Call WA guidance around the ecology of the PLNB (Bat Call WA, 2021) provides assessment of what is and what is not considered habitat critical to the survival of the species. Regarding loss of foraging habitat, the guidance states that "given the typical nightly foraging range of 10 to 20 km, broad-scale, patchy, low intensity anthropogenic changes induced by mining or pastoral projects are unlikely to impact the species significantly". It is noted that areas with permanent pools should be considered critical habitat, and widespread loss of vegetation in areas with a PLNB habitat rating of 4 or 5 within 20 km of a roost site should also be considered as a loss of critical habitat. Areas with a habitat rating of 5 are areas immediately outside a diurnal roost entrance, and areas with a habitat rating of 4 are those that include watercourses and other sites with semipermanent or permanent surface water. The Proposed Action area is located at the top of a ridge, and there are no permanent or semi-permanent sources of water within the immediate vicinity of the Proposed Action. The Proposed Action is located over 2 km from the nearest diurnal roost entrance. The clearing of 82.72 ha will be a loss of approximately 0.07% of the 125,600 ha of available foraging habitat within 20 km of a roosting site, which is not broad scale clearing. The clearing of foraging habitat for the PLNB is generally not considered to be a significant adverse impact to habitat critical to the survival of a species. However, DCCEEW have determined that all areas with a habitat rating of between 2 and 5 are to be assessed as critical habitat. The habitat within the Proposed Action area has a habitat rating between 0 and 2, and approximately 5.56 ha of habitat with a habitat rating of 2 will be impacted by the Proposed Action.
Possibility that the activity disrupts the breeding cycle of an important population.	No breeding habitat for the Pilbara leaf-nosed bat is located within the Proposed Action area, meaning the activity is very unlikely to impact on the breeding cycle of the species.
Possibility that the activity modifies, destroys, removes or isolates or decreases the availability or quality of habitat to the extent that the species is likely to decline.	The habitats that will be impacted by the Proposed Action are widespread outside of the Proposed Action area. The Proposed Action is very unlikely to reduce the availability or quality of this habitat to the extent that the species is likely to decline.

Criteria	Impact Assessment
Possibility that the activity results in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	The Proposed Action may result in activities that have the potential to increase invasive flora and fauna in the area. However, implementation of the mitigation strategies outlined in Section 3.1.3 will ensure invasive species numbers do not increase and become harmful to the PLNB population.
Possibility that the activity introduces disease that may cause the species to decline.	No currently known diseases pose a threat to the PLNB population (Bat Call WA, 2021). The Proposed Action is very unlikely to introduce disease into this population.
Possibility that the activity interferes substantially with the recovery of the species.	There is no current recovery plan in place for the PLNB. The national conservation objectives outlined in the Conservation Advice for this species include ensuring that activities do not have a significant impact, elimination of key threats to the species, protection of all known roost sites and high value foraging habitat and supporting research efforts. The proposed mitigation strategies to be implemented as part of this Proposed Action are consistent with these objectives. No roosting sites will be impacted, and only a relatively small area of foraging habitat will be impacted. Mitigation strategies also involve management of invasive species that may pose a threat to the PLNB, and ongoing monitoring within the area will increase data availability on the species.

2.2.3 Ghost Bat

2.2.3.1 Surveys

The 2022 APM Biological Survey included an assessment of habitat available for Ghost bats. No recordings of Ghost bat calls were recorded, however they do not generally use echolocation outside of caves so this is not unexpected. An evaluation of the potential habitat areas was undertaken, and a search for evidence of use by Ghost bats was undertaken. No evidence of scats or food scraps were found in areas that had the highest likelihood of use by Ghost bats.

Given no direct evidence of the presence of Ghost bats was found during this biological survey, no further targeted surveys were considered to be required.

2.2.3.2 Ecology

Ghost bats are carnivores, which have two main hunting modes – either ambushing prey while perching in larger trees, or gleaning surfaces while in flight. Their diet consists of small mammals (including other bats) birds, reptiles, frogs, and large insects (Bullen, 2021).

They mate during the dry season, with females giving birth to single young. Mothers form nursery colonies separate from males until the young can hunt (Perth Zoo, 2023). They have a relatively long lifespan with a life expectancy of approximately 22 years.

2.2.3.3 Abundance, Distribution and Habitat

Ghost bats are a species endemic to northern Australia. No overarching population data is available, however Australia-wide estimates have been made ranging from 4000 to 6000 individuals, with approximately 1500 in Western Australia (Worthington Wilmer, 2012). Given the low number of Ghost bat encounters during field surveys in the Proposed Action area, no estimate of local population size is available.

Ghost bats are usually encountered either alone, or within smaller groups of up to 15 individuals. They are widely distributed within the Pilbara, and move around regularly, likely dependent on seasonality and availability of prey (Bullen, 2021).

Ghost bats tend to move between a number of caves or roosts, ranging from roosts with permanent Ghost bat occupants, to roosts that are only used opportunistically (Bullen, 2021).

2.2.3.4 Habitat Impacts

Within the study area, the caves are considered Category 4 roost sites at best and would only be suitable for nocturnal opportunistic resting locations (APM, 2022). These roosts are not considered critical habitat as they are only used throughout the night for short rests during foraging (Bullen, 2021) and are not considered adequate breeding or diurnal habitat roosts as they only provide shallow overhangs.

The Proposed Action is located approximately 2.5 km from a potential Category 2 or 3 Ghost bat roost (Figure 2-6), meaning the supporting habitat that may be used for foraging needs to be considered. Up to 82.72 ha of potential foraging habitat may be disturbed as part of the Proposed Action, which consists mainly of good and very good condition vegetation over low hills. This habitat type is widespread within the area.

Given no direct evidence of the presence of Ghost bats has been located within the Proposed Action area, it is unlikely that Proposed Action implementation will have any direct significant impacts on Ghost bat habitat or populations.

Indirect impacts on the Ghost bat may include impacts from light and noise resulting from the Proposed Action implementation. Diurnal roosts may be located within 1 to 3 km from the Proposed Action area, however significant impacts on Ghost bat distribution are unlikely. Additional indirect impacts to Ghost bat habitat may include dust generation, potential for increase in weed or feral animal species, and an increase in the frequency of fires in the area.

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690,000 692,000 694,000 696,000 698,000 700,000 702,000 704,000 706,000

7,678,000 7,676,000 7,674,000 7,672,000 7,670,000 7,668,000 7,666,000

ETRR
C6
C5
C18iv
C7iv
C12i
C11i
C6i
C16iv
C16iii
C11iii

Data source: Roads • Landgate, 2023. Imagery: ESRI, 2023.

LEGEND

- Lynas Find Mine Development Envelope
- Proposed Avoidance Area

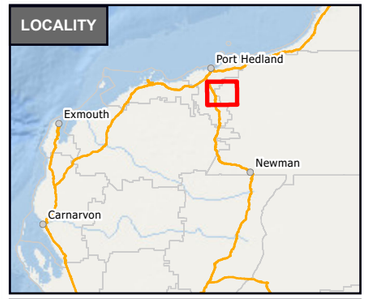
Ghost Bat Roost Sites

- Category 4 Roost
- Potential Category 2 or 3 Roost
- Potential Category 3 Roost
- Ghost bat camera capture

Western Australian Roads

- Minor Road

LOCALITY



0 200 400 600 800 1,000 km

GHOST BAT ROOST SITES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 500 1,000 1,500 2,000 2,500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:55,000

Prepared:	E Jackson	Date:	7/05/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

talis consultants

Figure 2-6

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2.2.3.5 Assessment Against Significance Criteria

Table 2-3 provides an assessment of the Proposed Action impacts against the significant impact criteria for Vulnerable species, including the Ghost bat.

Following assessment against the Significant Impact Guidelines (Department of the Environment, 2013) and guidance provided by DCCEEW (Bat Call WA, 2021), Pilbara Minerals do not consider that there are any significant residual impacts to the Ghost bat resulting from the implementation of the Proposed Action.

Table 2-3: Significance of Impacts to the Ghost Bat

Criteria	Impact Assessment
Possibility that the activity leads to a long-term decrease in the size of an important population of a species.	The population of Ghost bats in proximity to the Proposed Action has not been identified as an important population, as it is not clear that it is a key source population for breeding or dispersal to maintain genetic diversity, and it is not located near the limit of the species range. No Ghost bat roosts will be impacted by the proposal, and the supporting habitat that will be impacted by the Proposed Action consists of habitat types that are widespread throughout the local area. Direct mortalities may result through vehicle strike, entrapment, or altered fire regimes, however with implementation of the proposed mitigation strategies, the Proposed Action is unlikely to lead to a long-term decrease in the population of the Ghost bat.
Possibility that the activity reduces the area of occupancy of an important population.	The Proposed Action is not likely to reduce the AOO of the Ghost bat, based on the IUCN definition excluding foraging habitat. Additionally, there have been no Ghost bat individuals located within the Proposed Action area, with the nearest record approximately 2.5 km from the site. The AOO is generally determined using a 2km x 2km grid. As the roost and nearest recorded Ghost bat sighting is approximately 2.5 km from the Proposed Action Area, using this methodology no records of Ghost bat occupancy would exist within the Proposed Action footprint. Therefore, the calculated AOO is not reduced. Additionally, there is no evidence to suggest that the Ghost bats in the vicinity of the Proposed Action are part of an important population, as the nearest roost is not a confirmed breeding site, and the area is not located near the limit of the species range.
Possibility that the activity fragments an existing important population into two or more populations.	No Ghost bat roosts are located within the Proposed Action area. Ghost bats are capable of dispersal over many kilometres and are unlikely to be fragmented as a result of the Proposed Action.

Criteria	Impact Assessment
Possibility that the activity adversely affects habitat critical to the survival of a species.	The guidance around the ecology of the Ghost bat (Bat Call WA, 2021) included assessment of what is and what is not considered habitat critical to the survival of the species. It is noted that Category 1 and 2 roosts should be assessed as critical, however isolated Category 3 caves are not considered critical habitat. The guidance also recommends buffer zones be implemented around critical roosts; however, these buffer zones will generally range only 200-250m in radius. Information is also provided regarding the significance of typical mine impacts, with examples of roosts remaining viable as both diurnal roosts and maternal roost candidates within 100-500 m of existing operational open cut mine sites. Broad scale anthropogenic induced changes due to mining or pastoral projects are unlikely to cause significant declines in Ghost bat populations. The Proposed action will result in approximately 82.72 ha of native vegetation clearing. This equates approximately 0.18% of the 45,216 ha of available foraging habitat within a 12 km radius. This would not be considered broad scale clearing, and as such, the clearing of foraging habitat for Ghost bats is not considered to be a significant adverse impact to habitat critical to the survival of a species.
Possibility that the activity disrupts the breeding cycle of an important population.	No breeding habitat for the Ghost bat is located within the Proposed Action area, meaning the activity is unlikely to impact on the breeding cycle of the species.
Possibility that the activity modifies, destroys, removes or isolates or decreases the availability or quality of habitat to the extent that the species is likely to decline.	The habitats that will be impacted by the Proposed Action are widespread outside of the Proposed Action area. The Proposed Action is unlikely to reduce the availability or quality of this habitat to the extent that the species is likely to decline.
Possibility that the activity results in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	The Proposed Action may result in activities that have the potential to increase invasive flora and fauna in the area. However, implementation of the mitigation strategies outlined in Section 3.1.3 will ensure invasive species numbers do not increase and become harmful to the Ghost bat population.
Possibility that the activity introduces disease that may cause the species to decline.	Ghost bat populations are not currently impacted by any known diseases, other than one population in Queensland that may be affected by a herpes-type virus (Australian Government, 2016). The Proposed Action is very unlikely to introduce disease into this population.

Criteria	Impact Assessment
Possibility that the activity interferes substantially with the recovery of the species.	There is no current recovery plan in place for the Ghost bat. The key conservation actions outlined in the Conservation Advice for this species include protection of roosting habitat, and replacing barbed wire fences that may impact bats. The proposed mitigation strategies to be implemented as part of this Proposed Action are consistent with these objectives. No roosting sites will be impacted, and only a relatively small area of foraging habitat will be impacted.

2.3 Other Matters of National Environmental Significance

An assessment of other potential MNES that may be affected has been undertaken, with the outcomes presented in Table 2-4.

Table 2-4: Assessment of Proposed Action Impact on MNES

MNES	Outcome of Assessment
World Heritage	There are no World Heritage areas at or near the Proposed Action.
National Heritage	The nearest listed National Heritage Place is the Dampier Archipelago over 200 km from the Proposed Action. A nominated place, North Pole Dome / Meentheena, is almost 40 km away.
Ramsar Wetland	The nearest Ramsar wetland is over 140 km away (Eighty Mile Beach). A proposed Ramsar addition is over 130 km away (Fortescue Marshes). There is no hydrological connection between the area of the Proposed Action and either of these actions.
Migratory Species	Suitable habitat for migratory species does not occur within the area of the Proposed Action. Some suitable seasonal habitat may occur at the Turner River, located 23 km to the west of the Proposed Action.
Nuclear Actions	Drilling records for the Lynas Find resource show a mean level of radiation from naturally occurring uranium and thorium below 0.25 Becquerels per gram (Bq/g). Material containing less than 1 Bq/g is exempt from radiation-related regulation and is not triggered under the EPBC Act.
Commonwealth Marine Areas	The Proposed Action is not in or near the marine environment.
Great Barrier Reef	The Proposed Action is within Western Australia and will not impact on the Great Barrier Reef.
Water resources in relation to large coal mining developments or coal seam gas	The Proposed Action does not involve coal mining or coal seam gas.
Commonwealth Land	The Proposed Action does not occur on or near Commonwealth Land.
Commonwealth heritage places overseas	The Proposed Action occurs within Australia.
Commonwealth or Commonwealth Agency	The Proposed Action is not undertaken by the Commonwealth or a Commonwealth Agency.

3 Assessment and Management of Impacts

The following sections outline the potential impacts of the Proposed Action on MNES, as well as proposed avoidance, minimisation and rehabilitation strategies proposed to mitigate any anticipated impacts.

3.1 Direct Impacts

3.1.1 Vegetation Clearance and Loss of Habitat

The nature of the Proposed Action requires the clearing of native vegetation be undertaken for the placement of infrastructure. Both the native vegetation as well as the natural rock formations in the area provide habitat for native fauna, and the proposed disturbance will result in impacts to the area.

A maximum of 87.1 ha of vegetation will be disturbed as a result of Proposed Action implementation. Of this 87.1 ha, up to 4.62 ha is considered to be high quality denning habitat for Northern Quolls. The remaining vegetation consists of good condition vegetation, that is well represented in the surrounding areas. Additionally, 5.56 ha of habitat with a moderate habitat value to the PLNB will be impacted.

3.1.1.1 Avoidance

The location of the proposed infrastructure has been chosen to avoid fauna habitat for the native quoll to the extent possible. The proposed open pit will require disturbance of up to 4.62 ha of important native quoll habitat, however as the pit location is based on mineralisation there is very little ability to relocate this infrastructure.

The original Proposed Action concept placed the proposed Lynas Find WRL to the south of the pit, along the ridge line that comprises the Northern Quoll habitat. Following identification of the importance of this habitat, the proposed WRL footprint was relocated to the west of the pit, where surveys have indicated no quoll habitat exists.

Additionally, an avoidance area has been proposed covering the remaining areas of Northern Quoll habitat within the proposed MDE. No disturbance will be undertaken within this avoidance area, and only authorised personnel will be able to access this area. This enables the avoidance area to be utilised as a habitat corridor for dispersal of Northern Quoll.

3.1.1.2 Minimisation

A Northern Quoll Management Plan (NQMP) has been developed to encompass techniques to mitigate potential impacts on the Northern Quoll during Proposed Action construction and operation. These actions are also likely to reduce impacts on vegetation and other terrestrial fauna species in the area. The following actions are proposed to minimise impacts on the receiving environment:

- Prior to ground disturbance or clearing, trapping for Northern Quoll will be undertaken within the denning habitat areas by licenced personnel, with trapped animals released in nearby appropriate habitat;
- Further monitoring and assessment of Northern Quoll habitat will be undertaken;
- Disturbance to native vegetation will be constrained within clearing boundaries, and minimised;

- Clearing will be undertaken progressively to retain habitat for as long as possible; and
- Internal Land Use Certificates (LUCs) will be required prior to clearing activities commencing.

An Environmental Management Plan has also been developed for the Proposed Action, and this is included as Appendix F. This Management Plan combines key aspects of the site Northern Quoll Management Plan and the site Conservation Significant Bat Management Plan with additional actions to minimise potential impacts on other native species that may be present within the Proposal area.

Land Clearance Procedures

Land disturbance is only to be undertaken once a LUC has been issued. The process of issuing a LUC includes an assessment of the proposed disturbance area against relevant approvals, and whether there are specific conditions that need to be fulfilled prior to clearing the area.

The PLS LUC Procedure has been included as Appendix G.

3.1.1.3 Rehabilitation

Rehabilitation will be undertaken in accordance with a Mine Closure Plan approved by DEMIRS. This MCP will include actions and outcomes that are geared toward providing suitable habitat for Northern Quoll, as well as revegetating the area to provide foraging habitat for native species. As part of the rehabilitation efforts the construction of artificial dens for Northern Quoll will be installed. These dens will be designed to emulate existing known habitat, and information from trials undertaken in similar habitat will be analysed to determine the best designs.

Rehabilitation will be undertaken progressively throughout the life of the Proposed Action and the larger Pilgangoora operations to minimise the time between disturbance and rehabilitation.

3.1.2 Habitat Fragmentation

Habitat fragmentation occurs as a result of direct clearing of habitat, leading to smaller areas being suitable for habitation and limited connectivity between areas. Currently populations of Northern Quolls are known to inhabit the rocky ridges to the east of the Pilgangoora (where the Proposed Action will impact), with another population located approximately 16km to the west near the Turner River (APM, 2023). Connectivity between these two populations may occur via creeks and channels providing greater vegetative cover, however there is no current evidence of this connectivity.

Northern Quolls are known to have home ranges of at least 35 ha, with individuals known to have travelled over 2 km in a single day (Schmitt et al., 1989), meaning Northern Quolls are able to move between denning habitat in the area easily. While the pit construction will interrupt the denning habitat that runs north-south in the area, the avoidance area located to the east of the pit will act as a habitat corridor for dispersal of Northern Quoll individuals. The majority of the area within this avoidance zone consists of low hills, interspersed by patches of stony gullies. Existing patches of denning habitat in the surrounding area that have been surveyed are separated by up to 600 m of this habitat type (outside the Proposed Action area – See Figure 2-4), and the maximum distance between denning habitat following pit construction will be 880 m. As Northern Quoll are able to travel over 2 km in a single day, it is unlikely that the pit will result in significant fragmentation of Northern Quoll habitat.

3.1.2.1 Avoidance

As described in Section 3.1.1.1, the proposed location of the infrastructure has been selected to reduce the impacts to the rocky ridge habitat type as much as possible.

The current rocky ridge habitat suitable for denning habitat for Northern Quolls is distributed as patches running along a ridge, with areas of other habitat type in between. The avoidance zone proposed as part of the Proposed Action provides a corridor of unimpacted ground between the habitat areas to the north of the proposed pit, and the habitat to the south. This ensures connectivity between habitat types and reduces the impact of habitat fragmentation.

The maximum distance between areas of unaffected rocky ridge habitat is under 1 km. For a Northern Quoll to travel between the northern and southern areas of rocky ridge habitat and avoid the proposed pit area, the individual would need to travel approximately 880 m. As such, Northern Quoll distribution should not be significantly impacted by the Proposed Action.

3.1.2.2 Minimisation

The following actions are proposed to minimise impacts of habitat fragmentation on the receiving environment:

- Disturbance to native vegetation will be constrained within clearing boundaries, and minimised;
- Clearing will be undertaken progressively to retain habitat for as long as possible; and
- Internal Land Use Certificates (LUCs) will be required prior to clearing activities commencing.

3.1.2.3 Rehabilitation

Rehabilitation will be undertaken progressively in accordance with a Mine Closure Plan approved by DEMIRS throughout the life of the Proposed Action to minimise the time between disturbance and rehabilitation. Rehabilitation will focus on providing suitable habitat for native species.

3.1.3 Increased Risk of Feral Animals, Weeds, and Fire Risk

Implementation of the Proposed Action has the potential to increase the risk of feral animals, weeds and fire within the area, due to:

- An increase in vehicle movement within the area potentially spreading weeds;
- Increased vehicle movement and other human activity increasing risk of fire ignition;
- An increase in the susceptibility of vegetation to fire; and
- Domestic waste and mine site water sources attracting feral animals to the area.

A number of mitigation techniques will be adopted by PLS to minimise the risk of increasing feral animals, weeds and fires in the area.

3.1.3.1 Avoidance

In order to avoid impacts to the site resulting from an increase in feral animal populations, weeds and instances of fire, access to site will be restricted to only necessary personnel and vehicles. No unauthorised access will be permitted. Additionally, only driving on established or demarcated tracks will be permitted, and no access to the proposed avoidance zone will be permitted outside of emergency situations.

3.1.3.2 Minimisation

Weed Management Procedures

Eight introduced flora species have been recorded locally with three species identified during field surveys of the Proposed Action area (Table 3-1).

Table 3-1: Introduced Flora within Proposed Action Area

Species	Common Name	Description (Florabase, 2022)
Aerva javanica	Kapok	Erect, much-branched perennial herb, 0.4-1.6 m high. Flowers white from January to October. Often found growing on sandy soils and along drainage lines.
Cenchrus ciliaris	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.
Cenchrus setiger	Birdwood grass	Erect, tussocky, stoloniferous perennial, herb or grass-like. Grows to 0.5 m high. Flowers cream to purple from April to May. Grows on brown sands, red loam, or pindan soils on sand dunes, plains, rangelands, stony hillsides, or floodplains.

Weed management will be undertaken in accordance with the site Weed Management Procedure, and actions will include:

- Management of site access to ensure all vehicles on site are free of weeds and soils;
- Restriction of access to avoidance areas;
- Management including physical removal of weed species and application of appropriate weed killer to weeds present on site;
- Wash down bays to be provided for vehicles required to travel outside existing site roads;
- Establishment of weed hygiene zones around areas of Northern Quoll habitat; and
- Annual weed monitoring will be undertaken to determine if further weed management actions are required.

Feral Animal Management Procedures

A number of introduced fauna species have been recorded within 30 km of the Proposed Action area (APM, 2022), including:

- Camel (Camelus dromedarius);
- Cat (Felis cattus);
- Cattle (Bos taurus);
- Dog (Canis lupus);
- Donkey (Equus asinus)
- Fox (Vulpes vulpes)
- Horse (Equus caballus); and

- House Mouse (Mus musculus).

Of these, only cattle have been sighted during fauna surveys of the Proposed Action area.

Feral animals on site will be managed in accordance with the site Fauna Management Procedure. Generally, prevention of access to site is preferred over direct management including culling. Management measures for reducing feral animal numbers on site include:

- Inductions, training and site signage to educate site personnel on identification of likely feral species and reporting requirements and procedures;
- Records of all feral animal sightings to be maintained;
- All bins containing putrescible waste on site to have secure lids;
- Any open water storage will be fenced to prevent access; and
- Where numbers indicate an increasing feral animal population, baiting or trapping programs will be considered in consultation with the WA Department of Biodiversity and Conservation.

Fire Management Procedures

A number of actions will be taken to minimise the risk of an increase in fires in the area as a result of the Proposed Action, including:

- Firebreaks will be installed around all project infrastructure, with haul roads and access roads acting as a firebreak where possible;
- No vehicle access to areas off main mine roads (unless expressly authorised);
- Implementation of a hot works permitting process; and
- Weed management as per the above to minimise fuel loads.

3.1.3.3 Rehabilitation

Rehabilitation on site will be undertaken progressively where possible to minimise bare area that is highly susceptible to weed infestations. As part of rehabilitation monitoring, weed mapping will be undertaken to enable development of a weed management strategy for rehabilitated areas.

Firebreaks around new rehabilitation will also be installed to protect young vegetation from the potential impacts of a direct fire.

3.1.4 Direct Mortality

The implementation of the Project may impact upon native fauna species via direct mortality through:

- Vehicle strike;
- Collision with fences (particularly for birds and bats); and
- Entrapment in site infrastructure.

Avoidance and minimisation techniques will be undertaken in order to reduce the potential for direct mortality incidents on site as a result of the Project.

3.1.4.1 Avoidance

In order to avoid fauna mortalities, only authorised vehicles will be permitted on site, and no vehicles will be permitted to enter the avoidance zone outside of emergency conditions.

Fences will only be installed as necessary to provide adequate security to a maximum height of 2 m, and no barbed wire fencing will be utilised on site.

3.1.4.2 Minimisation

The following policies and actions will be implemented to minimise the risk of direct fauna mortalities:

- Vehicle speed on site will be restricted to 60 km/hr;
- Any deceased fauna will be removed from roadways to discourage scavenging and further potential vehicle strikes;
- Fauna egress matting will be installed in all dams or trenches that have the potential to trap fauna;
- Records of fauna mortalities will be maintained;
- Fauna injury procedure will be developed; and
- Should multiple fauna mortalities be recorded in one instance, investigation into the cause of the mortalities will be undertaken. Multiple fauna mortalities will include any instance of 2 or more fauna mortalities recorded within a short timeframe (1-5 days) and/or location in close proximity (within 500 metre radius).

3.1.4.3 Rehabilitation

Rehabilitation of the Project area will enable a reduction in the risk of direct fauna mortalities through an increase in area for fauna foraging, that is not susceptible to interference through the use of vehicles.

Any trenches or dams will be rehabilitated to a gentle slope to allow for fauna egress.

3.2 Indirect Impacts

3.2.1 Increased Light, Dust, Noise, and Vibration

The Project is expected to operate on a 24-hr basis, with an anticipated mining life of 3 years. The WRL will operate for a longer period, accepting waste rock from the greater Pilgangoora operations.

Given the proposed operation period, there will be a significant increase in the amount of noise, vibration, light and dust generated in the area, predominantly from machinery operations, as well as blasting activity. This may impact on native fauna through modification of behaviour to avoid the operations, which may also result in a reduction in habitat utilisation of nearby areas.

Changes in lighting patterns of the area may also result in behavioural changes to nocturnal species, which include the Northern Quoll, Ghost bat and PLNB. Lights may also attract invertebrates, which in turn may increase predation by bats, increasing the risk of further impacts such as vehicle strike.

The increase in fugitive dust generation may also impact upon local vegetation, decreasing the quality of both foraging area and habitat.

Increased vibration levels resulting from operation of heavy machinery as well as blasting activity may also impact fauna through avoidance of the area, as well as potential for habitat damage resulting from increased intensity of vibration in the area.

3.2.1.1 Avoidance

The Project location has been modified to minimise the impact on usable denning habitat of the Northern Quoll, with the WRL located on the far side of the proposed pit. This will ensure that the areas that are to be operational the longest are located away from important fauna habitat.

3.2.1.2 Minimisation

A number of controls will be implemented during Project operations to minimise indirect impacts to native fauna, including:

- Equipment is designed to meet occupational noise standards, and minimise noise emissions where possible;
- Potential blast zones will be mapped against Northern Quoll habitat;
- Blasts are designed to minimise vibration impacts;
- Use of heavy machinery in close proximity to the avoidance area to be minimised as much as possible, including drilling;
- In close proximity to Northern Quoll habitat, drilling should take place outside of the 'young in den' period;
- Water carts to be used along haul roads and other cleared areas as required for dust suppression purposes;
- Vehicle speeds restricted to a maximum of 60 km/hr;
- Directional lights to be utilised where possible to minimise light spill into denning and foraging habitat; and
- Lighting in place only where required, and engineered to minimise light spill to surrounding areas.

3.2.1.3 Rehabilitation

Progressive rehabilitation of cleared areas will reduce the impact of wind-blown dust, through stabilisation of the landform soils as vegetation develops. Following rehabilitation of the landforms, impacts from light and noise will also be reduced due to a significant decline in the vehicle and machinery traffic.

3.2.2 Water Resources

The Proposed Action is unlikely to have a significant impact on local water resources given it is located on a topographical ridge.

There are no permanent surface water features within the Proposed Action footprint. The construction of a water diversion bund around the proposed pit ensures that downstream surface water flows are maintained. Increased sedimentation of surface waters may result from water flows across cleared areas, as well as from the WRL. The WRL will be bunded to capture surface run-off and prevent mixing of run-off with natural creek waters.

Groundwater impacts are expected to be limited to changes in standing water level in the area immediately surrounding the pit due to groundwater drawdown. Given the properties of the waste rock and climate of the area, impacts to groundwater quality are not expected.

3.2.2.1 Avoidance

The Proposed Action location at the top of a topographical ridge will limit the amount of surface water flows that will be impacted by the Action. Additionally, there are no major or minor creeks or rivers flowing in the proposed footprint of the landforms or other clearing, and no groundwater dependent ecosystems in the vicinity of the area to be dewatered.

3.2.2.2 Minimisation

A number of controls will be implemented during Project operations to minimise indirect impacts to water resources, including:

- Groundwater abstraction will be limited to mine dewatering where necessary for open pit operations to continue;
- Surface water flows are to be diverted around the open pit via the construction of bunds, limiting inflows to direct rainfall; and
- Monitoring of groundwater levels and quality will be undertaken on a regular basis to better understand the baseline conditions and any impacts that may be the result of the Proposed Action implementation.

3.2.2.3 Rehabilitation

On closure of the open pit operations, the pit is intended to be backfilled with waste rock from operations within the broader Pilgangoora area. This will enable the landforms to be partially restored, and more natural patterns of surface water flow to be re-established.

3.3 Key Mitigation Measures

The key mitigation measures to be implemented during the construction, operation and rehabilitation of the Proposed Action have been listed in Table 3-2 below. Completion criteria for each mitigation measure have been developed, and the monitoring and reporting requirements to ensure the performance or completion criteria are met have also been outlined in Table 3-2. Risks of implementation of each mitigation and measures to avoid these risks eventuating have also been identified.

Table 3-2 Mitigation Measures, Performance Criteria, and Monitoring Requirements

Mitigation Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Establishment of avoidance area surrounding Northern Quoll habitat.	No disturbance within avoidance area.	Disturbance data is reported on an annual basis through DEMIRS MRF and AER systems.	Avoidance area incorrectly established leading to disturbance of Northern Quoll habitat.	Avoidance area demarcation to be undertaken by qualified surveyors, and shape files checked against approved areas prior to disturbance.
Prior to ground disturbance or clearing, trapping for Northern Quoll will be undertaken within the denning habitat areas.	Trapping scheduled and undertaken for all clearing within denning habitat. Trapped fauna to be released to nearby appropriate habitat.	Records of fauna trapped as part of programs prior to clearing will be kept, and submitted to DBCA and DCCEEW as required.	Trapping unable to be undertaken prior to clearing due to lack of suitably qualified personnel (DBCA fauna handling licence holders), inclement weather or unsuitable access.	Clearing will be postponed until conditions allow for trapping to be undertaken.

Mitigation Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Further monitoring and assessment of Northern Quoll habitat will be undertaken.	Targeted Northern Quoll surveys to be carried out triennially.	Reports relating to Northern Quoll surveys will be kept and submitted to DBCA and DCCEEW as required.	Northern Quoll monitoring unable to be undertaken due to lack of suitably qualified personnel (DBCA fauna handling licence holders), inclement weather or unsuitable access.	Monitoring events for Northern Quoll are planned within 2 years of the previous monitoring event, to allow contingency for scheduling monitoring events.
Disturbance to native vegetation will be constrained within clearing boundaries, and minimised.	No clearing outside of approved areas.	Disturbance data is reported on an annual basis through DEMIRS Mining Rehabilitation Fund and Annual Environmental Reporting systems. A reconciliation of cleared vs approved areas is undertaken annually.	Clearing boundaries incorrectly established.	Clearing demarcation to be undertaken by qualified surveyors, and shape files checked against approved areas prior to disturbance.
Clearing will be undertaken progressively to retain habitat for as long as possible.	Clearing completed in a staged manner over the years of operation.	Disturbance data is reported on an annual basis through DEMIRS MRF and AER systems. Records of timing of clearing will be kept.	Clearing not undertaken progressively, leading to a significant change in habitat in a short time frame.	Mine planning to ensure that clearing areas are completed in stages, separated by a minimum of 6 months between major clearing events of over 10 ha.
Internal Land Use Certificates (LUCs) will be required prior to clearing activities commencing.	No clearing undertaken without	Records of all approved LUCs are to be maintained and	LUC procedure not followed, leading to unauthorised clearing.	All staff are trained in the requirements for an approved

Mitigation Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
	an approved LUC in place.	used in the annual disturbance reconciliation.		LUC to be in place prior to disturbance activities.
Existing weed infestations on site will be effectively managed to reduce spread and overall density, and hygiene areas will be established around the avoidance zone.	No increase in weed infestations on site or within the avoidance zone.	Weed monitoring is to be undertaken annually to determine if there are any increases in weed infestations, and to ensure a targeted management approach.	Weeds not effectively managed and/or weed hygiene zone not enforced, leading to an increase in weed density and dispersion on site.	Weed management is undertaken on an ongoing basis, informed by results of annual monitoring events.
Feral animal management program to be implemented by site staff.	No increase in feral animal populations within the Development Envelope.	Records of all feral animal sightings on site to be maintained, and any significant increase to be investigated. Fauna monitoring to be completed triennially and include an assessment of feral animal populations.	Feral animal management not undertaken, or measures are ineffective.	Best practice options for management of feral cats and foxes will be undertaken. Animal management activities will be routinely scheduled on site.
Fires on site to be banned, except for emergency response training in low fire risk conditions.	No unauthorised fires on site.	Records of all fires or near misses to be maintained, and investigations into the cause of the fire to be undertaken.	Fires deliberately set outside of low risk conditions. Fire management procedures not followed leading to out of control fires on site.	Fire training to be undertaken by qualified personnel, with reference to fire risks at the time of training. Fire breaks and other fire management equipment to be inspected annually.

Mitigation Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
In order to avoid fauna mortalities, only authorised vehicles will be permitted on site, and no vehicles will be permitted to enter the avoidance zone outside of emergency conditions.	Avoidance zone to be barricaded and signed to prevent unauthorised access.	Records of permitted access, as well as any cases of unauthorised access are to be maintained.	Unauthorised access to the avoidance zone leading to impacts on Northern Quoll habitat.	Procedure for access to avoidance zone to include sign-off by the HSEQ team. Barricades to be inspected every 6 months to ensure integrity is maintained.
Equipment is designed to meet occupational noise standards, and minimise noise emissions where possible.	Noise emissions of plant and equipment to meet noise standards. No excessive noise emissions from site.	Records of equipment compliance with noise standards to be maintained.	Changes in equipment leading to increases in noise emissions.	Regular equipment maintenance undertaken to ensure operation of equipment is in line with manufacturer recommendations.
Progressive rehabilitation to be undertaken on landforms.	Rehabilitation to commence on WRL within 3 years of commencement of dumping.	Areas rehabilitated to be reported through the annual MRF submission. Monitoring of rehabilitation condition to be undertaken annually following establishment.	Progressive rehabilitation not commenced within 3 years due to changes in mine schedule or landform design.	Changes to mine schedule or landform design are to consider implications of rehabilitation, and ensure that progressive rehabilitation can be undertaken as a priority.

Mitigation Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Rehabilitation of landforms and other cleared areas are to include fauna habitat creation, with investigation into areas suitable to support Northern Quoll.	Northern Quoll present in provided habitat and rehabilitated areas.	Monitoring of rehabilitation condition to be undertaken annually following establishment. Assessment of utilisation of rehabilitated areas to be undertaken following establishment of rehabilitation vegetation.	Northern Quoll may not use rehabilitated areas. Investigation into artificial habitat use may indicate designs are unsuitable.	Rehabilitation program design to be informed through trials undertaken at other mine sites with impacts to Northern Quolls. Assessment of establishment of trials to determine best practice measures for artificial habitat design.

3.4 Residual Significant Impacts

Following implementation of the avoidance, mitigation and management measures outlined above, residual risks of the Proposed Action include:

- Direct impacts through clearing of native vegetation, including 4.62 ha of denning habitat for Northern Quolls. This habitat may also be used as an opportunistic resting location for the PLNB and Ghost bat during foraging;
- Clearing of Northern Quoll habitat increasing the distance between suitable habitat patches, leading to minor potential habitat fragmentation impacts;
- Clearing of supporting habitat, including:
  - Areas within 1 km of Northern Quoll critical habitat; and
  - Areas within 20 km of PLNB critical roost sites (with a habitat rating between 2 and 5);
- The risk of direct mortality through vehicle strike and entrapment remains throughout Project operations; and
- Behavioural changes caused by an increase in light and noise in the Project area during operations.

PLS has experience operating similar mines in the Pilbara area, and believes that with the aforementioned management of impacts, the Project can be implemented with no significant impact to Northern Quoll, PLNB, or Ghost bat populations.

3.5 Cumulative Impacts

Cumulative environmental impacts are defined as 'the successive, incremental and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities' (EPA, 2021).

The Proposed Action is located within a region containing a number of existing mines operated in a similar manner to the Proposed Action. The area also contains vast areas of remnant natural bushland of varying health and condition.

Cumulative potential environmental impacts to this region may increase the significance of the overall impact of the Proposed Action. Therefore, further assessment of the potential environmental impacts of the Proposal will be undertaken during the environmental impact assessment process to determine the significance of potential impacts from the Proposal from both a local and cumulative prospective.

PLS is not aware of any other activities in the area that would impact on the local rocky ridge habitat for Northern Quolls, as mapped in the area. There are several other historic and current mining operations within the broader Pilbara area that may increase the impacts on other types of local fauna habitats, including foraging habitat for threatened species and potential bat roosting habitat. However given the mitigation techniques proposed to be undertaken as part of the Proposed Action, cumulative impacts of the Project in combination with surrounding land uses is not expected to be significant.

3.6 Event Contingencies

Given the survey effort undertaken in the Proposed Action area, it is unlikely that new areas of conservation significant habitat will be located as part of the implementation of the Proposed Action.

Should new information become available about conservation significant species and the importance of other habitat types in the area, an additional risk assessment will be undertaken. This assessment will ensure no unacceptable risk to conservation significant species as a result of clearing of other habitat types within the Proposed Action Area.

3.7 Threat Abatement Plans and Recovery Plans

DCCEEW have developed a number of threat abatement plans and national recovery plans with the aim of reducing impacts of serious threats to native wildlife, and increasing the populations and abundance of threatened species. Relevant plans to the Proposed Action include:

- National Recovery Plan for the Northern Quoll Dasyurus hallucatus (Recovery Plan);
- Threat abatement for predation by European red fox; and
- Threat abatement plan for predation by feral cats.

No current Recovery Plans are in place for the PLNB or the Ghost bat.

3.7.1 Northern Quoll National Recovery Plan

The Proposed Action is consistent with the objectives of the Recovery Plan for the Northern Quoll. One of the major threats to the Northern Quoll outlined in the Recovery Plan is the presence of cane toads, which is not a risk factor for the Proposed Action. Surveys in the Proposed Action area have increased local knowledge relating to Northern Quoll populations and habitat, and the proposed avoidance zone will assist in the protection of local populations.

Additionally, feral animal management on site may reduce the impact of local predators on Northern Quolls, and training on site will increase education and awareness of the importance of conservation significant species in the area.

3.7.2 Threat Abatement Plans

The Threat Abatement Plans for predation by the European ref fox and by cats both have the broad objective of controlling the numbers of feral animals to reduce predation of native species. Both foxes and cats have been found within the vicinity of the Proposed Action (APM, 2022) and therefore may be considered a threat to the Northern Quoll and other native species.

Feral animal management actions have been outlined in Section 3.1.3 and are consistent with the objectives of the relevant Threat Abatement Plans.

4 Offsets

Offsets for the Proposed Action are to be managed through contributions to the Pilbara Environmental Offsets Fund (PEOF). The PEOF is a combined fund with the purpose of delivering environmental offsets in the Pilbara, through a strategic landscape-scale approach. This enables efficiency in delivery of offsets, by enabling larger scale projects due to funding from a number of projects within the area (Government of Western Australia, 2023).

The contribution from the Proposed Action is determined through an assessment of the impact of the Action on the environmental values of the area, as well as the Interim Biogeographic Regionalisation of Australia (IBRA) subregion of the impacted area. The entire Proposed Action lies within the Chichester subregion of the Pilbara (DCCEEW, 2023b). The environmental values included in the offsets calculation for the Proposed Action are:

- Rocky ridge habitat (critical habitat for the Northern Quoll);
- Supporting habitat within 1 km of critical denning habitat for the Northern Quoll; and
- Supporting habitat with a habitat rating between 2 and 5 within 20 km of critical roost sites for the Pilbara leaf-nosed bat.

The actual annual contribution to the PEOF will be determined as per the Impact Reconciliation Procedure (IRP), which has been developed for the Proposed Action, and is included as Appendix H of this Preliminary Documentation.

Impact Reconciliation reporting will be undertaken as per the requirements of the IRP, consisting of a biennial report outlining the impacts undertaken in the proceeding reporting period. Monitoring will be undertaken annually to ensure the correct fund contribution rate is applied to the measured impacts of the Proposed Action.

Further offsets are yet to be confirmed, however, establishment of habitat structures to support the Northern Quoll population has been considered. These proposed offsets have been developed in line with the EPBC Offsets Policy (DSEWPC, 2012).

Table 4-1 below outlines the proposed offsets for the Proposed Action, following advice from DCCEEW on 10 July 2024 regarding the offset rates.

Table 4-1: Proposed Offsets

Species	Offset Area	Protected Matter	Offset Rate	Total Offset
Northern Quoll	4.62 ha	Critical habitat	$3,306	$15,273.72
	82.72 ha	Supporting habitat within 1 km radius of critical habitat	$1,653	$136,736.16
Pilbara leaf-nosed bat	5.56 ha	Vegetation within 20 km of a Pilbara leaf-nosed bat Category 1, 2 or 3 roost, with a habitat rating between 2 and 5.	$1,653	$9,190.68

5 Economic and Social Impacts

5.1 Cost Benefit Analysis

The Lynas Find Project has an estimated overall economic benefit of AUD $0.45B. This value has been obtained by using mine scheduling optimisation software to generate Net Present Value (NPV), by maximising mines schedules including and excluding the Lynas Find resource.

The inputs for this estimate include future projections of:

- Spodumene concentrate and tantalum prices;
- Exchange rates; and
- Costs including mining, processing, handling, transport, shipping, insurance, marketing, state third party and native title royalties, and corporate head office costs.

The costs assessment includes all approvals costs, as well as the predicted offset cost over the life if the Proposed Action.

5.2 Stakeholder Engagement

The purpose of the stakeholder engagement strategy is to identify key stakeholders and outline the means to undertake consultation where the stakeholders are informed of the proposed plans, and are able to voice any questions or concerns they may have regarding the Proposed Action. The engagement strategy is based upon the principles of communication, transparency, collaboration, inclusiveness and integrity.

5.2.1 Stakeholder Identification

All relevant stakeholders for the Proposed Action have been consulted regarding the proposed activities and their locations. Key stakeholders will continue to be informed as the Project develops.

Stakeholders relevant to the Proposed Action include:

- DCCEEW;
- Department of Water and Environmental Regulation (DWER);
- DEMIRS;
- Department of Biodiversity, Conservation and Attractions (DBCA);
- Shire of East Pilbara;
- Njamal People;
- Njamal Aboriginal Corporation; and
- Wallareenya Station.

5.2.2 Stakeholder Engagement Strategy

PLS has implemented an ongoing active engagement program with identified stakeholders, which includes regular meetings and reports, as well as engagement triggered by major changes to the Project. The Lynas Find stakeholder consultation will be included in the broader Pilgangoora stakeholder strategy.

Table 5-1 provides an outline of the Stakeholder Engagement Strategy relating to the Proposed Action.

Table 5-1: Stakeholder Engagement Strategy

Stakeholder	Action	Timing
Wallareenya Pastoral Station	Ongoing consultation on mine status. Engagement via contracting opportunities for the pastoralist and employees. Written confirmation required to take responsibility for any infrastructure post closure.	Monthly and as required
Njamal Traditional Owners and Njamal Aboriginal Corporation	Ongoing consultation regarding mine status, as well as consultation on heritage survey protocols. Development of employment and business opportunities.	Quarterly implementation meetings.
Shire of East Pilbara	Ongoing consultation regarding mine status.	As required
DEMIRS	Ongoing consultation regarding mine status. Annual environmental reporting. Submission of Mine Closure Plan triennially.	Annually and as required for Project updates.
DWER	Ongoing consultation regarding mine status. Referral under Part IV of the EP Act, and monitoring and reporting as per conditions of approvals.	As required.
DCCEEW	Referral under the EPBC Act, and monitoring and reporting as per conditions of approvals.	As required.

5.2.3 Stakeholder Engagement Register

Table 5-2 provides a brief summary of the consultation undertaken regarding the Proposed Action.

Table 5-2: Stakeholder Engagement Register

Stakeholder	Date	Type	Topic	Outcome
DWER – EPA Services	19 July 2023	Teams Meeting	Lynas Find Project pre-referral meeting	Given the DCCEEW have assessed the Proposed Action to be a Controlled Action, referral to the EPA is also expected. There is no reason to delay EPA referral to wait for the outcome of DCCEEW assessment.
Nyamal People	19 July 2023	In person meeting	Quarter 2 Implementation Committee meeting	Overview of Lynas Find Project provided. Requests for contracting opportunity for future surveys.
Nyamal People	6 February 2023	In person meeting	Quarter 1 Implementation Committee meeting	Overview of Lynas Find Project provided, with information on heritage surveys conducted, and confirmation that no sites have been identified.
DEMIRS	24 Jan 2023	In person meeting	Scoping meeting on future approvals including Lynas Find.	Overview of Lynas Find Project provided. Mining Proposal due late 2023.
DWER (EPA services)	28 Nov 2022	In person meeting	Scoping meeting on future approvals including Lynas Find.	Overview of Lynas Find Project provided.
Wallareenya Station (Zane Days)	2 Nov 2022	In person meeting	Lynas Find Project	Overview of Lynas Find Project provided.
DCCEEW	22 Aug 2022	Teams meeting	Lynas Find Project pre-referral meeting	Overview of Lynas Find Project provided. Potential impacts to listed threatened species may require project referral.
DWER (EPA services)	14 April 2022	Teams meeting	Lynas Find Presentation	Proposed plan for Lynas Find operation presented. No mandatory requirement for referral, but may consider impacts on threatened species.

5.3 Aboriginal Cultural Heritage

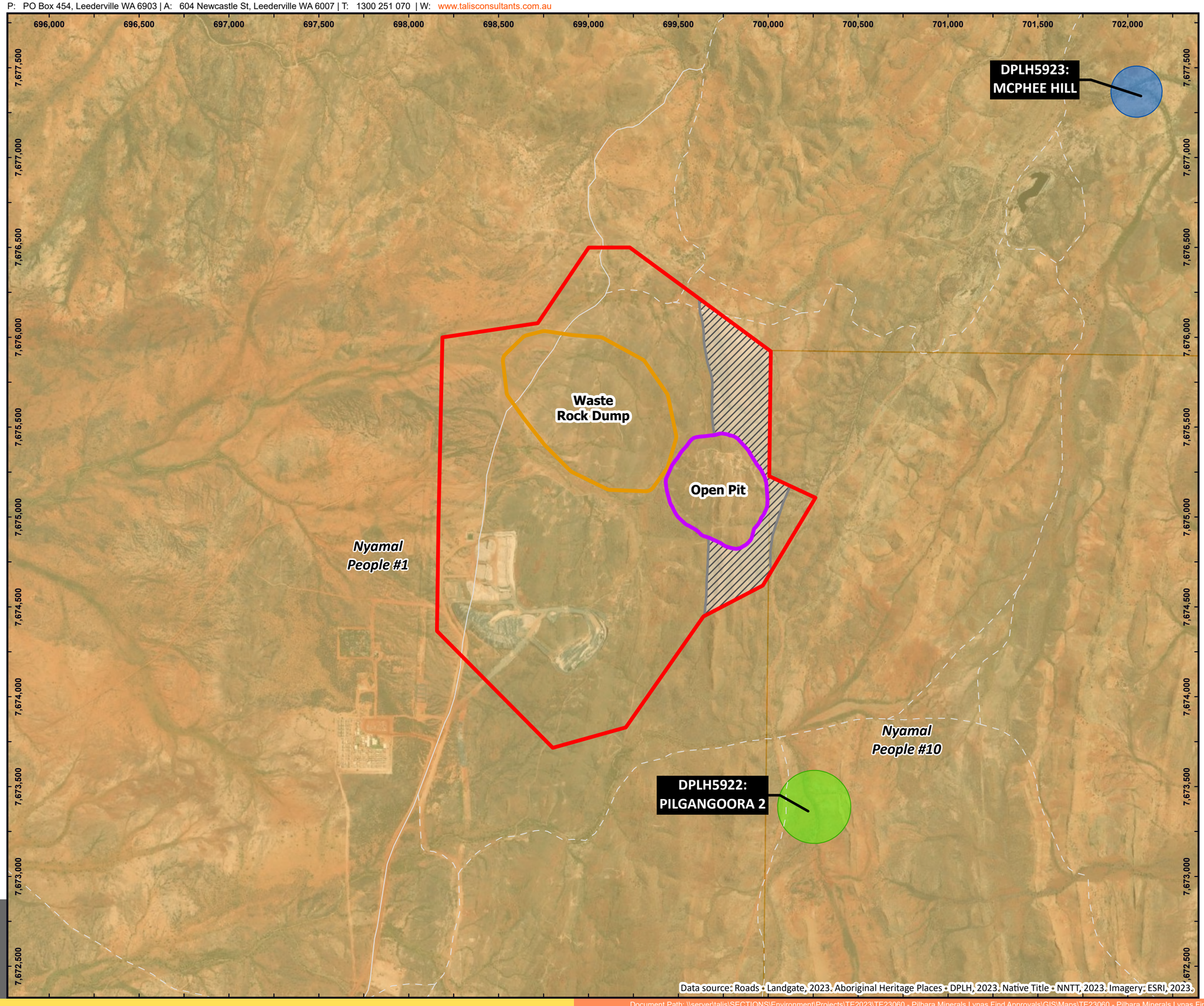
5.3.1 Native Title

The Proposed Action is located within the Nyamal Native Title Determination area (Federal Court File No WAD6028/1998 and Tribunal File No. WC 1999/008). PLS have a Heritage Protection Agreement in place with the Nyamal Group, which outlines the required engagement prior to undertaking actions within the Determination Area. PLS and the Nyamal Group have members making up an Implementation Committee, which is included as part of the ongoing quarterly reporting processes.

5.3.2 Heritage Areas

Two Aboriginal heritage surveys have been completed over the Lynas Find area, in accordance with Nyamal heritage protocols. No indigenous heritage sites have been recorded within the Proposed Action area. A search of the Aboriginal Cultural Heritage Inquiry System shows the nearest registered site is over 3 km to the South of the Proposed Action area, with a Lodged site approximately 3km to the north east (Department of Planning Lands and Heritage, 2023) (Figure 5-1).

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au



Data source: Roads - Landgate, 2023. Aboriginal Heritage Places - DPLH, 2023. Native Title - NNTT, 2023. Imagery: ESRI, 2023.

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2023\TE23060 - Pilbara Minerals Lynas Find Approvals\GIS\Maps\TE23060 - Pilbara Minerals Lynas Find Approvals\TE23060 - Pilbara Minerals Lynas Find Approvals.aprx

LEGEND

- Lynas Find Mine Development Envelope

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

Aboriginal Heritage Places

- Lodged
- Stored Data / Not a Site

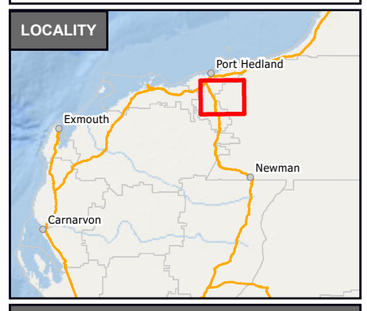
Native Title Determination Outcomes

- Native title exists (non-exclusive)

Western Australian Roads

- Minor Road
- Other

LOCALITY



0 200 400 600 800 1,000 km

HERITAGE AREAS

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 200 400 600 800 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:20,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

talis consultants

Figure 5-1

6 Rehabilitation

Rehabilitation of the Proposed Action area will be undertaken in accordance with a Mine Closure Plan approved by the Department of Mines Infrastructure Regulation and Safety. The Sections below provide a broad rehabilitation plan for the Lynas Find Project site.

6.1 Rehabilitation Objectives

Rehabilitation Objectives for the Proposed Action will be to ensure the Post Mining Land Use (PMLU) can be achieved. Given the current land use is pastoral, the main proposed PLSU is to return the land to pastoralism. The area also contains habitat that is important for the Northern Quoll species, and as such, returning these areas to native vegetation will be a priority.

To achieve these outcomes, the landforms will be required to be safe, stable and non polluting. Topsoils management will be key to ensure sufficient stocks are available for rehabilitation, to promote growth of native vegetation. The open pit void will need to be rendered safe through the installation of abandonment bunds in accordance with DEMIRS Guidance (DoIR, 1997).

The introduced species buffel grass (*Cenchrus ciliaris*) is present in the Proposed Action area and is locally and regionally prevalent, particularly along creek lines where it is spread by surface water and cattle. As the grass is desired by pastoralists for stock fodder, there is no plan to attempt to eradicate the species.

The PMLU and associated rehabilitation methods may be updated in accordance with community expectations and scientific advancements. Any changes will be incorporated into an updated MCP and require approval by DEMIRS.

6.2 Rehabilitation Methods

6.2.1 Open Pit

An abandonment bund and ramp access barrier will be installed around the mine pit whilst operating to restrict inadvertent access into the pit area. The location of the abandonment bund is outside of the zone of instability as required by. Works will include barricading the pit ramp to ensure no vehicle access into the pit. The abandonment bund will be at least 2 m high, 5 m wide at base, and wherever possible, constructed from unweathered, freely draining rockfill, and outside the zone of instability plus 10 m allowance as per DEMIRS requirements. The mine pit will be backfilled with mine waste from pits in the broader Pilgangoora project area.

As the proposed pit is located on a topographical ridge, specific water management measures will not be required. Surface water and ground water flows into the pit are expected to be minimal (Pentium Water, 2022).

6.2.2 WRL

Progressive rehabilitation will be undertaken where possible, however the outer surfaces of some sections of the WRLs will not be completed until the end of mine life. The proposed rehabilitation prescription for the WRLs is summarised below:

- A final overall slope of 18° with 10 m wide berms;

- Berms will be back graded to a 5° slope with baffles every 50 – 100 m;
- 2 m competent rock berms to prevent ponded water spilling over the crest;
- WRL will have 1 m high walls across the top to create internal cells of 1 ha or less; and
- Drains and sediment traps at toe of WRL to prevent uncontrolled runoff.

The top of WRL should be constructed to be back-sloping from the crest but may need to be graded to meet the water retention requires on the crest.

The flat surfaces will be covered with sub-soil (where available) and 100 mm of topsoil. The slopes will be covered with topsoil that has a high gravel and cobble content to prevent erosion. All surfaces will be contour ripped to at least 1 m depth. Toe drains will be constructed to capture run-off and sediment, directing flows to sumps.

The surface will then be seeded with local provenance species.

6.3 Rehabilitation Monitoring

Rehabilitation monitoring will include visual monitoring of soil and WRL stability following completion of rehabilitation earthworks. Additional monitoring events may be undertaken following significant rainfall events. Visual inspections will also include an assessment to determine if any potentially acid forming or fibrous materials have been deposited on the WRL surface, and investigations will commence if any findings are apparent.

Triennial monitoring of revegetation will be undertaken following rehabilitation works. The progress of revegetation will be assessed and any remedial works required will be undertaken.

7 Compliance with Ecologically Sustainable Development

One of the objects of the EPBC Act is to promote ecologically sustainable development (ESD). Section 3A of the Act provides a definition of ESD principles:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation (the precautionary principle);
- The principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
- Improved valuation, pricing and incentive mechanisms should be promoted.

Table 7-1 below outlines the actions taken regarding the Proposed Action to ensure alignment with the principles of ESD. These have been developed in line with the Criteria for Determining ESD Relevance (DoE 2003).

Table 7-1: Compliance with Principles of ESD

Principle	Compliance
Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	Decision making processes at PLS are undertaken in a manner to avoid the potential for excessive costs, including financial, social and environmental costs. The Proposed Action has been designed to enable exploitation of the physical ore resource to provide an economic benefit to the company and regional surroundings, while minimising the impacts on the local community and environment. This includes relocating required infrastructure where possible to areas with a lower impact, ensuring clearing is undertaken in a staged manner, and minimised to only the required footprint, as well as additional management measures to reduce risks of social or environmental harm.
The precautionary principle.	In order to demonstrate compliance with the precautionary principle, PLS have undertaken extensive surveys over the Lynas Find area, in order to fully understand the impact of the Proposed Action on the biodiversity and hydrology of the area. This ensures that no threats of serious environmental harm as a result of the Proposed Action are overlooked. Where threats to the environment remain uncertain, PLSwill take a conservative and precautionary approach.

Principle	Compliance
The principle of inter-generational equity.	The impacts from the Proposed Action will be managed to ensure that changes to the landscape and biological diversity in the area will be minimised. Rehabilitation of the Proposed Action area will be undertaken progressively and upon final mine closure, with the aim of returning the area to be used as suitable fauna habitat for conservation significant species. Rehabilitation will be undertaken in accordance with a Mine Closure Plan approved by DEMIRS.
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	Decision making regarding the Lynas Find Project has been undertaken in a manner to avoid any unnecessary impacts to biological diversity and ecological integrity. Project infrastructure has been located to avoid impacts to areas of high quality fauna habitat as much as possible, and the implementation of the proposed avoidance zone aims to protect species of conservation significance in the area, which is a key component of maintaining biological diversity. PLS has also taken into account the importance of habitat linkages, ensuring that the distance between remaining habitat following implementation of the Proposed Action is within the known range of the Northern Quoll. This allows for mobility of individuals within the broader area to ensure diversity within populations is maintained.
Improved valuation, pricing and incentive mechanisms should be promoted.	As part of the Proposed Action, PLS will contribute to the Pilbara Environmental Offsets Fund. This financial contribution allows for projects with a larger scope to be more efficiently implemented across the Pilbara region. PLS will also contribute to the Mining Rehabilitation Fund as required, which provides a financial incentive to avoid clearing where possible. Should additional valuation, pricing or incentive mechanisms become available over the life of the Proposed Action, PLS will promote the adoption of these mechanisms.

8 Legislative Context

8.1 Pilbara Minerals Environmental Record

PLS has not been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment of the conservation and sustainable use of natural resources.

The Proposed Action will be undertaken in accordance with the PLS Environmental Policy, which has been included as Appendix A. This policy includes commitments to "make environmental protection an integral part of business operations and of equal importance with other key operational and strategic business objectives" and to "ensure we are always compliant with all applicable environmental laws and regulations".

Environmental management is integrated into the normal work practices at PLS by setting clear objectives and targets, having sound systems and controls, ongoing data collection and regular environmental monitoring and reporting.

Since the commencement of the Pilgangoora Project, PLS have embraced the expanded environmental responsibility and continue to meet or exceed statutory requirements. Risks associated with environmental incidents are managed through risk assessments, introduction of preventative measures, ongoing review and monitoring, and where necessary, effective and efficient mitigation actions.

8.2 Further Approvals Required

8.2.1 Environmental Protection Act 1986

8.2.1.1 Part IV Approvals

Part IV of the *Environmental Protection Act 1986* (EP Act) regulates Proposals that may have an impact on one or more Environmental Factor, as listed by the WA Environmental Protection Authority (EPA).

Given the minimal potential impacts of the Project on environmental factors, and following discussions with EPA personnel, the Proposed Action will be not referred to the EPA. Potential impacts of the Proposed Action will be controlled through conditions placed under EPBC Act approvals, *Mining Act 1978* approvals and approvals required under Part V of the EP Act.

8.2.1.2 Part V Approvals

Approvals under Part V of the EP Act include Licences and Works Approvals, which regulate discharges and emissions resulting from the Project, as well as Native Vegetation Clearing Permits (NVCPs) which regulate clearing to be undertaken.

Given the scope of the Project does not include processing of ore, or any other type of regulated discharge, no licences or Works Approvals are required for the Project. Ore will be processed as part of the broader Pilgangoora Project under existing Licences.

An NVCP will be required to permit clearing of native vegetation for the Project. Given the Project is related to the implementation of a mining operation, the NVCP will likely be assessed by the DEMIRS.

8.2.2 Mining Act 1978

Under the *Mining Act 1978* (Mining Act), an approved Mining Proposal is required prior to commencement of mining operations in WA. Mining Proposals outline the proposed disturbance relating to the mining operation, as well as the environmental management and expected outcomes.

Submission of a Mining Proposal also requires a Mine Closure Plan (MCP), to outline the proposed rehabilitation and closure of the site. The MCP requires a set of closure criteria, as well as an outline of the likely outcomes and monitoring of the site and impacts.

A Mining Proposal and MCP will be prepared for the Lynas Find Project.

8.2.3 Rights in Water and Irrigation Act 1914

The Rights in Water and Irrigation Act 1914 (RIWI Act) regulates the taking of surface and groundwater in WA. PLS currently source groundwater as per Groundwater Licence 183354(6), which allows abstraction of up to 6,900,000 kL of water annually.

No further water licencing is required as part of the Proposed Action, and no changes to current licences are required.

8.2.4 Aboriginal Heritage Act 1972

Aboriginal heritage in WA is currently governed under the *Aboriginal Heritage Act 1972* (AH Act). This Act includes recent amendments relating to requirements for due diligence in relation to identification and protection of Aboriginal Cultural Heritage.

Two Aboriginal heritage surveys have been completed over the Proposed Action area, in accordance with Nyamal heritage protocols. No indigenous heritage sites have been recorded within the Proposed Action area, and no heritage approvals are required for the commencement of the Proposed Action.

9 Cross Referencing Tables

Table 9-1 provides an index for the information required as part of the Preliminary Documentation, and where it can be found in the text.

Table 9-1: Request for Further Information Cross- Reference

Request for Further Information	Relevant Sections Within this Document
Description of the Action	
This should include the location of all works to be undertaken (including plans and maps) and elements of the action that may have impacts on Matters of National Environmental Significance (MNES). The description of the action must also include details on how the works are to be undertaken (including stages of development and their timing) and design parameters for any structural elements of the action that may have impacts on MNES. Please highlight changes that have been made to the project since referral documentation was submitted. A description of the proposed action must include: • A summary of all components of the proposed action. • The activities associated with the proposed action. • The location, boundaries, and size (in hectares) of the proposed action area, any discrete disturbance areas, and any adjoining areas which may be directly or indirectly impacted by the proposed action, including nearby habitat and areas for stockpiles, laydowns/storage, construction camps, substations, temporary transmission lines, vehicle access and associated activities. • A layout plan (or plans) for the project, including but not limited to key infrastructure, laydown areas and construction camps, new access tracks, conservation areas and heritage agreements the project corridor passes through. • The anticipated timing and duration (including start and completion dates) for construction and operation of the proposed action. • A description of operational requirements of the action including any anticipated maintenance works. • A description and likely timing of rehabilitation activities associated with the proposed action.	Section 1.1 Figure 1-1 Figure 1-2

Request for Further Information	Relevant Sections Within this Document
Description of the environment and Matters of National Environmental Significance	
At the referral decision stage, the proposed action was determined as likely to have a significant impact on the following threatened terrestrial species: • Northern Quoll (Dasyurus hallucatus) – Endangered • Pilbara leaf-nosed bat (Rhinonicteris aurantia) – Vulnerable • Ghost bat (Macroderm gigas) – Vulnerable The preliminary documentation must provide a general description of the environment impacted by and surrounding the proposed action area, in both the short and long term. Specific matters this section must address include, but are not limited to: • A description of the protected matters, including but not limited to those listed above, that are, or have the potential to be in the proposed action area and surrounds. • A description of the current land use, topography, surface and groundwater bodies, waterways and vegetation communities within the proposed action area and surrounds. • For listed threatened species and communities that are known or have the potential to be present within the proposed action area and surrounds, and are likely to, or may be significantly impacted by the proposed action, a minimum of: o Information on the abundance, distribution, ecology and habitat preferences for each listed species or community. o Quantification of the extent of habitat and the number of individuals likely to be impacted, or historical patterns of use by those species, within the proposed action area and surrounds (including mapping identifying known and/or potential habitat). o Assessment of the quality and importance of known or potential habitat for the relevant listed species or communities within the proposed action area and surrounds o Information detailing known occurrences of listed ecological communities within a 3 km radius of the proposed action area and the size of these occurrences. o Information detailing known populations or records of individuals of listed species within a 3 km radius of the proposed action area and the size of these populations, if available. For mobile species such as birds and bats,	Section 2.1 – Baseline Environmental Quality Section 2.2.1 – Northern Quoll Section 2.2.2 – Pilbara Leaf-nosed Bat Section 2.2.3 – Ghost Bat Section 2.3 – Other MNES

Request for Further Information	Relevant Sections Within this Document
population information and records of individuals must be considered at a relevant radius from the proposed action area. o An assessment of the adequacy of any surveys undertaken (including survey effort and timing). In particular, the extent to which these surveys were appropriate for the listed species or community and undertaken in accordance with relevant departmental survey guidelines. The preliminary documentation should include all potential impacts to MNES and associated avoidance and mitigation measures outlined in the referral information plus the additional information listed in this document.	
Assessment of Impacts	
The preliminary documentation must include an assessment of potential impacts (including direct, indirect, consequential and cumulative impacts) that may occur as a result of all elements and project phases of the proposed action on MNES that are likely to be present within the proposed action area and surrounds. The impacts of the proposed action should be considered at the broadest scope: all components of the proposed action should be considered, including any associated supporting infrastructure. The department considers the proposed action may result in, but not be limited to, the following impacts: • vegetation clearance and loss of habitat; • habitat fragmentation; • increased risk of feral animals and weeds; • direct mortality; • impacts on water resources; • increased dust; • increased risk of vehicle strike; • increased light and noise and dust pollution; • increased risk of fire; • anthropogenic disturbance; • risk of collision.	Section 3.1.1 – Vegetation clearance and loss of habitat; Section 3.1.2 – habitat fragmentation; Section 3.1.3 – feral animals, weeds and fire; Section 3.1.4 – direct mortality, including vehicle strike; Section 3.2.2 – water resources; and Section 3.2.1 – dust, light and noise. Risk of collision is included within the direct mortality risk, and anthropogenic

Request for Further Information	Relevant Sections Within this Document
Please provide an assessment of impacts to listed threatened species which should include, but is not limited to: • Details of the direct and indirect loss and/or disturbance of protected matters and their habitat as a result of the proposed action. This must include the area (in hectares), habitat features such as caves, burrows etc. and quality of the habitat to be impacted and quantification of the individuals to be impacted. • An assessment of the impacts of habitat fragmentation in the project area and surrounding areas, including considerations of species/ movement patterns. • A discussion of whether the impacts are likely to be repeated, for example as part of maintenance. • A discussion of whether any impacts are likely to be unknown, unpredictable or irreversible. • Please demonstrate that the action has regard to relevant conservation advice and is not inconsistent with recovery plans and/or threat abatement plans	disturbance is incorporated in vegetation and habitat clearance. Each section includes an assessment of the likely impacts as a result of the Proposed Action. An assessment of the Proposed Action against relevant recovery plans and threat abatement plans is included in Section 3.7.
Avoidance, mitigation and management measures	
The preliminary documentation must provide information on specific measures proposed to avoid, mitigate, and manage impacts to the relevant protected matters from the proposed action. Documentation should clearly set out the following measures for each environmental issue and protected matter likely to be impacted by the proposed action. Measures including, but not limited to, the following items must be outlined in the documentation: • A consolidated list of impact avoidance and mitigation measures based on best available practices that will be implemented to reduce impacts on protected matters (including any additional to those proposed in the original referral). This must include a description of each measure proposed, relevant protocols, the name of the agency responsible for each measure, as well as the location and timing for each measure. The following measures should be included but are not limited to: o Project specific details such as hours of operation and activity schedules o Details of pre-clearance and clearance procedures. o Measures to minimise risk of injury and death, such as during construction and from vehicle strike.	Section 3 – mitigation measures included under assessment of each impact. Event contingencies are outlined in Section 3.6. Rehabilitation and revegetation measures are included as part of the assessment of each impact, and additional rehabilitation

Request for Further Information	Relevant Sections Within this Document
o Measures to minimise impacts on surrounding areas used by the Northern Quoll. This may include noise, dust, light pollution etc. o Measures to manage unexpected finds (e.g. active denning site) or injuries / death of fauna. o Measures to prevent impacts to bat and bird species via collision with fences (including those temporarily erected during construction). o Measures to mitigate impacts from disturbance at all stages of the project. o Measures to avoid or mitigate likelihood of impacts on water resources. o Details of training to be provided to those onsite. • Describe contingencies for events, such as the identification of protected matters during construction searches (e.g. translocation management protocols for specific species). • Details of any rehabilitation or revegetation measures to be implemented, including objectives, target species, timing of relevant stages, methodology, maintenance, and monitoring. • For each proposed mitigation measure, please also include: o Performance and completion criteria o Monitoring and reporting arrangements o Potential risks/threats, including residual risks, and any measures that would be implemented to mitigate against these risks, and any proposed monitoring to confirm the effectiveness of these measures. • Discussion of the likely residual impacts to the protected matter after proposed avoidance and/or mitigation measures are taken into account. • Management commitments by the person proposing to take the action must be clearly distinguished from recommendations or statements of best practice made by the document author or other technical expert. It is preferable to provide a consolidated table of management commitments, including details on funding, roles and responsibilities and measurable performance criteria. Commitments should be made using unambiguous language, i.e. use 'will' and 'must' when committing to actions instead of 'where possible', 'where practicable', 'as required', 'to the greatest extent possible', and 'should' or 'may'. This information should also be included in an Environmental	information is included in Section 6. Table 3-2 provides performance criteria, monitoring and reporting requirements, and risks, as well as proposed measures to mitigate against those risks. Residual impacts are outlined in Section 3.4. An Environmental Management Plan has been compiled and is included as Appendix F of this document. This Management Plan provides an outline of the Management Commitments proposed in this document, that will aim to minimise impacts on conservation significant fauna. The Fauna Management Plan has been prepared in accordance with the DCCEEW Environmental

Request for Further Information	Relevant Sections Within this Document
Management Plan (EMP) which is to be EPBC Act specific and details the management of potential environmental impacts to the listed threatened and migratory species associated with the proposed action. The EMP provided should be consistent with the department's Environmental Management Plan Guidelines (2014) (See Table C 2.4b). The Fauna Management Plan will be reviewed as part of the assessment stage.	Management Plan Guidelines.
The referral documentation states that the proponent does not expect any objection to the development of the proposed action as there has been multiple interactions and communication with relevant Indigenous stakeholders. It further states that the project area has been subjected to two heritage surveys (archaeological and ethnographic) conducted in April 2017 and February 2021 in accordance with Nyamal Heritage protocols. No Indigenous heritage sites have been recorded within the project area. The department sought advice from the National Indigenous Australians Agency (NIAA) during the referral stage for the proposed action. Following are the recommendations from NIAA: • The NIAA recommends that proponents ensure they have engaged with the Traditional Owners and other First Nations stakeholders with an interest in a project, and have provided them with sufficient time to make informed assessments of the possible impact of the project on their interests. • The NIAA notes the proposed project is situated on pastoral leasehold land. If it has not already done so, and noting that the referral indicates there is a mining agreement already in place, we recommend Pilbara Minerals seek advice from the Western Australian Government on whether any processes are required under the future acts regime of the *Native Title Act 1993* (Cth) before work can commence. • The NIAA recommends that Pilbara Minerals continue to engage with the Traditional Owners and Nyamal Aboriginal Corporation (NAC) throughout the life of the project on the range of cultural, environmental, social and economic matters that may affect them.	Section 5.2 outlines stakeholder engagement undertaken and planned. Section 5.3 describes the Aboriginal Cultural Heritage in the Proposed Action area.
Offsets	
An offset is required to compensate for all predicted or potential residual significant impacts to EBPC Act listed threatened species and communities. This residual significant impact includes the total area of habitat lost and/or degraded for each MNES species. Offsets must meet the principles of the EPBC Act Environmental Offsets Policy (2012) (see Table C item 2.4c). To compensate for the residual significant impacts of the proposed action, the approval holder must make financial	Section 4

Request for Further Information	Relevant Sections Within this Document
contributions to the Pilbara Environmental Offsets Fund. The proponent must develop an Impact Reconciliation Procedure as required by the Western Australian Environmental Protection Authority. Further guidance is available at: https://www.epa.wa.gov.au/forms-templates/instructions-preparing-impact-reconciliation-procedures-and-impactreconciliation	
Economic and Social Impacts	
Please provide further detail on the social and economic costs and/or benefits of undertaking the proposed action, including: • An estimate of any anticipated economic costs and/or benefits (in AUD) • The basis for any estimation of costs and /or benefits • Any potential employment opportunities expected to be generated at each phase of the proposed action, including any potential opportunities for local Indigenous people. Such opportunities on this project might relate to construction and operational activities, environmental management and monitoring, and apprenticeships. The department recommends the proponent incorporate the following recommendations provided by the NIAA: • The NIAA encourages the engagement of First Nations employees and businesses to help realise the economic benefit of projects for the local First Nations community. If it has not already done so, we recommend that Pilbara Minerals discuss with the NAC potential opportunities for First Nations employment and businesses in relation to the project	Section 5

Table 9-2 provides a cross referencing system for the required information from the original referral.

Table 9-2: Information from the Referral Cross Reference

Aspect	Requirement	Relevant Sections Within this Document
Description of the action	A description of all components of the action, as described in the referral documentation	Section 1.1

Description of the environments	A description of all environments, as it relates to the proposed action, as described in the referral documentation.	Section 2.1
Relevant MNES	Details of the relevant MNES, as described in the referral	Section 2.2 and Section 2.3
Baseline information	Description of the baseline data contained in the referral documentation.	Section 2.1
Impacts	Description of the impacts contained in the referral documentation, including: • Habitat loss • Habitat degradation	Section 3
Proposed avoidance and mitigation measures	Description of the avoidance and mitigation measures proposed in the referral documentation.	Section 3

Table 9-3 provides a response to Table C of the request for further information regarding the general content, style and formatting requirements.

Table 9-3: General content, Style and Formatting Requirements Cross Reference

Aspect	Requirement	Relevant Sections Within this Document
Considerations for decision making		
Ecologically Sustainable Development (ESD)	A description of how the proposed action meets the principles of ESD, as defined in section 3A of the EPBC Act. The following principles are principles of ecologically sustainable development: • Decision making processes should effectively integrate both long term and short term economic, environmental, social, and equitable considerations. • If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. • The principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. • The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making. • Improved valuation, pricing and incentive mechanisms should be promoted.	Section 7
Economic and social matters	An analysis of the economic and social impacts of the action, both positive and negative. Details of any public consultation activities undertaken and their outcomes Details of any consultation with Indigenous stakeholders. **Indigenous engagement** Identify existing or potential native title rights and interests, including any areas and objects that are of particular significance to Indigenous peoples and	Section 5 – Economic and Social impacts. Section 5.2 provides information on the stakeholder engagement undertaken and planned.

Aspect	Requirement	Relevant Sections Within this Document
	communities, possibly impacted by the proposed action and the potential for managing those impacts. Describe any Indigenous consultation that has been undertaken, or will be undertaken, in relation to the proposed action and their outcomes. The department considers that best practice consultation, in accordance with the Guidance for proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (2016) includes: • Identifying and acknowledging all relevant affected Indigenous peoples and communities • Committing to early engagement • Building trust through early and ongoing communication for the duration of the project, including approvals, implementation, and future management • Setting appropriate timeframes for consultation • Demonstrating cultural awareness Describe any state requirements for approval or conditions that apply, or that the proponent reasonably believes are likely to apply, to the proposed action with regards to Indigenous peoples and communities. Projected economic costs and benefits of the project, including the basis for their estimate through cost/benefit analysis or similar studies. Employment opportunities expected to be generated by the project (including construction and operational phases).	Section 8.2.4 outlines the legislative approvals required for the project regarding Aborigina Cultural Heritage. Section 5.1 provides a cost-benefit analysis of the Proposed Action.
Environmental record of the person(s) proposing to take the action	Include details of any past or present proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against: • The person proposing to take the action;	Section 1.1.6

Aspect	Requirement	Relevant Sections Within this Document
	• For an action for which a person has applied for a permit, the person making the application; • If the person is a body corporate—the history of its executive officers in relation to environmental matters; and • If the person is a body corporate that is a subsidiary of another body or company (the parent body)—the history in relation to environmental matters of the parent body and its executive officers.	
Other approvals and conditions	The preliminary documentation must include information on any other requirements for approval or conditions that apply, or that you reasonably believe are likely to apply, to the proposed action if applicable. This must include: • A description of any approval obtained or required to be obtained from a State or Commonwealth agency or authority (other than an approval under the EPBC Act), including any conditions that apply (or are reasonably expected to apply) to the action; and • A description of the monitoring, enforcement and review procedures that apply, or are proposed to apply, to the action.	Section 8
Content, style and formatting requirements		
Style	Be written so that any conclusions reached can be independently assessed. Include all key claims, findings, proposals, and undertakings in the main document.	Entire document. Document has included summaries of all relevant data, with original reports attached as Appendices.
Format	Be in a suitable format to be published in hardcopy (A4 or A3 size, with maps and diagrams in A4 or A3 size and in colour) and published in electronic format (e.g., MSWord or PDF) on the internet.	Document provided in PDF format.

Aspect	Requirement	Relevant Sections Within this Document
Content	Include a cross-reference table indicating where the information fulfilling the requirements in Table 1, 2 and 3 is included in the preliminary documentation.	Table 9-1, Table 9-2 and Table 9-3 provide a cross referencing system for requirements outlined in communications from DCCEEW.
Relevant standards, policies, and other guidance material	Refer to all relevant standards, policies and other guidance material published by the department. Any instances where published guidance is not followed must be justified. Where no Commonwealth standards exist, state government and industry standards may be useful. Relevant standards, policies and other guidance material include, but are not limited to: a. Department of Agriculture, Water and the Environment (2021). Guide for providing maps and boundary data for EPBC Act projects. Canberra, ACT: Commonwealth of Australia. Available from: https://www.environment.gov.au/system/files/resources/5bb0509e-c4b5-4f7a-910b-5b04d82db491/files/epbca-mapsdata-guidelines.pdf. b. Department of the Environment (2014). Environmental Management Plan Guidelines. Canberra, ACT: Commonwealth of Australia. Available from: Environmental Management Plan Guidelines 2014 (dcceew.gov.au). c. Department of Sustainability, Environment, Water, Population and Communities (2012). Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. Canberra, ACT: Commonwealth of Australia. Available from:	Figures and spatial data have been created in line with the Guide for providing maps and boundary data for EPBC Act projects. The Environmental Management Plan in Appendix F has been compiled in line with the Environmental Management Plan Guidelines 2014. Proposed offsets are managed through the PEOF, which supports projects in line with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy.

Aspect	Requirement	Relevant Sections Within this Document
	https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsetspolicy_2.pdf d. Department of Sustainability, Environment, Water, Population and Communities (2011). Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act. Available from Survey Guidelines for Australias threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act- DCCEEW e. Department of the Environment, Water, Heritage and the Arts (2010). Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act. Available from Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the EPBC Act – DCCEEW.	Faun surveys have been undertaken in accordance with the Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the EPBC Act, and Guidelines for detecting bats listed as threatened under the EPBC Act.
Maps, diagrams and images	a. a. Maps, plans, diagrams, technical information (e.g. specifications, schematics) and images provided must be clearly annotated, in colour and of high resolution. b. All maps submitted as part of the response must be consistent with the department's Guide for providing maps and boundary data for EPBC Act projects (2021) (see Table C item 2.4a).	Clear Project maps provided in PDF format. Spatial data has also been provided.
Referencing standards	Reference all sources using the Harvard standard of referencing. Ensure that other supporting documents (e.g. academic studies, regulatory standards) are publicly accessible, with electronic links provided where possible.	Harvard referencing system has been utilised (Section 10).
Evidence based conclusions	Where appropriate, the information provided must be supported by:	The information provided in this document is supported by various surveys undertaken by qualified experts. These surveys and reports

Aspect	Requirement	Relevant Sections Within this Document
	• Evidence-based conclusions based on the best available peer-reviewed scientific literature with supporting references cited or expert opinion provided and/or the views of suitably qualified experts. • Scientifically robust methodologies that are appropriate for purpose, and sufficient description of the methodology used and justification of why the methodology was selected. • Include detailed technical information, studies or investigations necessary to support the information in the standalone document as appendices.	have been included in the appendices.
Inclusion of sensitive information	• Must not contain any commercial in confidence markings. If the preliminary documentation contains sensitive information, please discuss this with the assessment officer. • Redact the contact details of departmental officers. • Include the names, roles and qualifications (where relevant) of all persons involved in preparing the Preliminary Documentation • The response will form part of the preliminary documentation that must be published for public comment. Therefore, the contact details of departmental officers must not be included in the response. The response should not contain commercial in confidence markings. If the response contains sensitive information, please discuss with the department.	This document does not contain any commercial in confidence markings or sensitive information. Details of the persons involved in the preparation of this document have been provided in the Executive Summary. No reference to departmental officers has been included in this report.
Ecological data	The preliminary documentation must include an appendix of occurrence records (both sightings and evidence of presence) for all listed threatened and migratory species identified during field surveys for the proposed action. This data may be used by the department to update the relevant species distribution models that underpin the publicly available Protected Matters Search Tool (PMST). The species occurrence records must be provided in accordance with the department's Guidelines for biological survey and mapped data (2018) using the	Species occurrence records have been provided as part of the spatial data package submitted with this document. This data has also been provided as Appendix E.

Aspect	Requirement	Relevant Sections Within this Document
	species observation data template provided with this request for additional information. Sensitive ecological data must be identified and treated in accordance with the department's Sensitive Ecological Data – Access and Management Policy V1.0 (2016) or subsequent revision.	

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APPENDIX A

Pilbara Minerals Environmental Policy

POLICY

ENVIRONMENTAL

Pilbara Minerals Limited (PLS) is committed to understanding and protecting the natural environment to ensure its sustainability in a way that continually demonstrates responsible environmental behaviour from everyone who works with the Company, including our contractors and partners.

Our Company is fully committed to minimising its impacts on the environment so that it may be enjoyed for many generations to come.

To achieve this commitment, Pilbara Minerals will:

- make environmental protection an integral part of business operations and of equal importance with other key operational and strategic business objectives;
- continually educate and train staff members on environmental issues, rules and practices and foster a culture whereby staff participation is welcomed to improve company performance;
- ensure we are always compliant with all applicable environmental laws and regulations;
- implement measures to minimise pollution, waste and other impacts to the environment as a result of our business activities;
- continually identify, monitor, manage and report on the environmental aspects of our business to create long term sustainability;
- always strive to improve the responsible use of natural resources; and
- embrace climate change and proactively implement measured and considered solutions to positively contribute to addressing the ongoing impacts of climate change.

Pilbara Minerals will periodically review this policy to ensure our business objects and targets are aligned with environmentally sustainable outcomes that reflect our Company values.

POLICY HISTORY

This Policy will be reviewed by Management on an annual basis and amended as required.

Established	15 September 2017
Last Reviewed	05 November 2020
Frequency	Annually

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Managing Director and CEO
November 2020

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APPENDIX B

Hydrology and Hydrogeology Assessment

PENTIUM
WATER

HYDROLOGY AND HYDROGEOLOGY ASSESSMENT

Lynas Find

Pilbara Minerals

PILLYNA_001

3 August 2022

Document Status

Version	Purpose of document	Authored by	Reviewed by	Review Date
Draft A	Draft for comment	GreBlo	RobSwi	14/07/2022
Rev 0	Final	GreBlo	RobSwi	02/08/2022

Approval for Issue

Name	Signature	Date
Rob Swift		03/08/2022

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Reviewer: Rob Swift

Approved by: Rob Swift

Version: Rev 0

Date: 03 August 2022

Prepared For

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1. Introduction

1.1. Background

Pilbara Minerals Limited (PML) owns the Pilgangoora project, comprising a Lithium-Tantalum resource estimated at 157 MT at 1.19 % Li2O, 120 ppm Tantalite (Pilbara Minerals, 2022). PML have developed a standalone operation at Pilgangoora, comprising mining of a series of five active open pits (Monster, Eastern, Central, Southern and Southern End) and an on-site processing facility.

PML are proposing an expansion of their operations to incorporate the Lynas Find resource, for which information on potential surface water and groundwater impacts and details about management strategies are required. This document provides an assessment of the hydrogeology and hydrology associated with Lynas Find pit, based on historical reports and data available for the site.

The Lynas Find development comprises:

- Development of the Lynas Find Pit
- Establishment of a waste dump near Lynas Find Pit

1.2. Locality

The Pilgangoora project shown in Figure 1 is situated approximately 24 km east of the Great Northern Highway and about 88 km south south-east of Port Hedland in the north-eastern Pilbara region of Western Australia. Lynas Find lies on a north-south trending range of hills that form a local watershed between the Turner River East and Strelley River West / De Grey River System.

The general layout of the pits at Pilgangoora is presented in Figure 1. The new Lynas Find pit is situated approximately 600 m northeast of Monster Pit and falls within Tenement M45/1266.

1.3. Land Use

The Project is within the Pilbara groundwater area as proclaimed in 1979 under the Rights and Water and Irrigation Act. The current land uses in the area are predominantly mining and stock raising.

1.4. Lynas Find Development

The general layout of the area close to Lynas Find is shown in Figure 2.

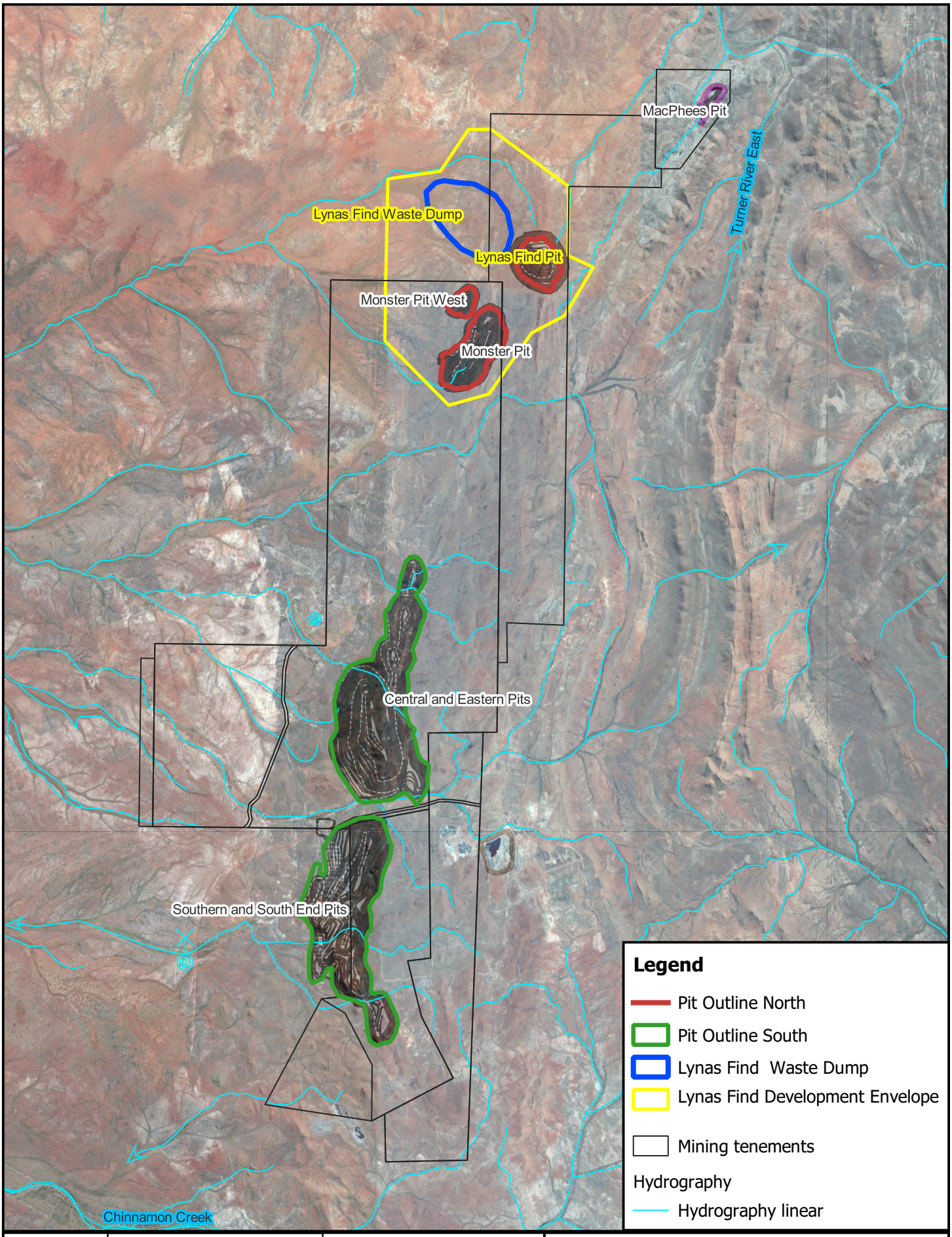
The development of the Lynas Find Pit is planned in two stages:

- Stage 1 – developing the pit to a maximum depth of 190 mAHD for the purpose of providing a direct ship ore product.
- Stage 2 – in the process of being finalised, progresses to 110 mAHD.

Stage 1, to 190 mAHD, does not progress below the prevailing water table at the site and therefore is not anticipated to have any significant impacts on the local groundwater environment (GRM, 2017).

Stage 2, however, is anticipated to extend up to 80 m below the prevailing water table and require dewatering (GRM, 2017).

A waste dump associated with the pit operation is planned in the area to the northwest of the pit.



PENTIUM WATER

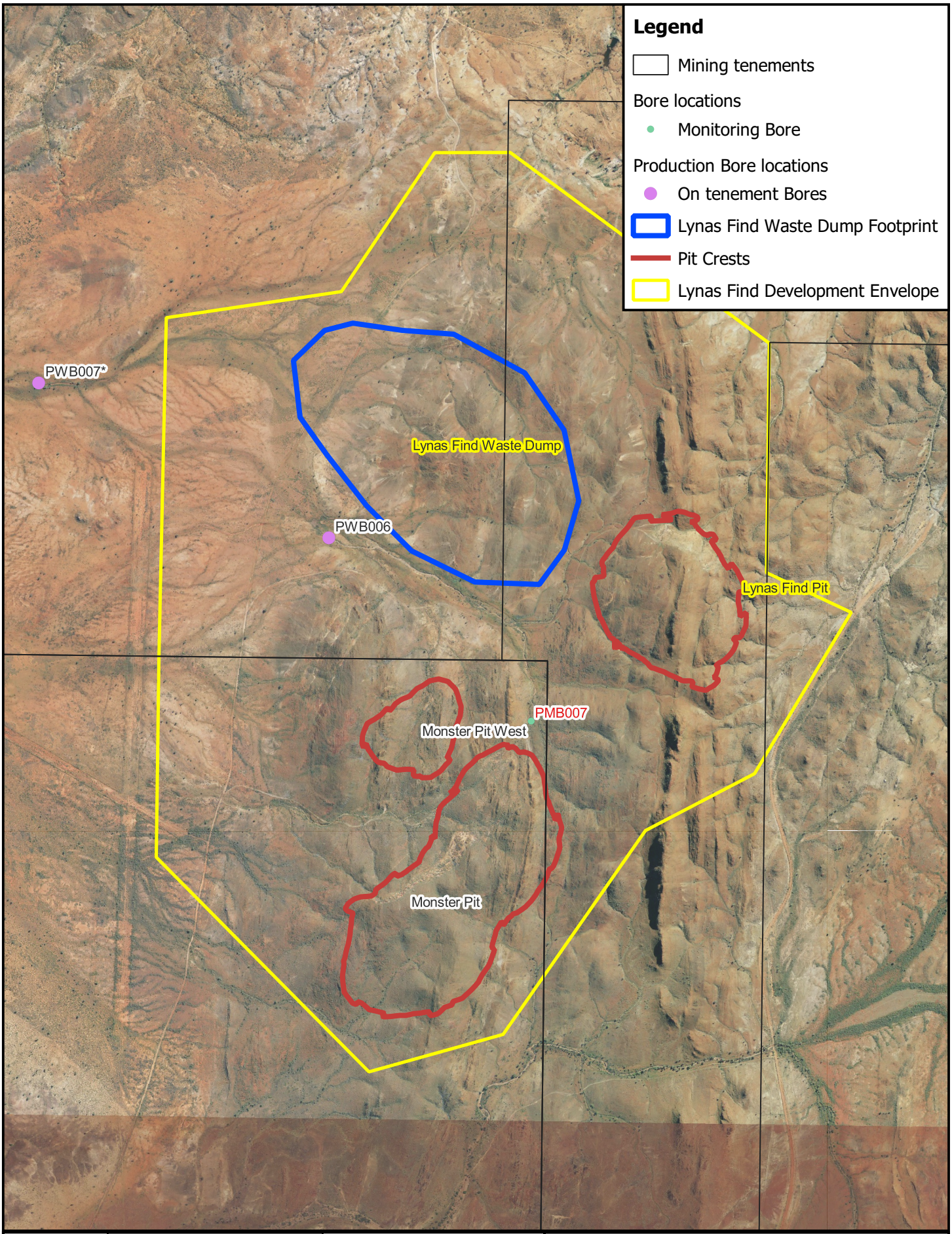
Project code:
Drawn by: Rob Swift
Date: 14/07/2022
Scale: 1:50000
Page size: A4
Sources: data.gov.au, DWER, landgate

0 0.5 1 km

GDA94 / MGA zone 50

Figure 1

Site and bore locations



PENTIUM WATER

Project code:
Drawn by: Rob Swift
Date: 14/07/2022
Scale: 1:15000
Page size: A4
Sources:

0 0.1 0.2 0.3 0.4 0.5 km

GDA94 / MGA zone 50

Figure 2

Lynas Find Pit local layout

1.5. Previous Groundwater investigations

There have been limited groundwater investigations in the immediate environs of Lynas Find Pit. Several studies have been undertaken across the Pilgangoora Project since 2015. The details of these reports have not been included in this report but are relevant to history of the site and have provided the basis for the compilation of this report. These reports have been listed below:

- Pilbara Minerals Pilgangoora Water Options Study, Groundwater Development Services, November 2015
- Pilgangoora Lithium Tantalum Project – Pit Lake Closure Modelling Groundwater Resource Management 2016
- Water Supply Assessment Pilgangoora Lithium Tantalum Project, Groundwater Resource Management 2016
- Dewatering Assessment Pilgangoora Lithium tantalum Project, Groundwater Resource Management, 2016
- Operating Strategy For Pilgangoora Southern Borefield, Groundwater Resource Management, 2017
- Pilgangoora Lithium Tantalum Project- 5 MTPA Hydrogeological Detailed Feasibility Study, Groundwater Resource Management 2018
- Pilgangoora Project – Dakota DSO Pit Hydrogeological Assessment, Groundwater Resource Management 2017
- Preliminary Groundwater Modelling Results - Baldy North Turner East Borefield Groundwater Resource Management 2019
- Pilgangoora Project – Revised Groundwater Modelling Groundwater Resource Management 2019
- Groundwater Monitoring Review Pilbara Minerals Limited Pilgangoora Project Groundwater Resource Management, 2020
- Groundwater Monitoring Summary Pilbara Minerals Limited Pilgangoora Project, Groundwater Resource Management 2021
- Groundwater Monitoring Summary Pilbara Minerals Limited Pilgangoora Project, Groundwater Resource Management 2022

These various reports focus on the existing pits and water supply borefields that support the Pilgangoora Operations.

Hydrogeological investigation around the Lynas Find pit is limited to consideration of the Stage 1 progression (above water table) assessment, part of which involved slug testing of four RC exploration holes (GRM, 2017).

2. Climate/Rainfall

2.1.1. General

The Pilbara region is semi-arid and characterised by highly variable rainfall, both spatially and over time. The climate is dominated by tropical cyclones, which are typically experienced between November to March. These are generally high intensity rainfall and streamflow events. Extended durations without significant rainfall or surface water flow are experienced often within the Pilbara.

The nearest current registered Bureau of Meteorological (BoM) weather station to the project site is at Wallareenya Station. The nearest BoM station with the most complete long term historical rainfall data is Indee Station, 40 km to the north-west. Rainfall is also recorded from a weather station located on site.

Evaporation data is recorded at Port Hedland Airport and Marble Bar and an average of these two stations has been used to provide an estimate of likely evaporation rates. Evaporation for the year is generally an order of magnitude greater that the rainfall totals. Monthly average rainfall data from Indee and Wallareenya presented in Table 1, along with the estimated evaporation data from the average of Port Hedland Airport and Marble Bar.

Table 1: Monthly Rainfall Averages (mm) From 1911-2022 And Estimated Pan Evaporation (BOM)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Indee	68	82	72	20	25	22	9	5	2	1	4	24
Wallareenya	70	83	67	17	22	25	8	4	1	2	4	26
Pan Evap.	358.1	317.3	320.9	288.0	265.1	226.5	203.1	200.0	214.5	262.0	303.0	347.2

The average rainfall data recorded from the site weather station since 2018 is shown in Table 2. The long-term data indicates an average rainfall of 335 mm per year, with most of the rainfall reporting during the months of January to March. The driest months are typically September and October recording on average less than 2 mm.

The onsite weather station data has some data gaps during the monitoring period, this has led to some differences in the base data from the averages for Indee and Wallareenya data. To correct for this any reporting or modelling has the missing data replaced with the same period data from the nearest monitored sites with data.

Table 2: Site Weather Station Monthly Rainfall Totals and Averages (mm) from 2018-2022 (POPL)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2018	158	46	16.5	0	0	61.5	0	0	0	0	0	0
2019	5	0	341	9.5	0	4.2	0	0	0	0	53	7.5
2020	166.5	279	36.6	19	12	0	0	4	0	1	1.8	216
2021	29.6	66	13	30	0	26	0	0	0	0	0	0
2022	106	35	9	7	142							
Average	93	85.2	83.2	13.1	30.8	22.9	0	1	0	0.2	13.7	55.8

Rainfall distribution is consistent with the long-term data, with most of the rainfall occurring during the summer months.

2.1.2. Rainfall Intensity-Frequency-Depth

Intensity-Frequency-Depth (IFD) data is required to characterise storm rainfall intensities and is provided by BoM. The BoM website provides information for various AEPs (Annual Exceedance Probability). The rainfall intensity data for the site is shown below:

Table 3 Intensity-Frequency-Depth (IFD) (mm)

AEP Duration	63%	50%	20%	10%	5%	2%	1%
1 hour	28	32	47	57	67	81	92
2 hour	34	40	58	72	85	104	120
6 hour	46	54	84	107	130	164	191
12 hour	55	67	108	139	172	219	257
24 hour	66	81	134	174	218	278	325
72 hour	84	104	168	216	266	330	380

2.1.3. Topography

The topography of the project site is determined by the range of hills that it is situated within. These hills provide in the order of 90 m relief with ground elevations rising from about 170 mAHD on the plains to the west of the site to about 260 mAHD within the project site.

The prominent geographic features being Mount York (268 mAHD) located at the south edge of the project area and McPhee Hill (217 mAHD) located 5 kilometres to the north-east.

The project site is in a series of north-south aligned hills which have an altitude of 90m to 100m above the surrounds.

The project also lies 18 km east of the main channel of the Turner River and is in the uppermost extent of the Turner River East tributary and McPhee Creek, a tributary of the East Strelley River.

3. Hydrology and Drainage

3.1.1. General

The Pilbara landscape can be subject to heavy rainfall. Activities such as vegetation and topsoil removal, mining activities, stockpiling and general construction activities substantially increase the risk of erosion, generating coarse and suspended sediment from disturbed land. This can adversely affect downstream water quality, dependent vegetation communities and ecosystems.

The general objective with regards to hydrological processes is to maintain surface water regimes, so that existing and potential users (including the ecosystem) are also protected. Effective erosion, sedimentation and water quality control minimises sedimentation impacts on downstream waterways and the adjacent environment.

3.1.2. Regional Hydrology

The site lies on the eastern side of the Turner River catchment, near the Strelley River catchment boundary. Most of the site lies within the Chinnamon Creek catchment, which has a catchment boundary of ~368 km^2. There are two sub-catchments of Chinnamon Creek that are impacted by the proposed pits and waste dump, these are Northern Creek (Ac ~20.4 km^2) and Houston Creek (Ac ~18.8 km^2). Refer to Figure 4 below for the Lynas Find catchment boundaries.

A portion of the Lynas Find pit lies within the Oakover River (Turner River East tributary) catchment, this has a catchment area of ~800 km^2.

At closure it is assumed that 100% of runoff is lost from the pit areas and 50% runoff is lost from waste dumps.

Monster West Pit, and about half of the Lynas Find and Monster East pits lies within the Northern Creek catchment, these have an approximate total pit area of 0.36 km^2. The Lynas Find waste dump also lies within the Northern Creek catchment, the waste dump has an area of ~0.47 km^2, therefore about 0.23 km^2 area of runoff is lost. This is a total area of runoff loss of about 0.59 km^2, this is ~2.9% of the Northern Creek catchment.

The remaining Monster East pit lies in the Houston Creek catchment and has an area of ~0.22 km^2. This makes up ~1.2% of the Houston Creek catchment area. The remaining area of the Lynas Find pit lies within the Oakover River catchment, an area of about 0.16 km^2. This is ~0.02% of the total Oakover River catchment area. Therefore, the pits and waste dump are not expected to have an impact on downstream flows.

3.1.3. Local Hydrology

The Monster and Lynas Find Pits are located at the top of hills and at the edge of local / regional catchment boundaries. As a result, there are no upstream flows impinging on the creeks and standard pit bunds will be sufficient. As a result, the pits will only be impacted by direct rainfall on the pit.

The Lynas Find waste dump is located near the top of a catchment boundary, there are minimal upstream flows impacting it and therefore no external surface water management (i.e. diversions) is required. Surface water runoff from the waste dump should be captured to prevent dirty water entering the natural creek system. The waste dump should be bunded off to capture water which can then infiltrate / evaporate or be treated in a sedimentation basin and released downstream.

3.1.4. Rainfall on Pits

Flood water collecting in pits needs to be pumped out to allow mining to continue. The pit stormwater management system (i.e., pumping capacity) and flood storage capacity in combination should ideally be able to accommodate the 72-hour rainfall event. DMIRS (Department of Mines, Industry Regulation and Safety) uses the 100 - year (1% AEP) 72-hour rainfall event as a guideline for operational flood storage impacts and is commonly used in “volume” dependent storm events (such as pump out volumes and storm management for pits).

The in-pit volume of water based on direct rainfall over the pit for the 10% AEP and 1% AEP 72-hour rainfalls is shown in table 4 below. It has been assumed that 80% of the rainfall will runoff and accumulate at the bottom of the pit.

Table 4 Approximate in-pit run off volumes (m^3)

Rainfall Event	Monster Pit East	Monster Pit West	Lynas Find
63% AEP 72hrs	25,000	6,000	19,000
50% AEP 72hrs	31,000	7,000	24,000
20% AEP 72hrs	50,000	11,000	39,000
10% AEP 72hrs	64,000	14,000	50,000
2% AEP 72hrs	79,000	18,000	62,000
2% AEP 72hrs	98,000	22,000	77,000
1% AEP 72hrs	112,000	25,000	88,000

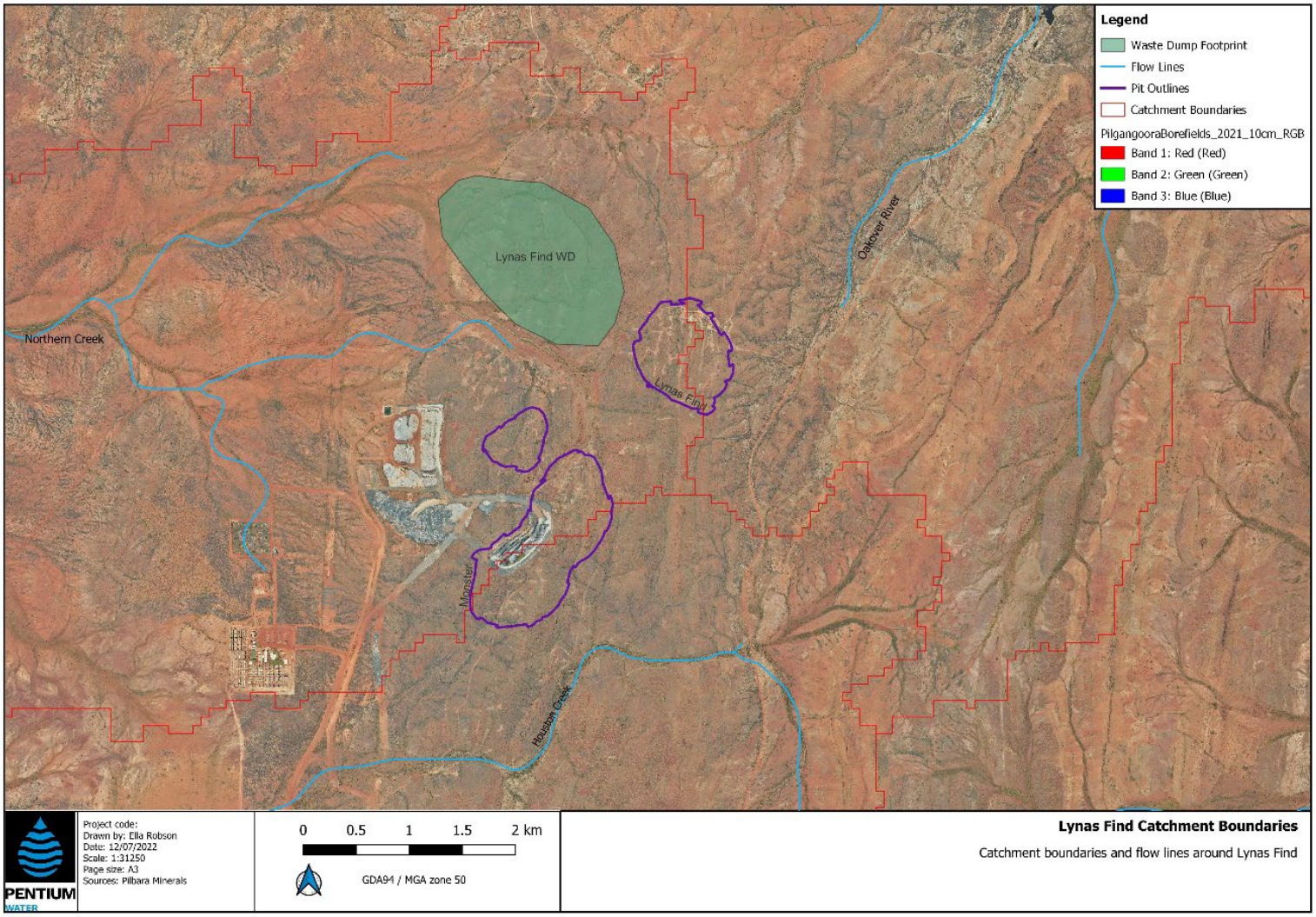


Figure 3 Lynas Find surface water catchment boundaries

4. Geology

4.1.1. Geology - Pilgangoora

Lynas Find is situated with the Archaean Pilbara Craton, comprising granite and greenstone terrain. Lynas Find lies along the Lynas Find Shear Zone within the East Strelley greenstone belt (Blewett and Champion, 2005).

The East Strelley greenstone belt is flanked to the south east and west by granite within the East Pilbara Granite-Greenstone Terrane.

The Pilgangoora pegmatites are hosted in the East Strelley greenstone belt, which is a series of steeply dipping, mafic meta volcanic rocks and amphibolites. At Pilgangoora, the greenstones have been intruded by a swarm of north-trending, east-dipping pegmatites extending from Mount York in the south, northwards for about 11 km to McPhees Mining Centre).

Many of the pegmatites are very large, reaching over 1000 m in length and 200 m to 300 m in width. Despite their large size, mineralisation within these zoned pegmatites appears to be restricted to alternating zones, mainly along vein margins containing quartz, albite, muscovite, and spessartine garnet. These mineralised zones contain varying amounts of lepidolite, spodumene, tantalite, cassiterite, and minor microlite, tapiolite, and beryl (Pilbara Minerals 2015).

Alluvial cover is typically thin or absent in the area and mostly confined to the creek beds and minor drainage systems. The weathering profile in the region is also thin, typically less than 20 m in depth.

4.1.2. Geology – Lynas Find

The local geology of the Lynas Find pit was investigated during the Dakota DSO (Lynas Find) Hydrogeological assessment undertaken in 2017 (GRM, 2017). The lithium ore is hosted in a splayed pegmatite dyke, which dips at about 45° to the south. The pegmatite varies in thickness from about 2 m to 35 m, increasing in thickness to the east, and ultimately terminated by a shear zone which forms the eastern boundary of the proposed pit. The pegmatite intrudes a mafic and ultramafic sequence.

The local geology of the Lynas Find Pit is shown in Figure 5 below.

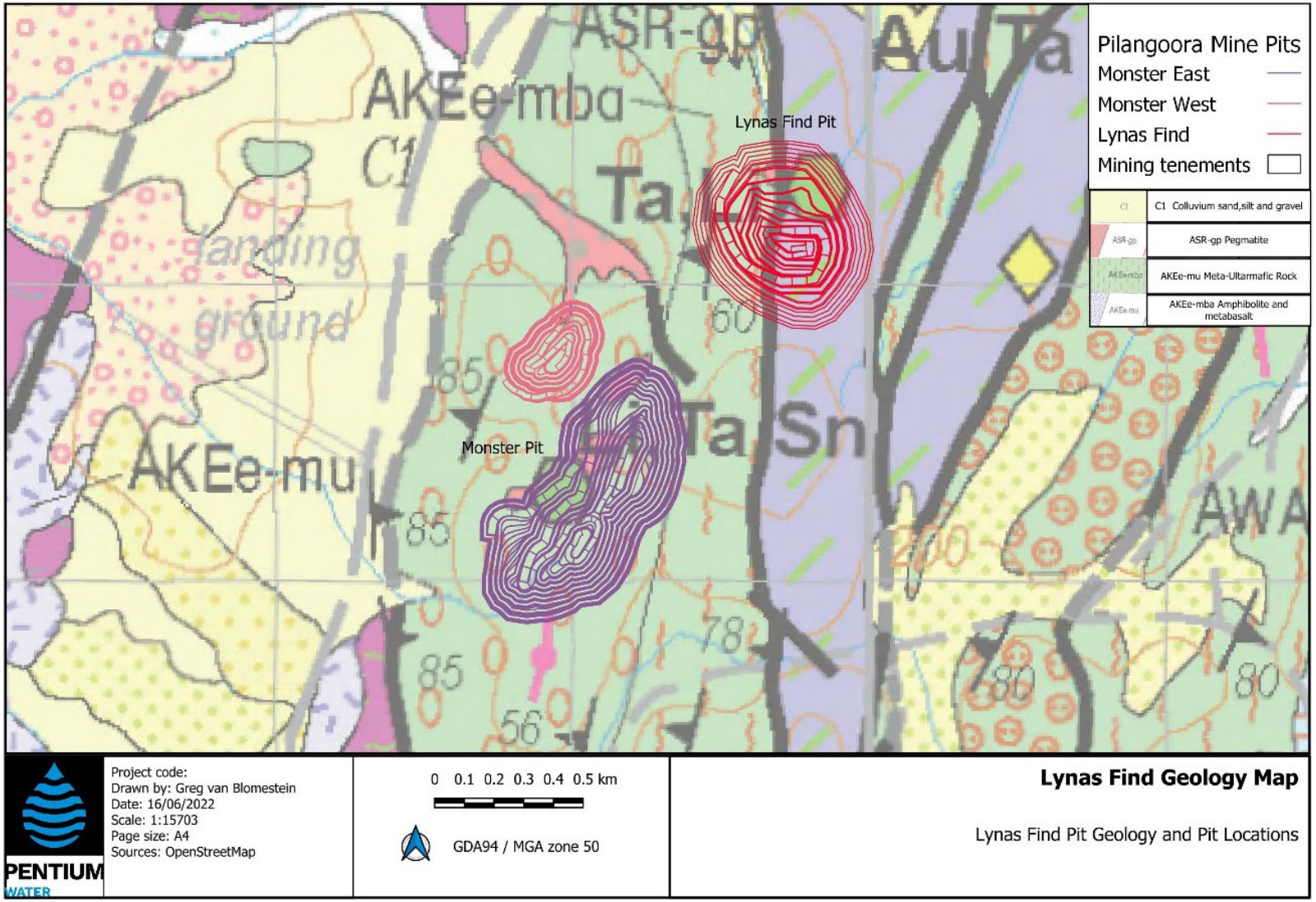


Figure 4: Lynas Find Pit Local Geology

5. Hydrogeology

5.1. Aquifers

5.1.1. Overview

The Pilgangoora project lies within the East Pilbara Granite Greenstone Terrane. There are no highly productive aquifers in this province although fractured rock aquifers are associated with the greenstones and occasional quartz veining (McFarlane DJ (ed.), 2015). Modern sandy alluvial deposts along numerous streamlines and fractures and dykes support Groundwater Dependent Ecosystems.

Data from the broader Pilgangoora project indicates that there is an east to west hydraulic gradient across the site (Figure 6), with a typical depth to groundwater of between 23 mgbl and 53 mbgl.

5.1.2. Lynas Find

Measurement during a slug testing program undertaken at Lynas Find in 2019 (GRM, 2019) identified that the prevailing water table was between 21 mbgl and 35 mbgl (179 mRL to 190 mRL). The average permeability derived from the slug testing was 0.012 m/d, which is considered consistent with the other Pilgangoora Pits.

The southern end of the Lynas Find pit potentially intersects an east-southeasterly oriented linear structure which has also been targeted as part of the 'on-tenement water supply borefield', specifically PWB006 and PWB007. Yields from PWB006 (~700 m west of Lynas Find), are reported to be approximately 2 L/s.

5.2. Groundwater recharge

Groundwater is recharged by direct rainfall or by stream flow during episodic rainfall events. Recharge is predominantly from surface water runoff and flooding events along the upper reaches of Pilgangoora Creek and Houston Creek (a tributary of Chinnamon Creek). Recharge occurs mainly on or adjacent to the groundwater divide and along drainage lines.

5.3. Groundwater throughflow

The hydrogeology of the Pilgangoora project area is characterised by an east to west draining system, with the groundwater divide coincident with the catchment divide (GRM, 2022). Throughflow is therefore considered to be limited given the setting at the top of the groundwater catchment.

5.4. Groundwater monitoring and water quality

There are no groundwater monitoring bores in the immediate environs of Lynas Find pit. Water quality data are limited – sampling from the nearby Monster Pit in 2020 was considered to be predominantly rainwater. Across the Pilgangoora site groundwater is typically neutral to slightly alkaline (pH 7.8 to 8.2), fresh to slightly brackish (TDS ranging from 710 to 4,000 mg/L) with a sodium chloride type water (GMR, 2021). The water quality at Lynas Find would be expected to be broadly consistent with that reported elsewhere at the Pilgangoora site.

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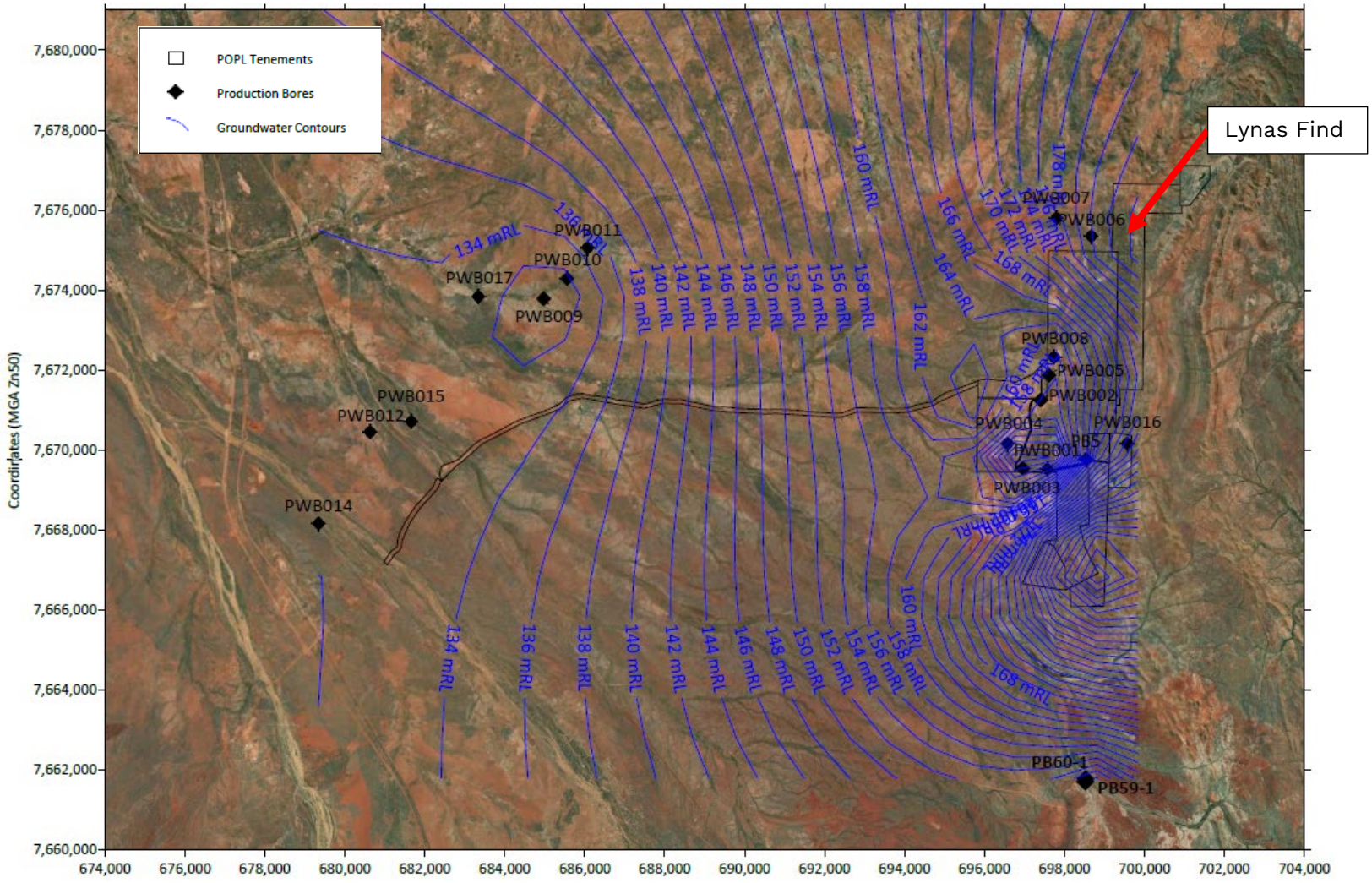

Figure 5: Groundwater Levels 2022 (GRM 2022)

6. Pit Progression and Dewatering

6.1. Pit Progression

Lynas Find is planned to gradually progress to a depth of 110 mAHD, as summarised in Table 5. There are several years where progression of the pit is on hiatus (years 8, 12, 16 to 20). Initial mining activity (Year 6 of the current mine plan) is to 190 mAHD, above the anticipated prevailing groundwater elevation at the site, however further progression to depth is anticipated to encounter groundwater.

Table 5 Lynas Find Pit Progression, including estimate bench and water volumes

Year of operation	Lowest Bench (mRL)	Approximate radius of pit (m)	Estimated volume of progression (m^3)	Estimated volume of water (m^3) (based on Sy 0.05)
6	190	185		
7, 9, 10	170	150	1769240	88460
11	165	140	330390	16520
13	150	90	633030	31650
14	130	60	278555	13930
15	115	40	75398	3770
21 / 24	110	20	14660	730

6.2. Analytical model setup

Due to the lack of site-specific hydrogeological data for Lynas Find a simple analytical model was considered appropriate to provide a high-level assessment of potential dewatering volumes and associated impacts.

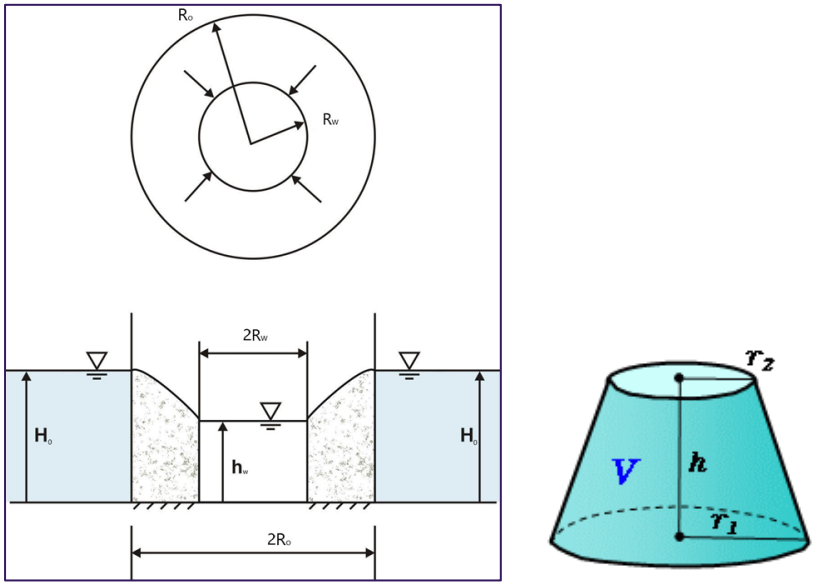

Figure 6: Radial flow into a circular excavation in an unconfined aquifer (Neville,2017) and volume of a truncated cone

6.2.1. Radial flow into a circular excavation

Based on the Dupuit-Thiem equation for unconfined aquifer conditions (below) (Fetter, 1988, Powers et al., 2007), mine inflows to maintain dry mining have been estimated for years 6

to 24, when the pit progresses below water table. A nominal hydraulic conductivity of 0.005 m/d, based on slug testing at Lynas Find, reflective of the range of permeabilities encountered. The simple setup of the model is summarised in Figure 6.

$$Q = \pi k \ ho^2 - hw^2 \ln(ro/rw)$$

Q = abstraction volume

K = hydraulic conductivity (m/d) (0.005 m/d)

ho = height of SWL above base of aquifer (assumed to be ~105 mRL (5m below base of pit))

hw = height of water level in pit (nominally 185 mRL)

rw = equivalent radius of pit

ro = maximum extent of cone of drawdown (SQRT(2.25 k.ho.t/Sy)

t = time since pumping or inflow started

Sy = specific yield, 0.05 as per Pilgangoora numerical model (GMR, 2018)

The radius of influence (ro, above) is calculated based on a rearrangement of the Jacob equation (Powers et al. 2007). The most reliable means of defining this is through a pumping test which would help identify potential recharge from other aquifers and recharge boundaries, but in the absence of this it is considered to provide a reasonable estimation of the likely radius of influence at this Order of Magnitude stage of assessment. The results of this are summarised in Table 6.

6.2.2. Volume of water within each bench

To include the volume of water within the pit shell itself a calculation considering the pit as a simple truncated cone was used (see Figure 6). The estimated total volume of water within each bench progression is presented in Table 5 and summarised as an equivalent rate (assuming the whole bench is removed in one year, for simplicity) in Table 6.

$$Volume, V = \frac{1}{3}\pi (r_1^2 + r_1 r_2 + r_2^2)h$$

r_1 = radius of upper surface (upper bench)

r_2 = radius of lower surface (lower bench)

h = difference in bench elevation

Table 6 Analytical model results

Year of operation	Bench elevation (mRL)	Step (days)	Time (days)	Hw-end of step (m)	Equivalent radius of pit (m)	Extent of cone of depression (ro end of step) (m)	Inflow – end of step (L/s)	Water removed from storage (L/s)
6	190	Above WT						
7	170	365	365	65	150	84	*	~3 L/s
8	170	365	730	65	150	118	*	-
9	170	365	1095	65	150	145	*	-
10	170	365	1460	65	150	167	5.1	-
11	165	365	1825	60	140	187	2.3	0.5 L/s
12	165	365	2190	60	140	205	1.7	-
13	150	365	2555	45	90	221	1.1	1 L/s
14	130	365	2920	25	60	236	0.9	0.5 L/s
15	115	365	3285	10	40	251	0.7	0.1
16	115	365	3650	10	40	264	0.7	-
17	115	365	4015	10	40	277	0.7	-
18	115	365	4380	10	40	289	0.7	-
19	115	365	4745	10	40	301	0.6	-
20	115	365	5110	10	40	313	0.6	-
21	110	365	5475	5	20	324	0.5	<0.1 L/s
22	110	365	5840	5	20	334	0.5	-
23	110	365	6205	5	20	344	0.5	-
24	110	365	6570	5	20	354	0.5	-

Note * model not valid at early time (ro calculated within pit rw)

Based on current data, indicating low prevailing permeability, inflows are anticipated to be limited. The extent of drawdown is also anticipated to be limited, not extending a significant distance from the pit, and focussed on fractured aquifer networks.

Due to the low permeability and reducing pit dimensions with progression to depth as the radius of influence expands the volume of incoming water is anticipated to reduce over time, from an initial approximate value of ~5 L/s to less than 1 L/s late on when most of the orebody is dewatered.

The dewatering strategy has not been defined yet, but it is anticipated that a dewatering bore (or two) supplemented with in-pit sump pumping would be required to adequately control groundwater inflows and allow for advanced dewatering of the orebody.

6.3. Uncertainty

Lynas Find is situated close to a northerly trending fault structure, which may act as a local fractured aquifer system. Further investigation is recommended to improve the hydrogeological understanding of the area around Lynas Find and refine any modelling associated with the deposit.

6.4. Site wide groundwater modelling

There is a site wide numerical groundwater model that has been constructed to assess the dewatering and impacts associated with the various other pits and water supply bores at the Pilgangoora project. It is recommended that this is updated to incorporate the Lynas Find deposit.

7. Groundwater receptors

7.1.1. On Tenement Borefield

There is one bore of the Pilbara Minerals on-tenement borefield (PWB006) which lies approximately 800 m west of the Lynas Find pit along a north westerly trending lineament. As the Lynas Find pit develops there is a risk, if the pit and bore are hydraulically connected, that drawdown associated with ongoing dewatering of Lynas Find may impact the performance of this bore.

7.1.2. Third Party Groundwater users

There are no groundwater protection zones or water reserves within 25 km of the Lynas Find pit. Most licenced users are 15 km to 20 km from the Pilgangoora project, with the exception of the Breccia Borefield operated by Mineral Resources which is approximately 5 km south of the Pilgangoora site, approximately 15 km south of Lynas Find pit.

There are no regionally significant aquifers in the envrions of the Lynas Find pit and dewatering impacts are anticipated to be localised to close to the pit itself. Therefore, no nearby groundwater users anticipated to be impacted by dewatering activity at Lynas Find.

7.1.3. Groundwater Dependent Ecosystems

A desktop review was undertaken by Groundwater Development Services in November 2015 to identify potential GDEs in the area. From this review it was determined that there are no listed wetlands within 25 kilometres of the project (GDS, 2015). There is limited spring development in the area and are those that do exist are assumed to flow seasonally and represent short term discharges of locally recharged groundwater.

Water levels in the Lynas Find area range between 21 mbgl to 35 mbgl, below the depth at which a GDE would realistically be expected to access groundwater.

A review of the Bureau of Meteorology's (BoM's) GDE Atlas indicated that the area of the Pilgangoora project are classified as

- no to low potential for groundwater interaction with vegetation reliant on subsurface groundwater
- no identified subterranean GDEs (caves or aquifers).

GDS' review identified thirty-five areas where GDE's could be present in a 25 km radius of the Pilgangoora project. These potential locations are shown in Figure 7 and described below.

- 9 sites, approximately 18 km to 24 km southwest and west, associated with the Turner River system.
- 10 sites, 15 to 25 km NNW in the upper reaches of the East Turner River tributary
- 5 sites, approximately 22 km NE in the upper Strelley River East and adjacent tributary forming McPhee Creek.
- 2 sites, approximately 25 km E in the upper Six Mile Creek, a tributary of the Strelley River.
- 9 aboriginal heritage sites are located to the northeast, east, southeast and south. These heritage sites could be associated with spring occurrences.

Based on the localised extent of impacts associated with the Lynas Find pit, it is anticipated that any potential impacts to GDEs will be minimal.

Given the present level of groundwater and surface water assessment, it is assumed that potential impacts to any groundwater dependant ecosystem (GDE) from development of the project will be minimal.

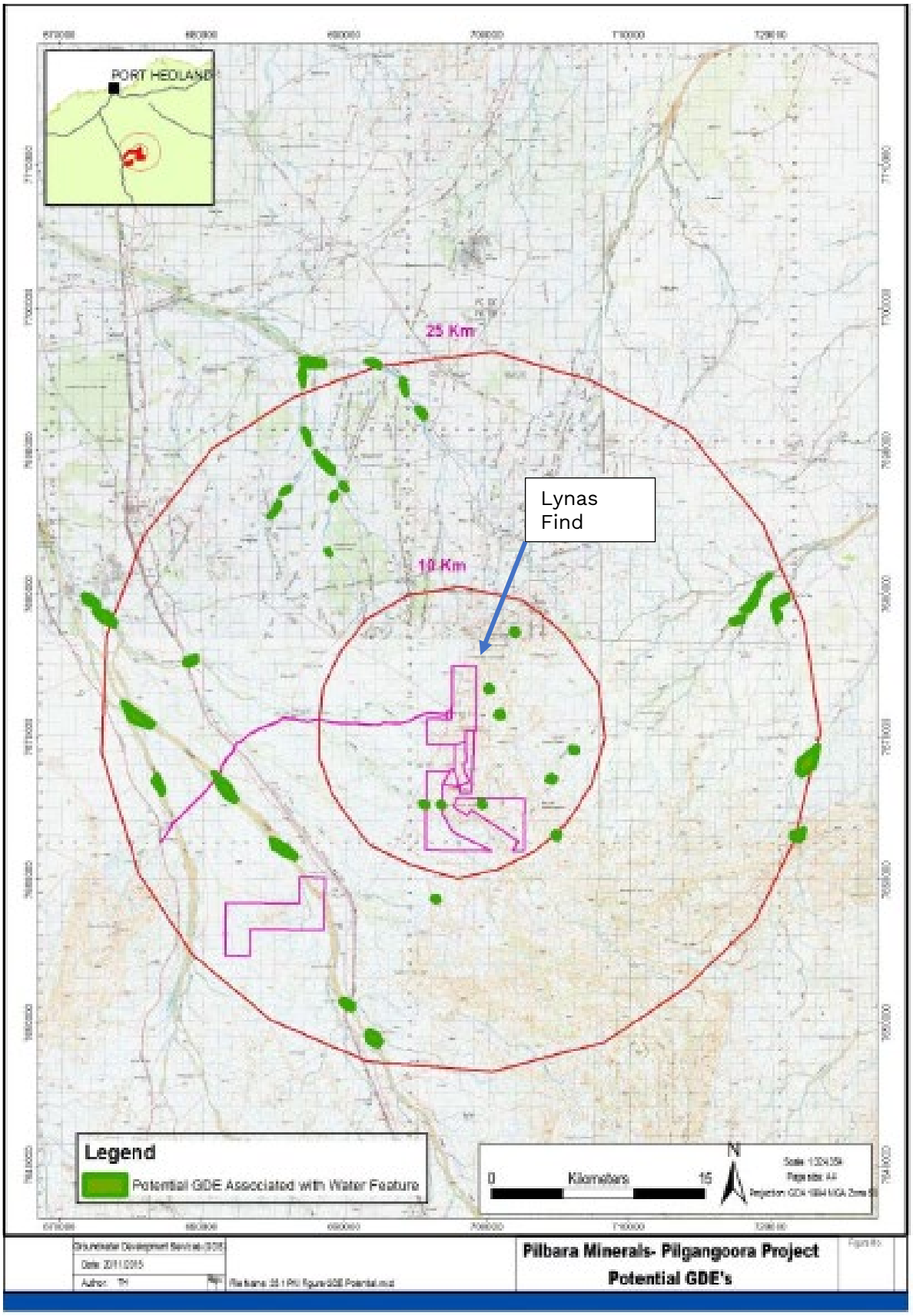

Figure 7: Potential GDE locations (GDS,2015)

7.1.4. Subterranean Fauna

7.1.4.1. Stygofauna

Stygofauna are groundwater dwelling fauna which are adapted for the subterranean environment. They are known to be present in a variety of rock types including Karst (limestone), fissured rock (e.g. granite) and porous rock (e.g. alluvium).

A desktop review and reconnaissance survey for the Pilgangoora project area was completed in 2016 (Bennelongia, 2016a, b), extending as far as the Monster Pit, approximately 500 m southwest of Lynas Find. The findings indicated a moderately rich stygofauna habitat with the known distribution of five of the species identified outside the project area. The report concludes that:

- Stygofauna species were primarily associated with Pilgangoora Creek and had habitat extents beyond the anticipated areas of impact from dewatering.
- The Pilgangoora project was considered unlikely to pose a significant threat to the conservation values of stygofauna.

Lynas Find is situated in a similar geological and hydrogeological setting to other pits at the site, therefore it is anticipated that the impacts on stygofauna habitats Lynas Find would be similarly low as the remainder of the Pilgangoora operations.

7.1.4.2. Troglofauna

There is limited alluvial cover at the site, with most of the site being exposed bedrock. Therefore, there is limited available habitat for potential troglofauna. Fractures and weathering features that occur within the bedrock and the alluvial deposits within the river/stream beds. The permeability of these bedrocks is known to be generally low, from the test pumping that has occurred onsite. The fractures that do occur have also been shown to extend well beyond the limits of the mining envelopes.

Bennelongia, 2016 (b), identified two species of troglofauna in the pit areas of the Pilgangoora project, and concluded:

- it is likely that, with little difference in lithology between the mine pits and surrounding mafic rock and basalts, troglofauna habitats extend beyond the pit footprint.
- The Pilgangoora project is unlikely to pose a significant threat to the conservation values of troglofauna.

Lynas Find is situated in a similar geological and hydrogeological setting to other pits at the site, therefore it is anticipated that the impacts on troglofauna habitats from Lynas Find would be similarly low as the remainder of the Pilgangoora operations.

8. Conclusions and recommendations

8.1. Conclusions

8.1.1. Surface water

- Lynas Find Pit is situated at the top of regional catchment boundaries with no upstream flows impinging on the creeks – standard pit bunds will be sufficient
- The pit will only be impacted by direct rainfall
- Lynas Find waste dump is located near the top of a catchment boundary, with minimal upstream flows – therefore no surface water management (i.e. diversions) is required.
- Surface water run-off from the waste dump should be captured to prevent mixing with the natural creek system. The waste dump should be bunded to capture water which can then infiltrate / evaporate or be treated in a sediment basin and released downstream

8.1.2. Groundwater

- Lynas Find pit is planned to progress to a depth of ~110 mAHD, approximately 80 m below the prevailing water table in a low permeability fractured rock aquifer.
- Long term groundwater inflows are anticipated to be of the order of 5 L/s or less.
- There are no nearby groundwater dependent ecosystems or groundwater users that may be detrimentally impacted by dewatering at Lynas Find.
- Previous assessment of the stygofauna / troglofauna habitats at the Pilgangoora project determined the mine operations presented a low risk to these potentially sensitive receptors. Lynas Find, being of similar geological and hydrogeological setting, is considered to present a similarly low risk.

8.2. Recommendations

Historically limited investigation into the Lynas Find deposit has been undertaken from a hydrogeological perspective, therefore the following are recommended:

- Installation and testing of 4 monitoring bores in the environs of the pit to provide an indication of groundwater inflow zones and rates and assess the potential influence on structural features (northerly trending faults) encountered at Lynas Find, indicative locations are shown in Figure 8 and Table 7. These could also form part of baseline and ongoing monitoring – in terms of water levels and water quality.
- Update / refinement of the simple analytical modelling undertaken to date to incorporate the findings of any additional investigation.
- Review and update the existing numerical groundwater model for the Pilgangoora site to include the proposed bench progression of the Lynas Find deposit and assess likely dewatering volumes, local impacts and post closure recovery.
- Update of the site water balance to incorporate the Lynas Find dewatering volumes / water requirements.

Table 7 Potential monitoring bore locations

Site ID	Easting	Northing	Objective	Note
LF_2022_MB1	699758	7675121	In pit – assess yields / inflow zones.	Could put in a production bore too to test hydraulics of the aquifer.
LF_2022_MB2	699671	7675487	Ex-pit – targeting northerly trending structure	
LF_2022_MB3	699696	7674840	Ex-pit – targeting northerly and easterly trending structure	
LF_2022_MB4	699409	7675241	Ex-pit – targeting basement	

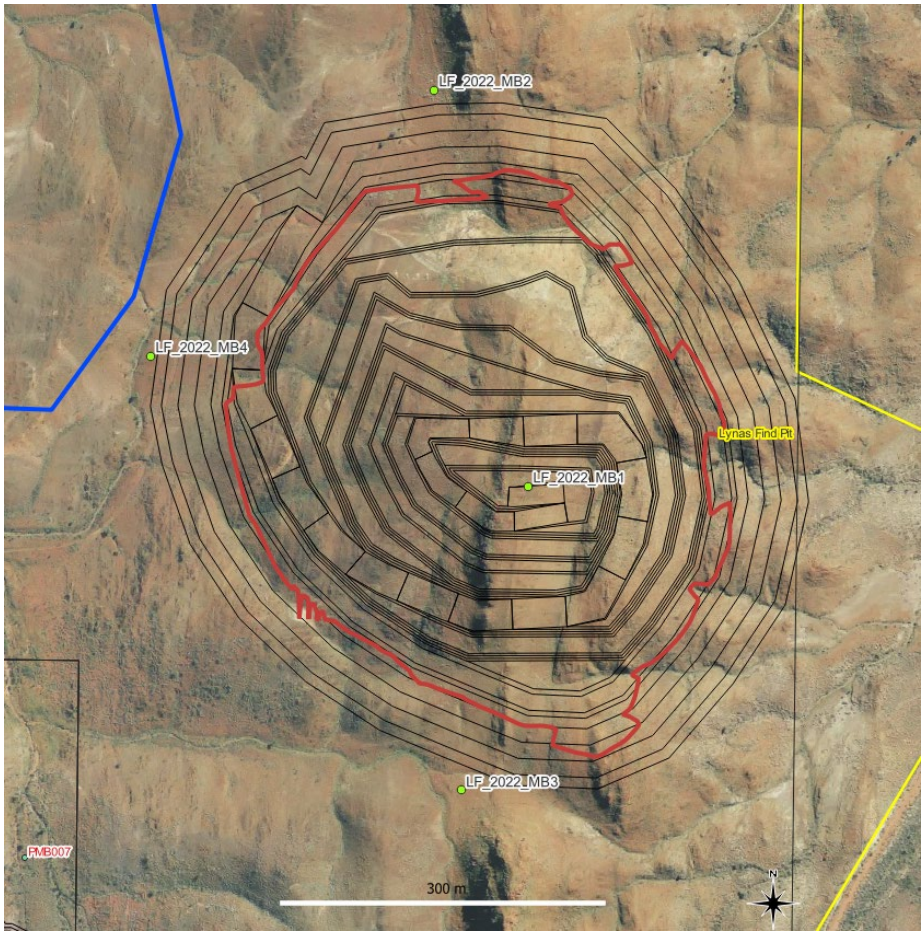

Figure 8 Suggested monitoring bore positions

9. References

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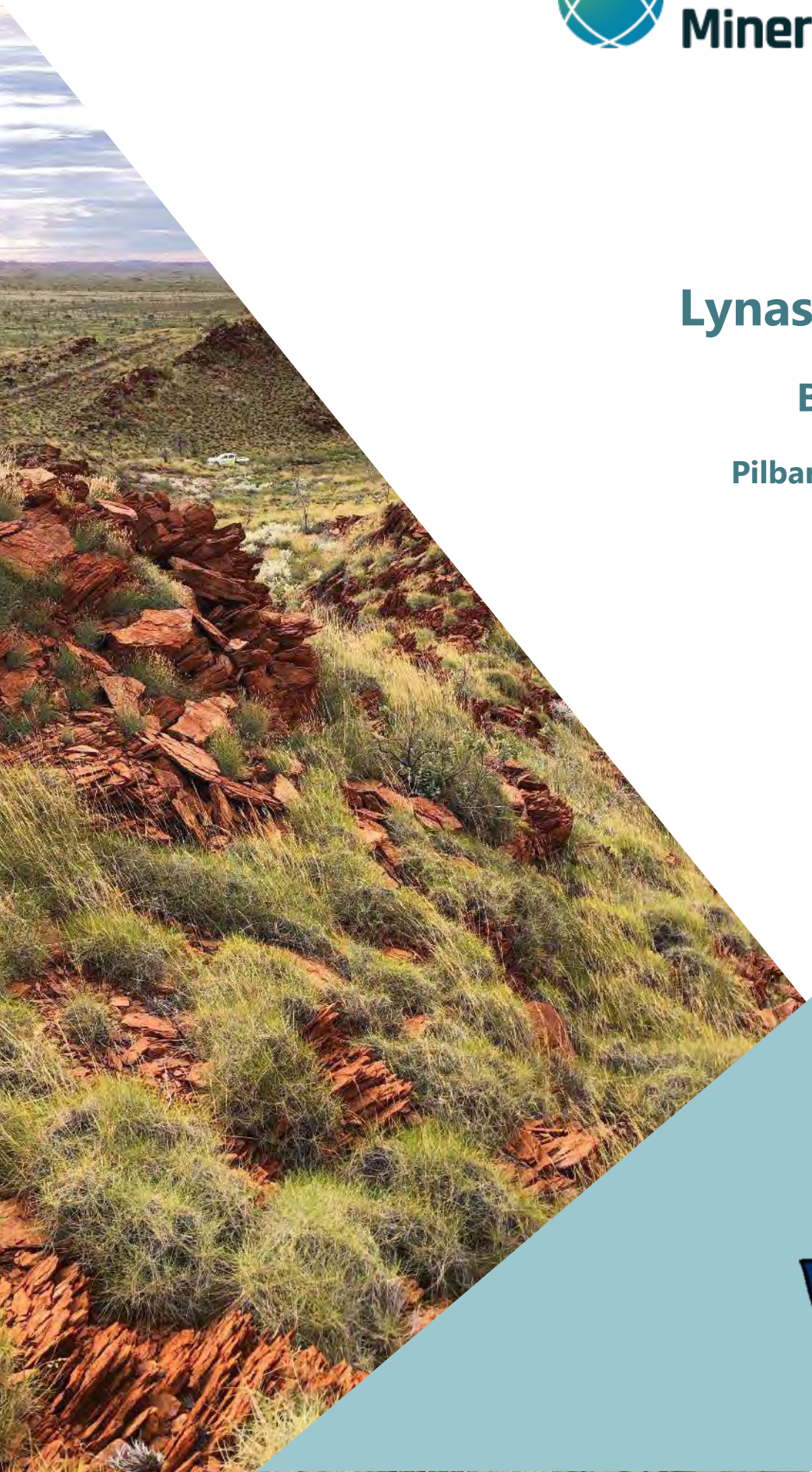
APPENDIX C

Biodiversity Survey



Lynas Find Project

Biological Survey

Pilbara, Western Australia

Prepared on behalf of
Ecotec (WA) Pty Ltd for Pilbara
Minerals Ltd by
Animal Plant Mineral Pty Ltd.

October 2022

DOCUMENT REVISION HISTORY AND STATUS

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EXECUTIVE SUMMARY

Animal Plant Mineral Pty Ltd was commissioned by Ecotec (WA) Pty Ltd to undertake a Detailed Flora and Vegetation and Targeted Terrestrial Vertebrate Fauna survey of the Pilbara Minerals Lynas Find deposit. The Lynas Find deposit is a possible future expansion for the Pilgangoora lithium project. The Study Area is 394 hectares and is located 84 km south-east of Port Hedland in the Pilbara region of Western Australia.

Field survey was conducted in August 2022. In the six months prior to survey, 358.2 mm of rainfall was recorded, a total greater than the long-term average of 278.8 mm for the same period. Furthermore, the rainfall in May was 123.8 mm which is almost 4.5 times higher than the long-term average of 52.3 mm for the same period. No adverse weather conditions occurred that would impact the results of the survey. The timing of the flora and vegetation field survey was within the recommended Supplementary survey period for the region. Survey timing was within that recommended for birds, amphibians and mammals. Conditions are generally unsuitable for reptiles in winter.

Nine vegetation types are described for the Study Area. One vegetation type is synonymous with that described for baseline survey for the Pilgangoora project, the remaining eight are different from previously described. No vegetation of conservation significance was recorded, and current extent of regional vegetation units is close to Pre-European extent. Vegetation is predominantly in very good condition with the main disturbances being low to moderate cattle grazing and vegetation clearing for mining activity. Completely Degraded areas comprise 73 ha or 18.5% of the Study Area.

No Threatened flora are known to occur in the Study Area or were recorded during the survey. Two Priority 3 flora were recorded – *Rothia indica* and *Triodia chichesterensis.* An additional seven Priority flora species identified in the desktop study also possibly occur, due to the presence of suitable habitat.

No Declared weeds or Weeds of National Significance were recorded. Three weeds were recorded – *Cenchrus ciliaris*, *Cenchrus setiger* and *Aerva javanica*. All three recorded weeds are assessed as a having a High ecological impact and a Rapid rate of invasiveness under the Pilbara Weed Prioritisation Process.

Six fauna habitats are described for the Study Area:

- FH1 – Boulder rock outcrops (4%)
- FH2 – Platy rock outcrops (1%)
- FH3 – Low hills (54%)
- FH4 – Sandy plains (3%)
- FH5 – Stony gullies (2%)
- FH6 – Stony plains (17%)

The remaining area is Disturbed.

Previous database records and surveys have recorded the Northern quoll and Pilbara leaf-nosed bat within the Study Area. Database records from the local area indicate that an additional nine conservation significant fauna may possibly occur.

Targeted survey for conservation significant fauna identified:

- A population important for the long-term survival of the Northern quoll;

- Habitat critical to the survival of the Northern quoll in three categories:
  - rocky habitat such as ranges (habitat FH1);
  - areas of native vegetation within 1 km of FH1; and
  - dispersal and foraging habitat associated with or connecting the population within FH1 to other nearby populations or foraging habitats, assumed to be defined by geological unit A-KEe-xmws-mus;
- Pilbara leaf-nosed bat is present within the Study Area but the quality of habitat is limited to Moderate value foraging over FH1 and FH5 and Low value elsewhere, with no roosting habitat present;
- Western pebble-mound mouse is present in the Study Area and Targeted Search identified mound locations. Suitable habitat was within the FH3 and FH6 habitats but was confined to the northern central section of the Study Area;
- Foraging habitat suitable for the Grey Falcon occurs within the Study Area. This may be used by populations known to occupy the Turner River area 23 km to the west; and
- Possible habitat for the Night parrot, Greater bilby, Ghost bat, Brush-tailed mulgara, Spectacled hare-wallaby, Long-tailed dunnart and Pin-striped finesnout ctenotus but no evidence of their presence was recorded.

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PLATES

APPENDICES

PROJECT TERMS

Abbreviation	Meaning
The Project	Lynas Find Project

UNITS OF MEASURE

Unit	Measure
%	Percentage
°C	Degrees Celsius
ha	Hectare
km	Kilometre
m	Metre
mm	Millimetre

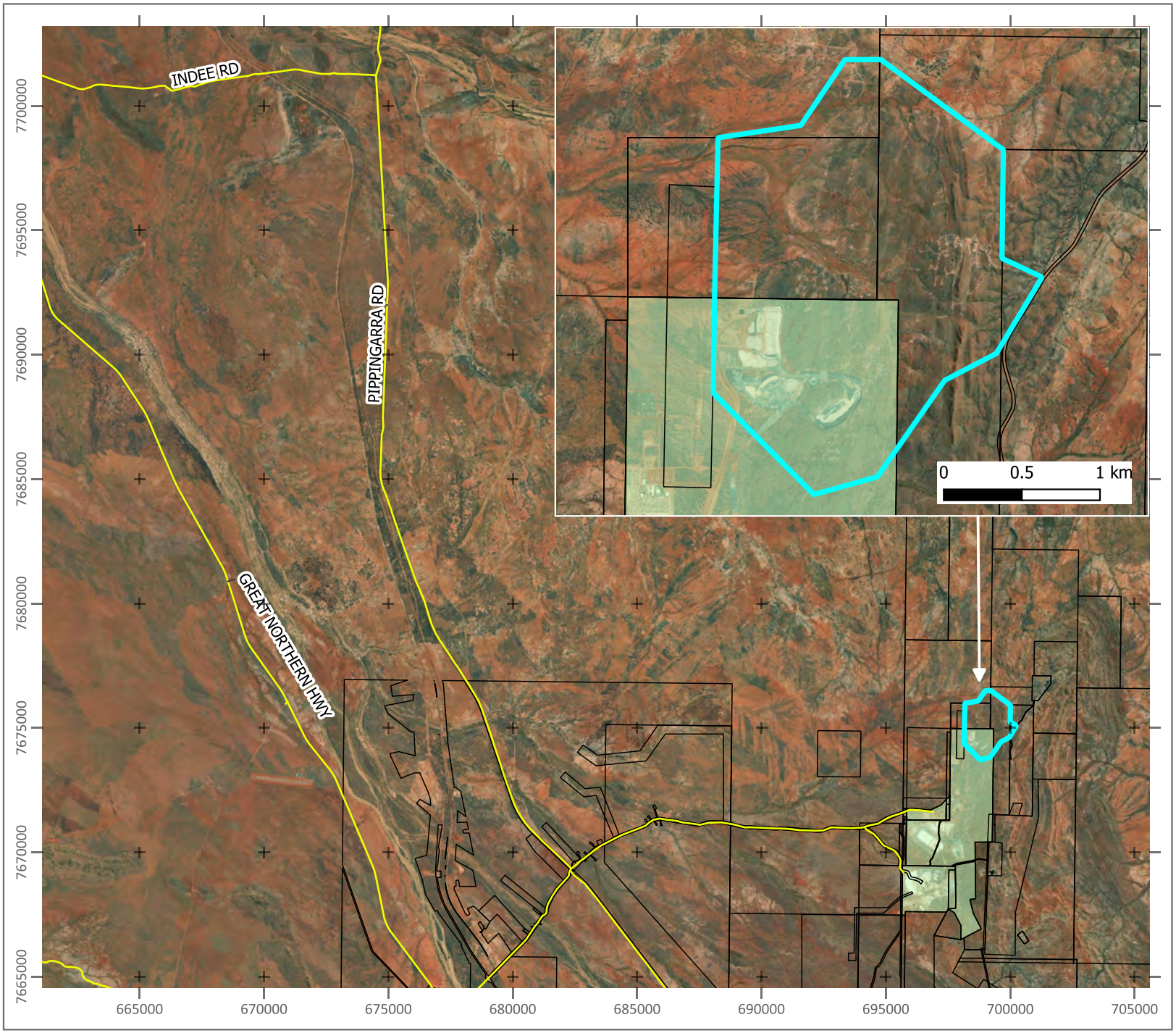
LIST OF ABBREVIATIONS

Abbreviation	Meaning
APM	Animal Plant Mineral Pty Ltd
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
DBCA	Department of Biological Conservation and Attractions
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environment Regulation
EN	Endangered
Ecotec	Ecotec (WA) Pty Ltd
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
IBRA	Interim Biogeographic Regionalisation for Australia
MI	Migratory
MNES	Matters of National Environmental Significance
OS	Other Specifically Protected
PEC	Priority Ecological Community
P	Priority
PMST	Protected Matters Search Tool
TEC	Threatened Ecological Community
T	Threatened
VU	Vulnerable
WA	Western Australia
WoNS	Weeds of National Significance

1 INTRODUCTION

1.1 PROJECT AND LOCATION

Animal Plant Mineral Pty Ltd (**APM**) was commissioned by Ecotec (WA) Pty Ltd (**Ecotec**) to undertake a Detailed Flora and Vegetation and Targeted Terrestrial Vertebrate Fauna survey of the Pilbara Minerals Lynas Find deposit (**the Project**), located 84 km south-east of Port Hedland in the Pilbara region of Western Australia (**WA**) (Figure 1-1). The Study Area is 394 hectares (**ha**) including 44 ha previously cleared as part of ongoing mining operations for the Pilgangoora lithium project. The Lynas Find deposit is a possible future expansion for the Pilgangoora lithium project.



Legend

- Study Area
- Roads
- Pilbara Minerals Limited: Pilgangoora Operations
- Pilbara Minerals Limited Tenements
- Project Location

Scale: @ A4
1: 22,000

0 2.5 5 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 19/07/2022

Project Location

Prepared for:
Pilbara Minerals

Figure: 1-1

1.2 SCOPE OF WORK

Survey data accompanies this report in a format suitable for submission to the Index of Biodiversity Surveys for Assessment (**IBSA**) online portal.

1.2.1 Flora and Vegetation

The scope of work was to conduct a detailed flora and vegetation survey, in accordance with the Environmental Protection Authority's (**EPA**) *Technical Guidance - Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment* (2016) at a Detailed level of assessment.

The aims of the desktop study were to:

- Establish vegetation associations previously determined for the site;
- Identify threatened (**T**) and priority (**P**) flora and threatened ecological communities (**TECs**) previously recorded on site;
- Identify weed species previously determined as present on site, in particular any Declared Weeds; and
- Identify potentially suitable habitat for conservation significant flora known from the region.

The aims of the field survey were to:

- Determine vegetation associations on the site;
- Identify species present on site including T and P Flora;
- Locate and identify, as far as possible, weed species, in particular any Declared Weeds;
- Map the vegetation and locations of T and P species; and
- Identify conservation significant features of the flora and vegetation.

1.2.2 Terrestrial Fauna

The scope of work was to conduct a basic and targeted terrestrial vertebrate survey in accordance with the EPA's fauna guidelines: *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (2020).

The aims of the desktop study were to:

- Identify species previously determined as present on-site including T and P Fauna (under the provisions of the *Biodiversity Conservation Act 2016* (**BC Act**) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (**EPBC Act**);
- Identify habitat types previously determined as present on site regarded as suitable for T and P fauna; and
- Identify introduced species previously determined as present on site.

The aims of the field survey were to conduct:

- Targeted quoll survey using unbaited camera traps;
- Bat survey using acoustic monitoring devices;
- Record incidental fauna observations;

- Conduct spotlight survey, without physical capture/collection of individuals; and
- Record habitats suitable for T and P fauna

2 BACKGROUND AND SUPPORTING INFORMATION

2.1 RELEVANT LEGISLATION

2.1.1 Commonwealth Government EPBC Act

The Commonwealth EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (**MNES**).

If a project has the potential to significantly impact on MNES it is to be referred to the DCCEEW for determination on whether the matter is a 'controlled action' and therefore requiring assessment.

The EPBC Act provides for the identification and listing of species under several categories listed in Appendix A. The EPBC Act also provides for the development of conservation advice and recovery plans, development of a register of critical habitat, recognition of key threatening processes and the development of threat abatement plans.

2.1.2 Western Australia BC Act

The BC Act provides a statutory basis for the listing of T species, specially protected species, extinct species, TECs, collapsed ecological communities, critical habitat and key threatening processes in WA. The BC Act provides for the listing of T flora and fauna species and ecological communities under specified conservation categories listed in Appendix A. Species and communities listed under the BC Act are protected and require authorisation by the Minister to take or disturb.

Species may also be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest to science. Species of special conservation interest, migratory species and species subject to international agreements are known as Specially Protected Species in the BC Act.

2.1.3 Western Australia Priority species and communities

Flora and fauna species and communities are listed by the Department of Biodiversity, Conservation and Attractions (**DBCA**) as P where they are considered to have a greater level of significance than other native species and communities. This generally occurs where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to T species and communities categories. Whilst P species and communities are not specifically listed in the BC Act, all flora and fauna are protected in WA following the provisions in Part 10 of the BC Act. This protection applies even when a species is not listed as T or specially protected. The categories covering P species and communities are listed in Appendix A.

2.1.4 BAM Act

Plants may be 'Declared' by the Agriculture Protection Board (APB) under the BAM Act 2007 (WA). Declared Plants are gazetted under three categories (C1-C3) which define the action required. Details of the definitions of these categories are provided in Appendix A. A declaration may apply to the whole

State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties.

2.1.5 Weeds of National Significance

The DCCEEW, along with the State and Territory governments, has endorsed 32 Weeds of National Significance (**WONS**). Four major criteria were used in determining WONS:

- The invasiveness of a weed species;
- A weed's impacts;
- The potential for spread of a weed; and
- Socio-economic and environmental values.

Each WONS has a national strategy and a national coordinator, responsible for implementing the strategy. WONS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts (DAWE 2020).

2.1.6 Guidelines

The terrestrial biological assessment was conducted in accordance with the above Commonwealth and State legislation, as well as EPA requirements for environmental surveys as outlined below:

- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)
- Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016)

Relevant species-specific survey and assessment guidelines include:

- Survey Guidelines for Australia's T Bats (Department of the Environment Water Heritage and the Art (**DEWHA**) 2010a).
- Survey Guidelines for Australia's T Birds (DEWHA 2010b);
- Survey Guidelines for Australia's T Mammals (Department of Sustainability Environment Water Population and Communities (**DSEWPAC**) 2011a);
- Survey Guidelines for Australia's T Reptiles (DSEWPAC 2011b); and

Relevant guidance for the preparation of spatial datasets to accompany this report are:

- Guidelines for biological survey and mapped data (Department of the Environment and Energy (**DEE**) 2018)
- Instructions for the preparation of data packages for IBSA (EPA 2020b).

2.2 LAND USE

The majority of the Study Area lies within the Wallareenya pastoral lease, and a small portion of the eastern side of the Study Area lies within the Strelley pastoral lease. The current land use is cattle grazing.

Active mining operations and exploration activities occur within the Study Area. Unrehabilitated drill pads and exploration tracks are present and a 45 ha area has been cleared by Pilbara Minerals as part of the Pilgangoora Project.

2.3 CLIMATE

The Pilbara has very hot summers, mild winters and low and variable rainfall. It is classified as hot desert in northern and inland areas and hot grasslands in the north-west. The climate of the Chichester subregion of the Pilbara is described as semi-desert-tropical, receiving 300 millimetres (**mm**) of rainfall annually (Kendrick and McKenzie, 2001).

The nearest Bureau of Meteorology (**BoM**) weather station with a long historical record is at Port Hedland Airport (BoM Site Number: 004032), approximately 75 km northeast of the Study Area. Port Hedland Airport has recorded rainfall from 1942 – 2022 (80 years), and temperature from 1948 – 2022 (74 years). The climate data recorded for the region over these periods is shown in Figure 2-1. Monthly mean maximum temperature ranges from 36.8°C in March to 27.4°C in July. Monthly mean rainfall ranges from 90.2 mm in February to 0.9 mm in October, with a mean annual rainfall of 317.7 mm (BoM 2022).

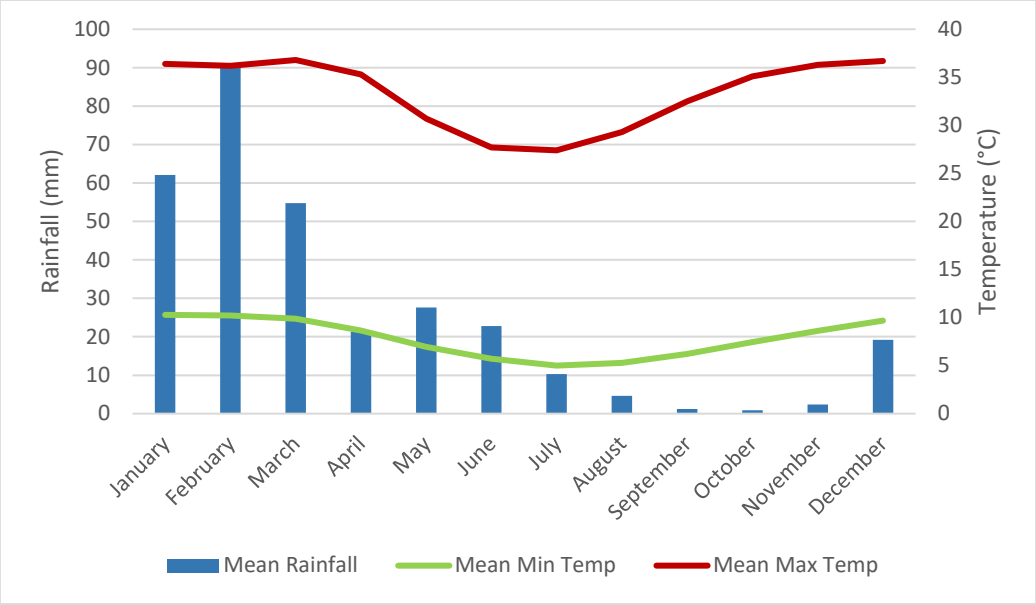


Figure 2-1. Temperature and rainfall averages for Port Hedland Airport weather station (Station No. 004032) (BoM 2022)

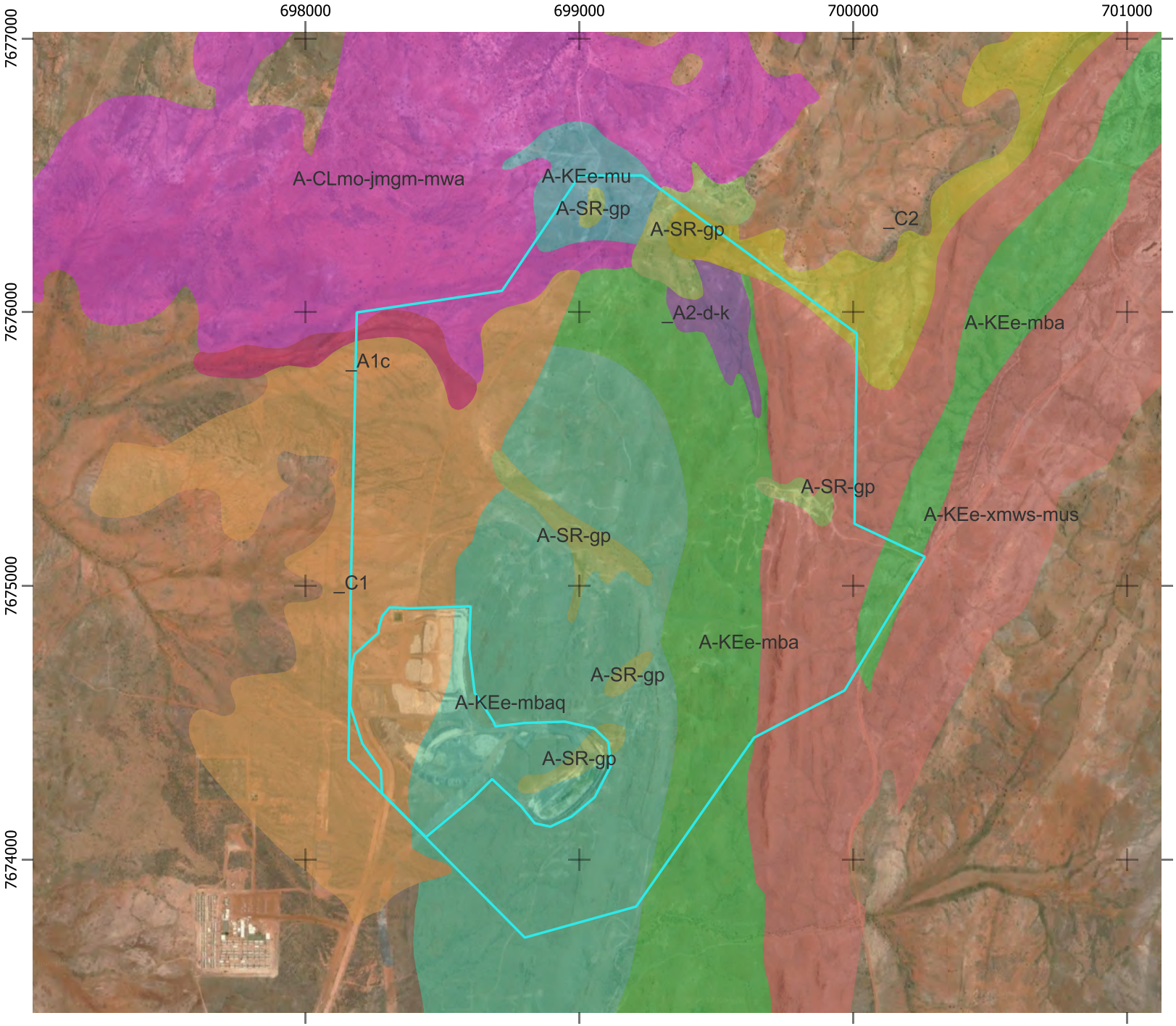
2.4 GEOLOGY

The Pilbara 2014 Geological Information Series dataset (Geological Survey of Western Australia 2014) features a 1:100 000 scale surface geology compilation. The digital layers are based on published maps from the 1994-2005 Pilbara Craton Mapping Project, carried out by the Geological Survey of Western

Australia and Geoscience Australia under the North Pilbara National Geoscience Mapping Accord. The Study Area is within the Wodgina (2655) map area and contains the following 10 geological formations:

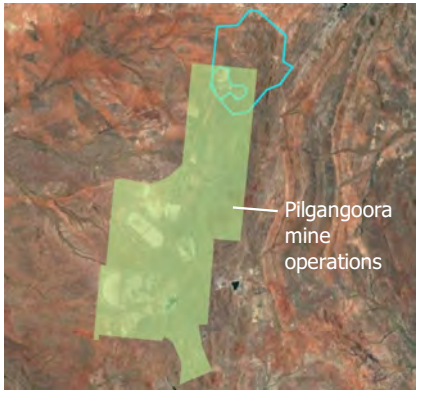
- _A1c – Alluvial unit; Sand, silt, and gravel in active drainage channels; includes clay, silt and sand in poorly defined drainage courses on floodplains; unconsolidated;
- _A2-d-k - Alluvial unit; Partly consolidated alluvial gravel, sand and silt; local carbonate cement; dissected by present-day drainage;
- _C1 - Colluvial unit; Colluvial sand, silt and gravel in outwash fans; scree and talus; proximal mass-wasting deposits; unconsolidated;
- _C2 - Colluvial unit; Partly consolidated colluvial sand, silt and gravel in proximal outwash fans; scree and talus; dissected by present-day drainage;
- A-CLmo-jmgm-mwa - Motherin Monzogranite; Interleaved seriate to porphyritic metamonzogranite, hornblende--biotite metagranodiorite, and pegmatite; strongly foliated and banded, locally gneissic; contains greenstone enclaves and pendants;
- A-KEe-mba; Euro Basalt; Amphibolite and metabasalt; includes local metadolerite and metamorphosed komatiitic basalt; locally schistose;
- A-KEe-mbaq; Euro Basalt; Silicified amphibolite and metabasalt;
- A-KEe-mu; Euro Basalt; Metamorphosed ultramafic rock;
- A-KEe-xmws-mus; Euro Basalt; Mafic and ultramafic schists; and
- A-SR-gp – Split Rock Supersuite; Pegmatite.

The geology of the Study Area is shown in Figure 2-2.



Legend

- Study Area
- _A1c
- _A2-d-k
- _C1
- _C2
- A-CLmo-jmgm-mwa
- A-KEe-mba
- A-KEe-mbaq
- A-KEe-mu
- A-KEe-xmws-mus
- A-SR-gp



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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Geology of the Study Area

Prepared for:
Pilbara Minerals

Figure: 2-2

The soils of the Study Area were mapped by Tille (2006). The Study Area is situated in the Fortescue Province, in the western edge of the Nullagine Hills Zone, with influences from the Abydos Plains and Hills Zone.

The Nullagine Hills Zone is characterised by:

"Hills and ranges (with some stony plains) on volcanic and sedimentary rocks of the Pilbara Craton (including the Hamersley Basin). Stony soils with Red shallow loams and sands. Spinifex grasslands with kanji and snappy gum. Located in the north-eastern Pilbara around Marble Bar and Nullagine (Tille 2006)."

The Abydos Plains and Hills Zone is characterised by:

"Stony plains (with some hills) on granitic rocks of the Pilbara Craton (East Pilbara Terrane). Red deep sandy duplexes and Red shallow loams with Stony soils, Red sandy earths and Red loamy earths. Spinifex grasslands with kanji (and some tussock grasslands). Located in the northern Pilbara between Yandeyarra Community, Bamboo Springs Station and Marble Bar (Tille 2006)."

2.5 BIOGEOGRAPHIC REGIONALISATION

The Interim Biogeographic Regionalisation for Australia (IBRA, version 7) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna and climate characteristics (Thackway and Cresswell 1995). The mapping completed by Beard (1975) provides the basis for the IBRA bioregions. IBRA mapping (Version 7), places the Project within the Pilbara Bioregion.

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses.

The Pilbara Bioregion is further subdivided into the Chichester (PIL1), Fortescue (PIL2), Hamersley (PIL3) and Roebourne (PIL4) Sub-regions. The Project lies entirely within the Chichester Sub-region.

The Chichester Sub-region comprises the northern section of the Pilbara Craton and is comprised of undulating Archaean granite and basalt plains and includes significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (Kendrick and McKenzie, 2001).

2.6 LAND SYSTEMS

Land Systems of the Pilbara region are described by van Vreeswyk *et al.* (2004). Mapping of Land Systems is available from Department of Primary Industry and Regional Development (**DPIRD**, 2019a). The Study Area falls within two soil landscape systems, as listed in Table 2-1 and illustrated in Figure 2-3.

Table 2-1. Land Systems of the Study Area

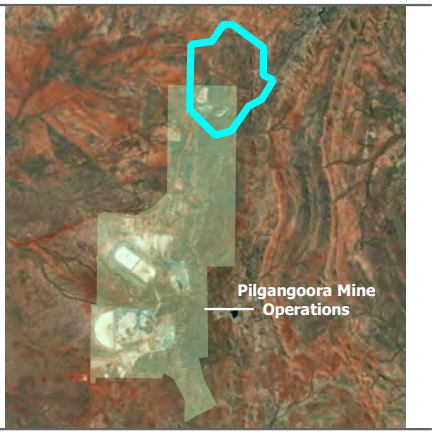
Land System	Geology	Description
Macroy	Level to gently undulating stony and gritty surfaced plains with occasional granite tor fields and domes and closely to moderately spaced dendritic tributary drainage floors, relief up to 25 m	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands
Talga	Hill and ridge tracts of mafic and ultramafic rocks (greenstones), other metamorphics and chert, relief up to 100 m	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands

Legend

- Study Area
- Cleared

Land Systems

- Macroy
- Talga



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0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 19/07/2022

Land Systems

Prepared for:
Pilbara Minerals

Figure: 2-3

2.7 REGIONAL VEGETATION

The Study Area is located within the Eremaean Botanical Province and contains one pre-European Beard vegetation association of the George Ranges System, and one vegetation association of the Abydos Plain – Chichester System as shown in Figure 2-4. The remaining extent of these vegetation associations is outlined in the most recent DBCA Statewide Vegetation Statistics table dated 2018 and summarised in Table 2-2 below.

Vegetation Associations within the Study Area have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the Study Area are of 'Least Concern'.

Table 2-2 Pre-European Beard Vegetation Associations within the Study Area

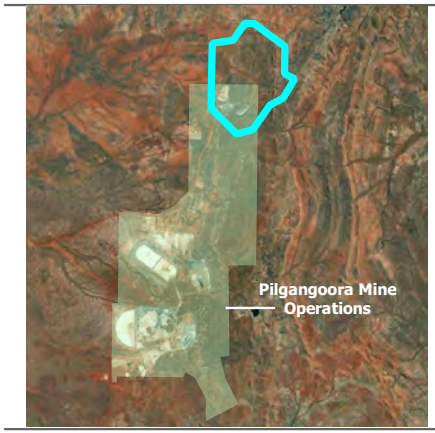
Unit	Vegetation Description	Pre-European Extent (ha)	Current Extent (ha)	Pre-European Extent Remaining (%)	Current Extent within DBCA Managed Lands (%)
82	Hummock grassland with scattered bloodwoods and snappy gum *Triodia* spp., *Corymbia dichromophloia, Eucalyptus leucophloia*	2,565,901	2,553,206	99.51	11.57
93	Hummock grassland with scattered shrubs or mallee *Triodia* spp. *Acacia* spp., *Grevillea* spp. *Eucalyptus* spp	3,044,310	3,040,641	99.88	1.96

Legend

- Study Area
- Cleared

Vegetation Association

- 82
- 93



Scale: @ A4
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0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 19/07/2022

Pre-European Beard Vegetation Associations

Prepared for:
Pilbara Minerals

Figure: 2-4

2.8 ENVIRONMENTALLY SIGNIFICANT AREAS

2.8.1 Conservation Estate

The Western Australian conservation estate includes land and waters vested in the Conservation and Parks Commission under the *Conservation and Land Management Act 1984*. The conservation estate is managed by the Parks and Wildlife Service of DBCA to protect Western Australia's biodiversity, and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DEE 2016).

A search of the Collaborative Australian Protected Area Database (**CAPAD**) returned no conservation estates located within 50 km of the Study Area. The nearest gazetted terrestrial conservation estate is Mungaroona Range, 85 km to the south-west of the Study Area.

2.8.2 Environmentally Sensitive Areas

Environmentally Sensitive Areas (**ESA**) are areas that are defined by the DWER (2019) as:

- A declared World Heritage property as defined in s.13 of the EPBC Act;
- An area that is included on the Register of the National Estate, because of its natural heritage value under the Australian Heritage Council Act 2003;
- A defined wetland and the area within 50 metres (**m**) of the wetland;
- The area covered by vegetation within 50 m of T flora, to the extent to which the vegetation is continuous with the vegetation in which the T flora is located;
- The area covered by a TEC;
- A Bush Forever site;
- Areas covered by the Gnangara Mound Crown Land Policy and Western Swamp Tortoise Policy;
- Areas covered by lakes, wetlands and fringing vegetation of the Swan Coastal Plain Lakes Policy, including Southwest Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy; and
- Protected wetlands as defined in the Environmental Protection (Southwest Agricultural Zone Wetlands) Policy 1998.

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare or unique, or wetlands that are considered of international importance (DEE 2019). The nearest wetlands listed in the Directory of Important Wetlands within 150 km of the Study Area are the Leslie (Port Hedland) Saltfields System, 80 km to the north, the De Grey River System, 85 km to the north-east, and the Fortescue Marshes, 130 km to the south-west.

Environmentally Sensitive Areas can be viewed on the DWER clearing permit system map viewer. There are no ESA's within the Study Area.

3 METHODOLOGY

3.1 DESKTOP STUDY

The desktop study provides background information on the known attributes of flora, vegetation and fauna of the Study Area.

3.1.1 Database Searches

A search for EPBC Act MNES was undertaken using the DCCEEW Protected Matters Search Tool (**PMST**). The PMST identifies EPBC listed flora and fauna species and communities based on predicted distributions of the species and/or their habitat, in conjunction with species records. The PMST may predict the occurrence of a species or community in an area where there are no documented records from the area, or documented records are historic. Therefore, for this search, a search area of 30 km from a central coordinate of 699160, 7675100 (GDA 1994, MGA Zone 50) was applied to ensure relevancy for the habitats present within and adjacent to the Study Area.

The conservation codes are described in Appendix A. The results of the PMST search are included in Appendix B.

The DBCA maintains databases for records of T and P species and communities. A request was made for a search of DBCA databases for T and P flora and fauna and the presence of TECs or PECs. A 50 km buffer was applied to the fauna, flora and threatened and priority ecological community search from a central coordinate of 699160, 7675100 (GDA 1994, MGA Zone 50).

Introduced flora and fauna records from within 30 km were obtained from the NatureMap database.

Table 3-1 lists the database searches conducted for the desktop study.

Table 3-1. Database Searches

Attribute	Search Area	Database	Location
Threatened and Priority Ecological Communities	50 km radius	DBCA	Figure 4-2; Section 4.1.2
	30 km radius	PMST	Appendix B
Threatened Flora	50 km radius	DBCA	Figure 4-1; Section 4.1.1
	30 km radius	PMST	Appendix B
Introduced Flora	30 km radius	NatureMap	Section 4.1.3
Threatened Fauna	50 km radius	DBCA	Figure 5-1; Section 5.1.1
	30 km radius	PMST	Appendix B
Introduced Fauna	30 km radius	NatureMap	Section 5.1.2

3.1.2 Literature Review

Flora, vegetation and terrestrial vertebrate fauna surveys have been conducted in the local area for the Pilgangoora Project, including the south-west portion of the Study Area.

The following local surveys were reviewed, and the results incorporated into the Desktop Study:

- Baseline Vertebrate Fauna Survey, Pilgangoora. Prepared on behalf of Pilbara Minerals Limited by 360 Environmental. Publication date: May 2016.
- Pilgangoora Access Road Borrow Pits - Flora and Vegetation Assessment. Prepared on behalf of Pilbara Minerals Limited by MMWC Environmental Pty Ltd. Publication date: July 2016.
- Pilgangoora Project Area – Flora, Vegetation and Fauna Assessment. Prepared on behalf of Pilbara Minerals Limited by MMWC Environmental Pty Ltd. Publication date: July 2016
- Pilgangoora Project – Stage 2 Expansion Desktop Environmental Assessment. Prepared on behalf of Pilbara Minerals Limited by Ecologia Environmental. Publication date: 26 October 2018.
- Pilbara leaf-nosed bat Survey, Pilgangoora Prepared for Pilbara Minerals by 360 Environmental November 2015
- Pilbara leaf-nosed bat Roost Survey, Pilgangoora Prepared for Pilbara Minerals by 360 Environmental February 2016
- Northern quoll survey on mining tenement M45/1266. Prepared for Pilbara Minerals by Terrestrial Ecosystems, January 2020.

3.1.3 Likelihood of Occurrence

Threatened and Priority flora, fauna and communities returned from the database searches and literature review were assessed for their likelihood of occurrence within the Study Area using the likelihood of occurrence criteria listed in Table 3-2.

Table 3-2. Likelihood of occurrence criteria

Likelihood of occurrence	Criteria
Recorded	Identified from database records or field survey as occurring within the Study Area
Likely	Suitable habitat is present in the Study Area and the species has previously been recorded within 15 km
Possible	Suitable habitat is present within the Study Area and the species has previously been recorded between 15 – 30 km of the Study Area
Unlikely	No suitable habitat is present in the Study Area

3.2 FIELD SURVEY

3.2.1 Survey Timing and Personnel

The terrestrial vertebrate field survey was carried out by Dr Mitchell Ladyman. The flora and vegetation field survey was undertaken by Dr Neil Pettit assisted by Mr Danah Blache.

Acoustic analysis and bat call identification was conducted by Dr Kyle Armstrong and Yuki Konishi at Specialised Zoological, a scientific consultancy business that specialises in bats, bioacoustics and genetic identification. Dr Armstrong has 20 years' experience in environmental consultancy specialising in bats.

Table 3-3 lists the personnel involved in the field survey.

Table 3-3. Field Survey Personnel

Survey Date	Personnel	Experience	Description
8th – 13th August 2022	Dr Mitchell Ladyman	20+ years	Terrestrial vertebrate fauna survey
	Dr Neil Pettit	25+ years	Flora and vegetation survey
	Danah Blache	under instruction	

3.2.2 Survey Conditions

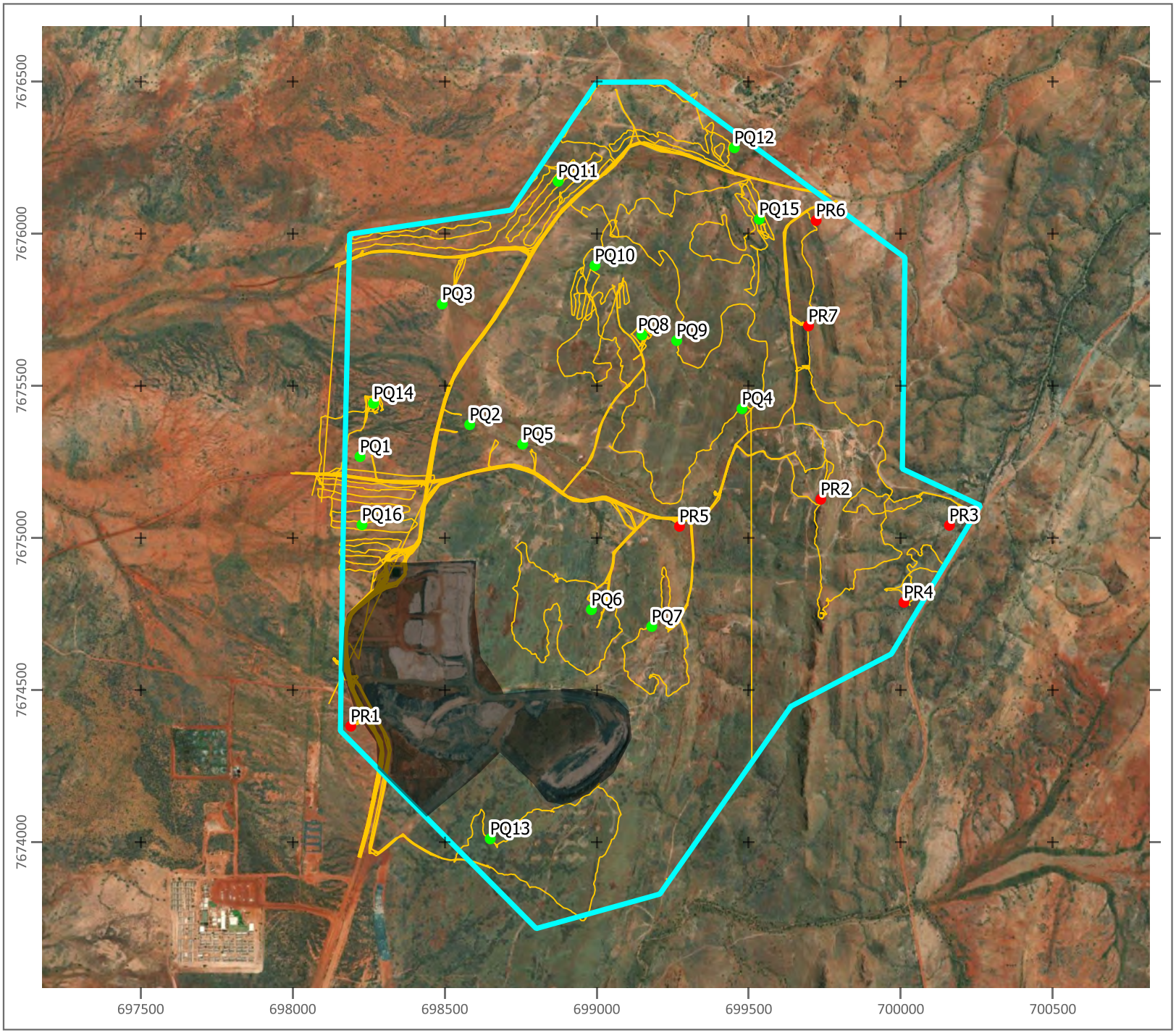
In the six months prior to survey, 358.2 mm of rainfall was recorded, a total greater than the long-term average of 278.8 mm for the same period (BoM 2022). Furthermore, the rainfall in May was 123.8 mm which is almost 4.5 times higher than the long-term average of 52.3 mm for the same period.

During the survey period, temperatures reached a maximum of between 22.8 and 30 °C and a minimum of between 10.7 and 18°C overnight, which is typical of the time of year (BoM 2022). No rainfall was recorded during the survey period and no adverse weather conditions occurred that would impact the results of the survey.

The Study Area is within the Eremaean botanical province. Recommended timing for flora and vegetation survey is 6-8 weeks post wet season (March – June) for Primary survey, and a Dry season survey (after winter rainfall if available) for Supplementary survey (EPA 2016). The timing of the field survey was within the recommended Supplementary survey period for the region.

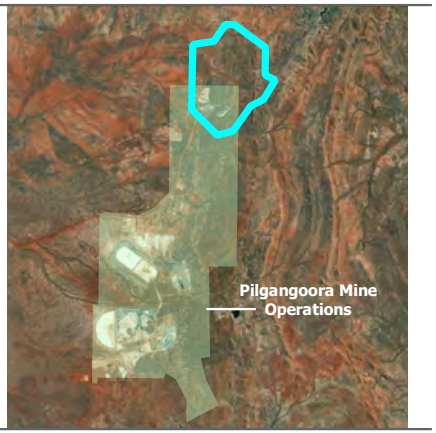
3.2.3 Flora and Vegetation

A detailed survey (EPA 2016) was conducted for flora and vegetation. Vegetation was sampled using 16 quadrats of 50 x 50 m and seven relevés of approximately the same size (Figure 3-1). Quadrats are vegetation survey plots which are accurately measured out as 50 x 50 m (or an area equivalent to 2500 m^2) and marked at the north-west corner using a handheld GPS unit. Relevés are 'unmarked quadrats', where a centre point is marked and an area equivalent to that of a quadrat is visually approximated around this point for the purpose of estimating species composition and cover.



Legend

- Study Area
- Cleared
- Quadrat
- Relevé
- Flora Targeted Search



Scale: @ A4
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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 25/08/2022

Flora Survey Sites

Prepared for:
Pilbara Minerals

Figure: 3-1

Field data at each survey site was recorded on a pro-forma data sheet and included the parameters listed in Table 3-4. The attributes of Detailed survey sites are provided in Appendix C.

Table 3-4. Parameters recorded at each Detailed site

Variable	Parameters
Collection attributes	Personnel/recorder; date, quadrat dimensions and marking method, photographs of the quadrat, site code.
Physical features	Landform, slope, aspect, soil attributes, ground surface cover, litter, rock type and physical attributes.
Location	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System tool (Garmin) to accuracy approximately ± 5 m.
Vegetation	Dominant growth form, height, cover and species for the three traditional strata (upper, mid and ground) compatible with NVIS Level V (ESCAVI 2003).
Vegetation condition	Vegetation condition was assessed using the condition rating scale devised by Trudgen (1988).
Disturbance	Level and nature of disturbances (*e.g.* weed presence, fire and time since last fire, impacts from grazing, vegetation clearing, erosion).
Flora	List of all species within the quadrat including weeds and listing species average height, cover and abundance.

A flora inventory was compiled from taxa listed in Detailed survey sites and from opportunistic floristic collections throughout the Study Area, with at least one collection made for every taxon encountered. Specimens were identified by an experienced botanical taxonomist in the Western Australia Herbarium (**WAH**) using published reference material. The nomenclature applied is consistent with Florabase (WAH 1998-).

The conservation status of all recorded flora was determined from the DBCA Wildlife Conservation Rare Flora Notice 2020, T and P Flora List 5 December 2020, and the EPBC Act List of T Flora (DCCEEW 2022). The BAM Act Declared Plants database was consulted to determine if any are Declared Plants (DAFWA 2015), and the Weeds of National Significance list to determine any WONS (DoE 2015).

The vegetation associations were described based on their structure and species composition, as defined by quadrat and releve data, and field observations. Vegetation was mapped in the field using handheld GPS units and aerial photographs, then digitised as map figures using GIS software. Vegetation is described at the association level (Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003) and referred to as Vegetation Types (EPA 2016).

Vegetation Condition was assigned using the scale developed for the Eremaean and Northern Botanical Provinces adapted from Trudgen (1988) as recommended in EPA (2016). Table 3-5 lists the six potential categories.

Table 3-5. Vegetation Condition Scale

Vegetation Condition	Eremaean and Northern Botanical Provinces adapted from Trudgen (1988)
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; *i.e.* areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs

For consistency with the existing Pilgangoora operations, data analysis was applied using the method presented by MMWC Environmental (2016). A species by site matrix was prepared that included the data from the current field survey and that presented by MMWC Environmental (2016). The Primer 7 (Clarke and Gorley, 2015), software was used to perform floristic composition vegetation classification. Data was square root transformed and a resemblance matrix was constructed using the Bray Curtis similarity measure. A cluster analysis was performed using group averages. The SIMPROF routine was used to test the hypothesis that the species and/or abundances are different at each group of sites using 999 permutations and a significance level of 5%.

The completeness of the survey was tested using a species accumulation curve and applying the Chao 2 model to estimate the species richness of the Study Area.

3.2.4 Fauna

Fauna habitat assessments were performed at 39 locations. Descriptive data was recorded including soil type, landform, presence of microhabitats, disturbances and images were recorded. Site photos are included in Appendix D.

Targeted search was conducted for signs of conservation significant fauna using traverses at 50-100 m intervals. Signs include scats, prints, slough skin, scratchings made during foraging and other diggings,

burrows and mounds. Traverses were conducted from sunrise to sunset (0700 to 1700 hrs) and included dawn and dusk.

Sixteen motion-triggered cameras were deployed throughout the Study Area between the 9th and 25th of August. Camera function was checked at deployment and collection so operational days could be confirmed. The total number of recording nights was 226. Table 3-6 lists the camera locations and operational days by target habitat.

Table 3-6. Motion-triggered camera setup and duration

Targeted Fauna Habitat	Location (GDA 1994 MGA zone 50)	Camera	Operational trap nights
Rocky Outcrops	699742, 7675156	MSC01	17
	698871, 7674864	MSC02	0
	699682, 7675703	MSC08	17
	699696, 7675565	MSC09	17
	699688, 7675219	MSC13	16
	698961, 7675548	MSC15	16
Total Rocky Outcrops			**83**
Gullies	699275, 7675041	MSC03	16
	699388, 7675148	MSC04	16
	698062, 7675866	MSC06	14
	699240, 7674713	MSC07	15
	699954, 7674833	MSC10	3
	700056, 7675138	MSC11	15
	698959, 7675235	MSC14	15
Total Gullies			**94**
Plains	698062, 7675866	MSC05	17
	698274, 7674867	MSR12	16
	698362, 7674913	MSR16	16
Total Plains			**49**
Total			226

Four Anabat Swift acoustic bat recording devices were deployed for between 8 and 17 nights between the 8th and 24th of August 2022 for a total of 51 trap nights. Table 3-7 lists the acoustic bat recording devices deployed in each habitat type, and the number of trap nights.

Bat call analysis was performed by Dr Kyle Armstrong of Specialised Zoological. A technical report with specifications on the analysis method is included as Appendix E. The scope of the analysis was limited to the detection of the conservation significant Ghost bat *Macroderma gigas* and Pilbara leaf-nosed bat *Rhinonicteris aurantia*. Attention was also given to determining if the Northern leaf-nosed bat *Hipposideros stenotis,* is present. This species is generally not known to occur in the Pilbara but database records from 2012 indicate it may be present in the local area.

Table 3-7. Acoustic bat recording device location and duration

Habitat	Location (GDA 1994 MGA zone 50)	Acoustic Bat Recorder	Trap nights
Stony Gully	699389, 7675152	AS45007	16 nights
Stony Gully	700055, 7675137	AS642029	8 nights
Sandy Plains	698157, 7675894	AS642022	10 nights
Stony Plains	698266, 7674859	AS450085	17 nights
Total			**51 trap nights**

Four Phillips DVT-7110 Digital Voice-Tracer Sound Recording devices were deployed for recording bird calls in .wav format, with the Night parrot as the target. Devices were deployed for four nights from the 8th to the 12th of August 2022, for a total of 16 trap nights. Locations were selected that provided the highest potential habitat quality. Habitat quality for Night parrot was assessed with reference to habitats described and depicted by the Night Parrot Recovery Team (2022).

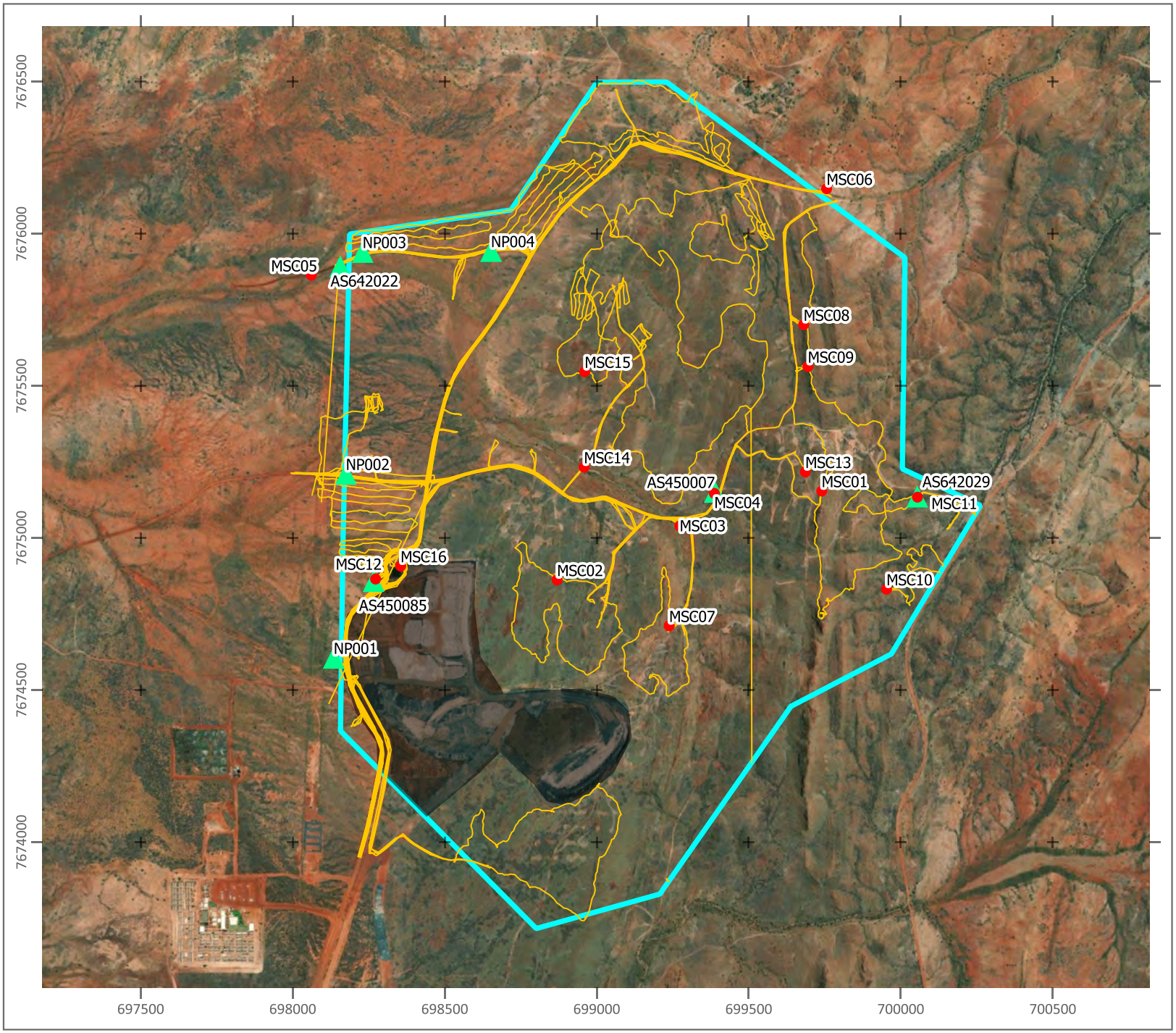
Table 3-8 lists the recording devices deployed in each habitat type, and the number of trap nights.

Table 3-8. Acoustic bird recording devices

Habitat	Location (GDA 1994 MGA zone 50)	Acoustic Bird Recorder	Trap nights
Stony Plains	698135, 7674606	NP01	4 nights
Stony Plains	698175, 7675211	NP02	4 nights
Stony Plains	698230, 7675941	NP03	4 nights
Stony Plains	698653, 7675944	NP04	4 nights
Total			**16 trap nights**

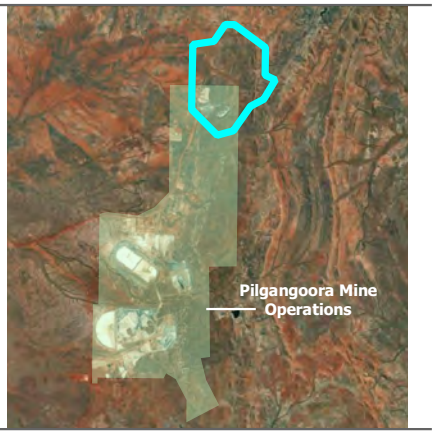
Acoustic recordings were assessed with reference to the calls available on the Night Parrot Recovery Team (2022) website. Sound files recorded between 04:30 to 06:00 and 17:00 to 19:00 were assessed, as these times would coincide with birds leaving or returning to roosting habitat. In addition to listening to call playbacks, calls were viewed using a spectrograph using the Audacity® software package. A profile of Night parrot calls was created by playing the calls available on the Night Parrot Recovery Team (2022) website, for comparison with recorded bird calls. The assessments were also made with reference to descriptions of known vocalisations of the Night parrot as published by Leseberg *et al.* (2019).

Nomenclature within this report is applied according to the WA Checklist of Terrestrial Vertebrates (Western Australian Museum, 2022). Figure 3-2 shows the location of motion-triggered cameras, bat acoustic recording devices and targeted searches. Detailed fauna habitat assessments were made at the locations where cameras and acoustic recording devise were deployed, and during traverses.



Legend

- Study Area
- Cleared
- Fauna Targeted Search
- Acoustic Bat Detector
- Motion-triggered Camera



Scale: @ A4
1: 18000

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 25/08/2022

Fauna Survey Sites

Prepared for:
Pilbara Minerals

Figure: 3-2

3.3 CONSTRAINTS

Several limitations may arise during field survey EPA (2016 and 2020). These potential survey limitations are listed below in Table 3-8 with comments on the constraint to the outcomes of the survey.

Table 3-8. Survey Constraints

Factor	Impact of survey outcomes
Access Problems	Not a constraint All of the Study Area was accessed.
Experience levels	Not a constraint The personnel were suitably qualified
Scope: Flora and Vegetation	Not a constraint Survey was carried out at a level of Detailed assessment
Scope: Fauna	Not a constraint The survey was carried out at a level of Targeted and basic assessment, suitable for the size and intensity of the proposed Project and the availability of previous local survey.
Timing, weather, season, cycle	Not a constraint The Study Area is within the Eremaean Botanical district. Survey was conducted in the recommended Supplementary season. Rainfall in the six months prior was higher than average and therefore, weather and seasonal conditions were not a constraint. No inclement weather occurred during the survey period that would impact the detection of target fauna. Survey timing was within that recommended for birds, amphibians and mammals. Conditions are generally unsuitable for reptiles in winter.
Sources of information	Not a constraint Previous biological reports and database records are available for the locality and region.
Completeness: Flora and vegetation	Not a constraint The scope was completed. Five plants (4.3% of the collection) were not able to be determined to the species level due to sterile specimens. Modelling indicates the survey captured 84% of the floristic richness in the area.
Completeness: Fauna	Not a constraint The scope was completed. The survey resulted in no ambiguous identifications of bat calls, bird calls or photos.

4 FLORA AND VEGETATION RESULTS

4.1 DESKTOP STUDY

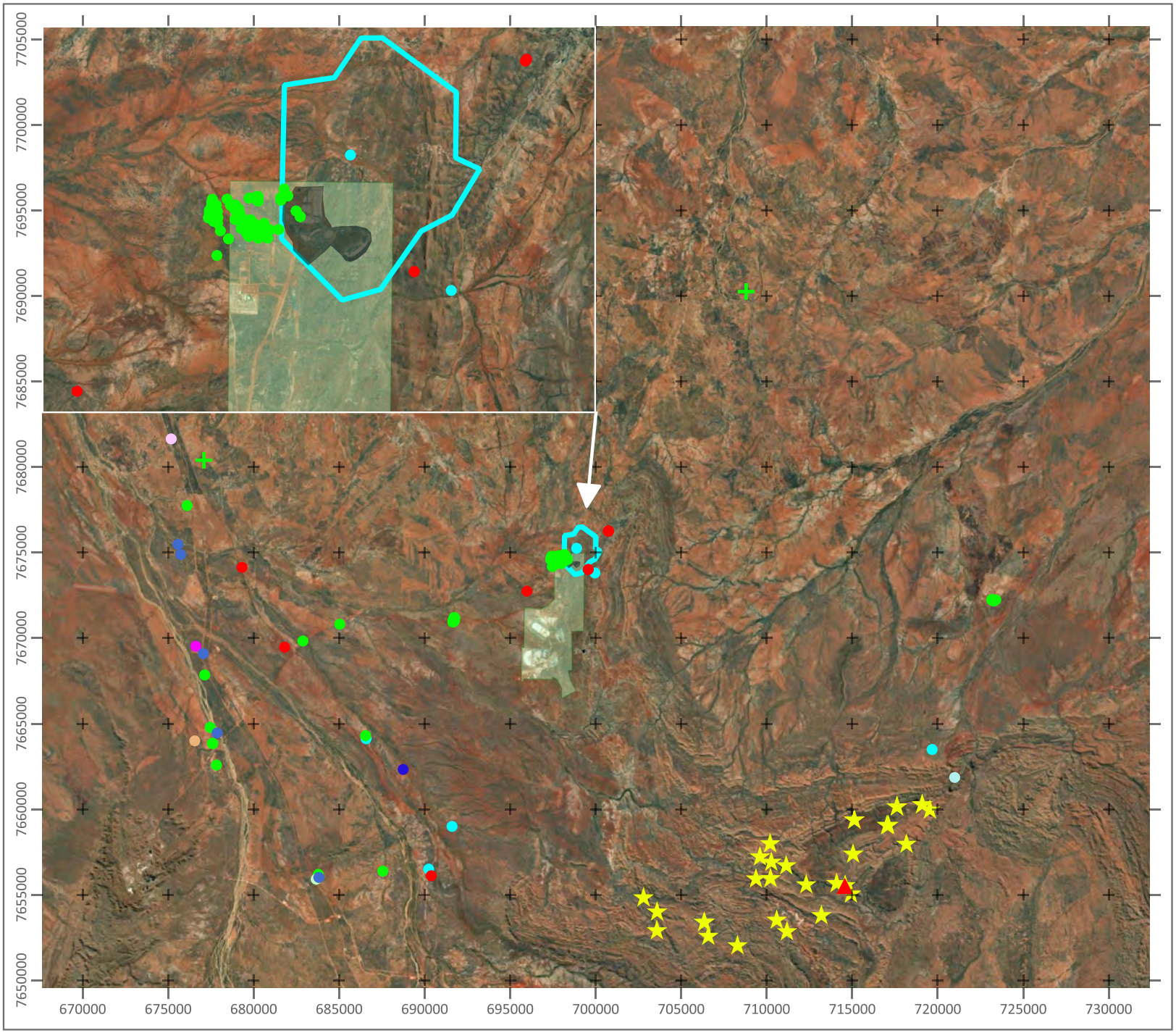
4.1.1 Significant Flora

No T Flora listed under the BC Act or EPBC Act have been previously recorded within the Study Area. Two P Flora species have been previously recorded in the Study Area, *Euphorbia clementii*, and a population of *Euploca mutica* (formerly *Heliotropium muticum*), both of which are listed as P3 in WA.

One T flora species has been recorded within 25 km, *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar, listed as Endangered under the EPBC Act and T under the BC Act). One P1, ten P3, and one P4 species have records within 30 km of the Study Area.

No additional T species were returned from the PMST or literature review.

T and P flora returned from the DBCA database with records within 30 km of the Study Area are shown in Figure 4-2.



Legend

- Study Area
- Cleared
- Pilgangoora Mine Operations

Threatened

- Quoya zonalis

Prority 1

- Themeda sp. Panorama

Priority 3

- Eragrostis crateriformis
- Euphorbia clementii
- Euploca mutica
- Gomphrena leptophylla
- Goodenia nuda
- Gymnanthera cunninghamii
- Nicotiana umbratica
- Terminalia supranitifolia
- Triodia basitricha
- Triodia chichesterensis

Priority 4

- Bulbostylis burbidgeae

Scale: @ A4
1: 32,000

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 18/08/2022

Threatened and Priority Flora Records

Prepared for:
Pilbara Minerals

Figure: 4-1

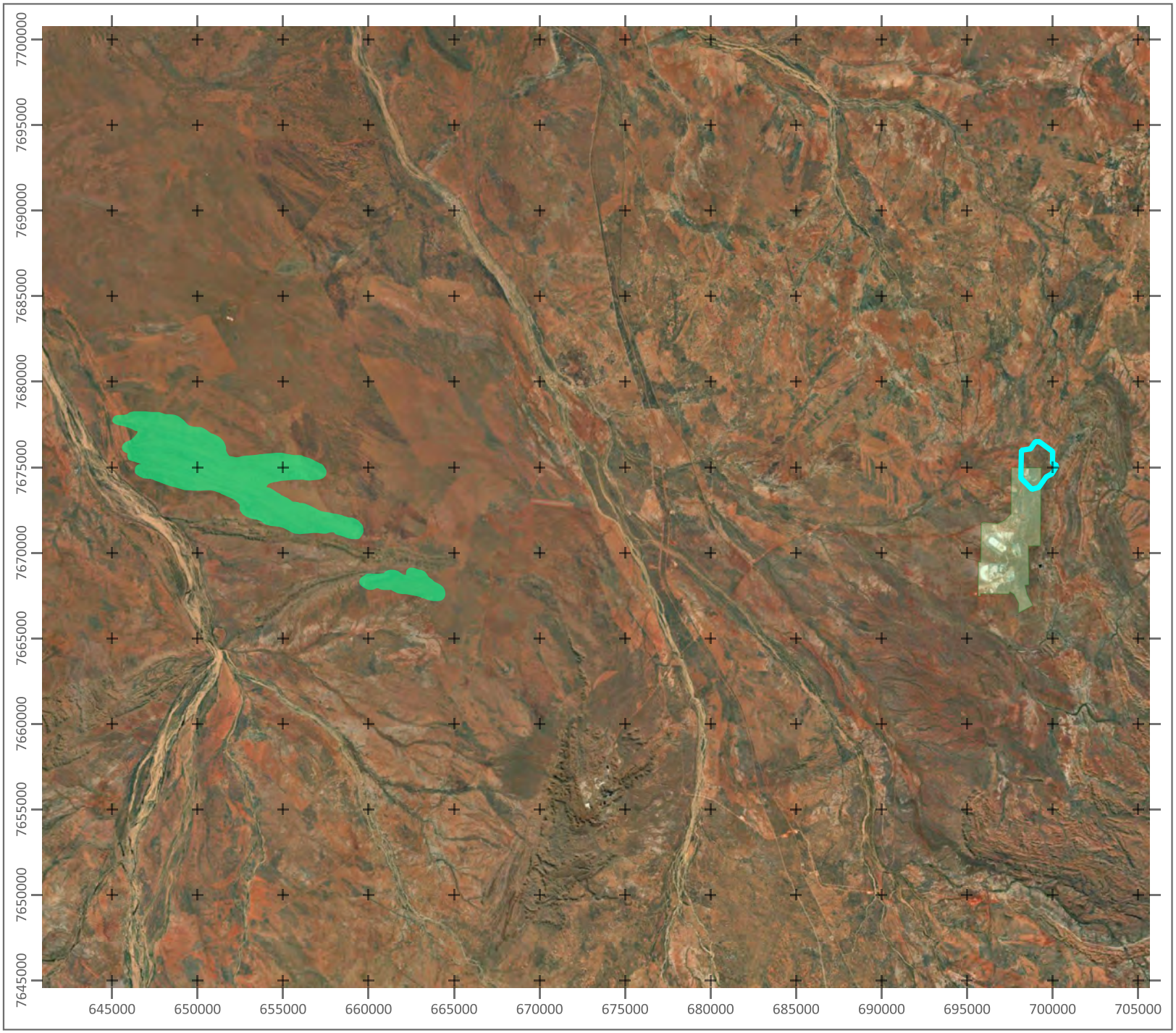
An assessment of the likelihood of occurrence of these 13 species within the Study Area was performed using the criteria listed in Table 3-2. The results of the assessment are listed in Table 4-1.

Table 4-1. Threatened and Priority Flora Likelihood of Occurrence

Species	Cons. Code		Preferred Habitat	Likelihood of Occurrence
	BC Act	EPBC Act		
Bulbostylis burbidgeae	P4		Granitic soils. Granite outcrops and cliff bases.	Possible. Suitable habitat in 10a, 11a, 11b
Eragrostis crateriformis	P3		Clayey loam or clay. Creek banks, depressions.	Unlikely to occur
Euphorbia clementii	P3		Gravelly hillsides, stony grounds.	Recorded
Euploca mutica	P3		Hummock grassland and sandplains.	Recorded nearby
Gomphrena leptophylla	P3		Open flats, sandy creek beds, edges salt pans and marshes, stony hillsides.	Possible. Suitable habitat in 7a, 9a, 9b
Goodenia nuda	P4		Has been previously found in drainage lines of red-brown loamy sand or sandy loam and in disturbed roadside areas	Unlikely to occur
Gymnanthera cunninghamii	P3		Sandy soils.	Possible. Suitable habitat in 7a
Nicotania umbratica	P3		Typically grows in shelter of large boulders on rocky outcrops and in shallow soils	Possible. Suitable habitat in 10a
Quoya zonalis	T	EN	Steep, rocky, sandstone conglomerate and granite slopes in skeletal, brown, sandy loam soils of the Capricorn Land System	Possible. Suitable habitat in 10a
Terminalia supranitifolia	P3		Sand. Among basalt rocks.	Unlikely to occur
Themeda sp. Panorama (J. Nelson *et al.* NS 102)	P1		Has been found growing along watercourses and creeklines and on rocky substrate	Possible. Suitable habitat in 6a, 8a and 8b.
Triodia basitricha	P3		Occurs on rocky and gravelly slopes of mountains or low hills.	Possible. Suitable habitat in 11a and 11b.
Triodia chichesterensis	P3		Occurs on sand or loam over rocky or gravelly substrates, often with quartzite.	Recorded

4.1.2 Significant Vegetation

There are no TECs listed under the BC Act or EPBC Act known to occur within the Study Area. One Priority 3 Ecological Community is located within 50 km of the Study Area; the Gregory Land System (Figure 4-2).



Legend

- Study Area
- Pilgangoora Mine Operations

Priority Ecological Communities

- Gregory Land System

Scale: @ A4
1: 320,000

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 19/07/2022

Threatened and Priority Ecological Communities

Prepared for:
Pilbara Minerals

Figure: 4-2

4.1.3 Introduced Flora Species

NatureMap returned eight introduced flora, including three species that are classed as Declared pests in WA, and two WoNS. Eight introduced flora species have been recorded locally by MMWC Environmental (2016), including one Declared pest.

Table 4-2 lists the introduced flora species recorded within 30 km of the Study Area. Where a local record and a database record is available, the local record is adopted as the source.

Table 4-2. Introduced Flora Records within 30 km of the Study Area

Species	Common Name	BAM Act Listing	WONS	Source
Aerva javanica	Kapok Bush	Permitted – S11	No	MMWC
Arivela viscosa (formerly *Cleome viscosa)*	Tickweed	Permitted – S11	No	Database
Boerhavia coccinea	Tar Vine	Permitted – S11	No	Database
Calotropis procera	Rubber Bush	Declared Pest – S22(2) (Exempt)	No	Database
Cenchrus ciliaris	Buffel Grass	Permitted – S11	No	MMWC
Cenchrus setiger	Birdwood Grass	Permitted – S11	No	MMWC
Chloris barbata	Purpletop Chloris	Permitted – S11	No	MMWC
Cynodon dactylon	Couch Grass	Permitted – S11	No	MMWC
Flaveria trinervia	Speedy Weed	Permitted – S11	No	MMWC
Opuntia elata	Prickly Pear	Declared Pest – S11(2) (C3 Restricted)	Yes	Database
Opuntia stricta	Common Prickly Pear	Declared Pest – S11(2) (C3 Restricted)	Yes	MMWC
Passiflora foetida var. *hispida*	Stinking Passion Flower	Permitted – S11	No	MMWC
Tamarix aphylla	Athel Pine	Declared Pest – S22(2) (Exempt)	Yes	MMWC

4.2 FIELD SURVEY

4.2.1 Flora

A total of 113 species of flora were recorded within the Study Area, comprising 110 native species and three introduced species. Five collections could not be identified beyond genus level due to the lack of flowering parts or fruiting bodies, or because they were only found in juvenile form.

The Fabaceae (pea family, 28 native) Poaceae (grass family, 21 native, 2 introduced), Malvaceae (13 native species) and Amaranthaceae (8 native species, one introduced) were the most species-rich families recorded. Twenty-six families were recorded across the Study Area.

The complete list of plant species recorded within the Study Area is presented in Appendix F. The mean species richness was 20 species per quadrat, slightly less than the MMWC Environmental (2016) survey which included 49 detailed sites with an average species richness of 25.

A species accumulation curve was performed with a modelled Chao 2 species richness of 128, indicating that the floristic survey was approximately 83% complete.

The survey recorded 30 species not previously recorded for the Pilgangoora project area. These species are identified in Appendix F and bring the total richness for the Pilgangoora project area to 231 including subspecies, and varieties. The newly recorded species includes two Priority flora that are detailed in Section 4.2.4.

Floristic groups identified in the cluster analysis were organised into vegetation types and are discussed in the following section.

The three introduced flora species recorded are detailed in Section 4.2.6.

4.2.2 Vegetation Types

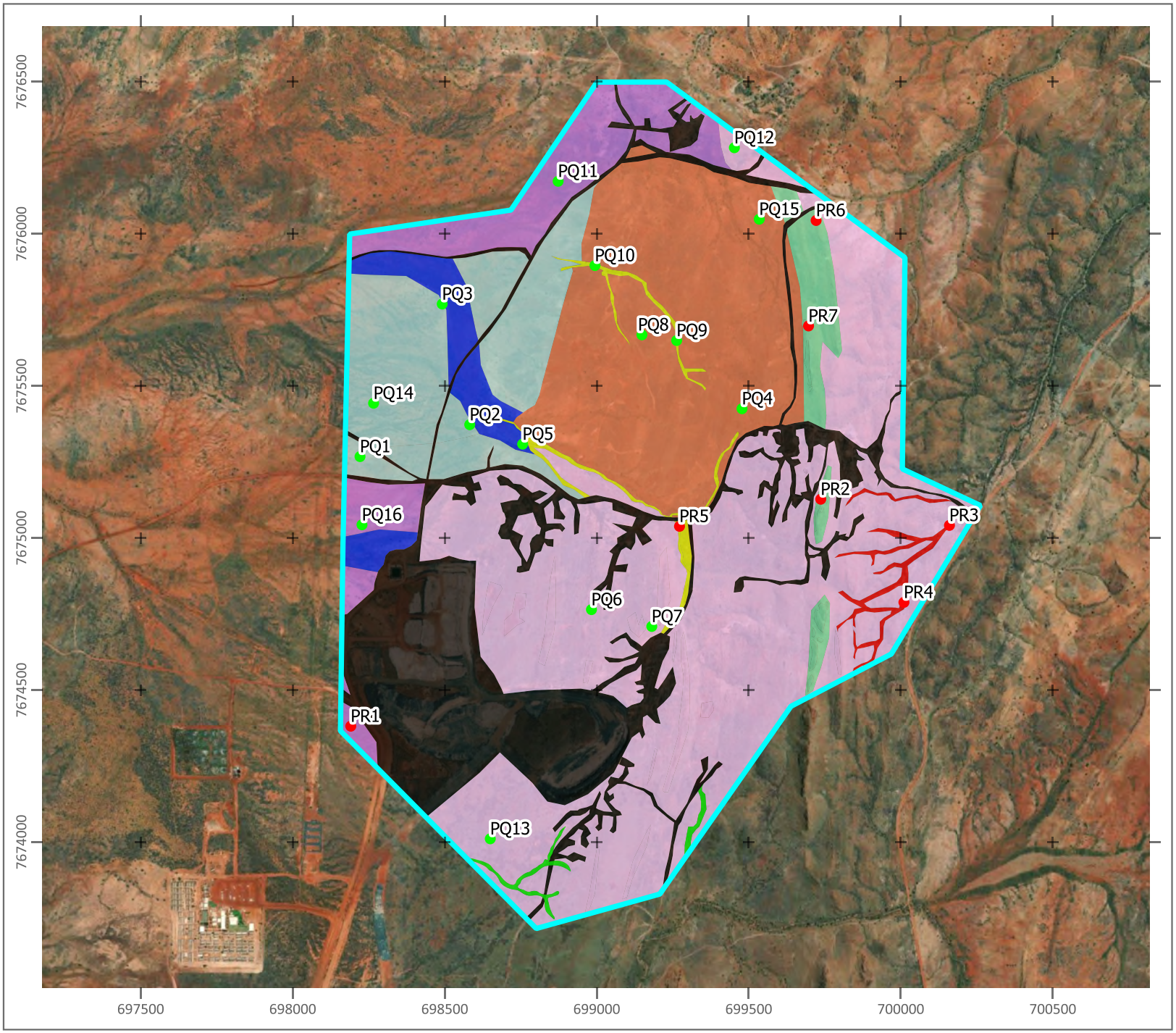
Nine vegetation types are described for the Study Area, as summarised in Table 4-3 and detailed in the subsections below. As the Lynas Find deposit is considered as an extension to the existing Pilbara Minerals Pilgangoora Project, the vegetation coding system previously used at the site has been retained and extended. MMWC Environmental (2016) described vegetation type using the numerals 1 to 6 and the letters a to c to group sites by landform and floristics respectively. Vegetation type 6a reported here is synonymous with vegetation type 6a as reported in MMWC Environmental (2016), with the remaining units labelled from 7 onwards being different from those recorded previously.

Distribution of vegetation types at a scale of 1: 18,000 is shown in Figure 4-3. The dendrogram resulting from the cluster analysis is shown in Appendix C, followed by the site data sheets and photos.

Table 4-3. Vegetation Types

Code	Landform	Vegetation Description	Extent in Study Area	
			(ha)	%
6a	Gully	Scattered low trees of *Corymbia hamersleyana* over high open shrubland of *Acacia acradenia* and *Grevillea wickhamii* subsp. *hispidula* over scattered shrubs of *Acacia bivenosa* and *Cajanus cinereus* over open hummock grassland of *Triodia epactia* and *Triodia wiseana* over very open tussock grassland of *Eriachne mucronata* and *Cymbopogon ambiguous*	1.26	0.3
7a	Valley Flat	Low *Corymbia hamersleyana* and *Acacia inaequilatera* isolated trees over *Acacia colei, Acacia ancistrocarpa,* and *Acacia bivenosa* sparse mid shrubland and *Triodia epactia,*	11.13	2.8

Code	Landform	Vegetation Description	Extent in Study Area	
			(ha)	%
		Triodia angusta and **Cenchrus setiger* mid open hummock grassland.		
8a	first order creeklines and drainage gullies	Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Grevillea wickhamii,* and *Acacia inaequilatera* open mid shrubland and *Triodia epactia, Triodia wiseana and Triodia chichesterensis* (P3) mid open hummock grassland	3.40	0.9
8b	Creekline	Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Grevillea wickhamii,* and *Acacia inaequilatera* sparse mid shrubland and *Triodia wiseana Triodia angusta* and *Cajanus cinereus* mid open hummock grassland/forbland	2.96	0.8
9a	Stony Plains	Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Acacia ancistrocarpa,* and *Grevillea wickhamii* sparse mid shrubland and *Triodia wiseana Triodia epactia* and *Triodia chichesterensis* (P3) mid hummock grassland	25.79	6.5
9b	Stony Plains	*Acacia ancistrocarpa, Acacia bivenosa* and *Acacia inaequilatera* mid open shrubland and *Triodia wiseana, Alysicarpus muelleri* and *Aristida holathera* mid hummock grassland/forbland/tussock grassland	40.10	10.2
10a	Ridge	Tall, isolated shrubs of *Acacia inaequilatera, Atalaya hemiglauca* and *Acacia colei* over a low sparse shrubland of *Hibiscus sturtii, Acacia acradenia, *Aerva javanica*, and *Triodia wiseana, Triodia brizoides* and *Triodia chichesterensis* (P3) mid open hummock grassland.	10.15	2.6
11a	Hill	Tall, isolated shrubs of *Acacia inaequilatera, Acacia colei* and *Acacia acradenia* over *Triodia brizoides, Triodia wiseana,* and *Triodia epactia* mid hummock grassland.	74.78	19.0
11b	Hill	Low isolated trees of *Corymbia hamersleyana* over tall, isolated shrubs of *Acacia colei, Acacia inaequilatera,* and *Senna glutinosa* subsp. *glutinosa* over *Triodia wiseana, Triodia chichesterensis* (P3), and *Triodia brizoides* mid hummock grassland.	151.24	38.4
D	-	Disturbed areas cleared of vegetation. Including rehabilitated areas where revegetation has not yet re-established.	72.96	18.5

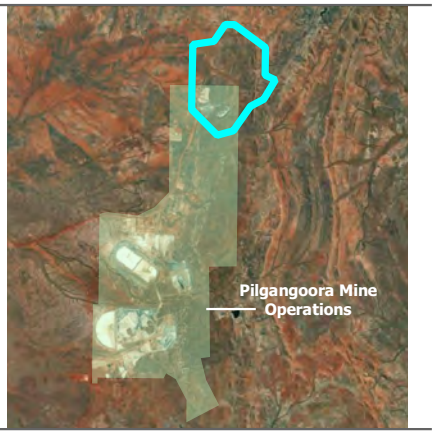


Legend

- Study Area
- Quadrat
- Relevé

Vegetation Unit

6a	9b
7a	10a
8a	11a
8b	11b
9a	D



Scale: @ A4
1: 18000

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 06/10/2022

Vegetation Associations

Prepared for:
Pilbara Minerals

Figure: 4-3

Landform: Gully

Vegetation Type: 6a

Scattered low trees of *Corymbia hamersleyana* over high open shrubland of *Acacia acradenia* and *Grevillea wickhamii* subsp. *hispidula* over scattered shrubs of *Acacia bivenosa* and *Cajanus cinereus* over open hummock grassland of *Triodia epactia* and *Triodia wiseana* over very open tussock grassland of *Eriachne mucronata* and *Cymbopogon ambiguous*

The ground layer is the dominant vegetation stratum and is characterised by *Triodia epactia* and *Triodia wiseana* hummock grasses. Tussock grasses such as *Eriachne mucronata* and *Cymbopogon ambiguous* occasionally occur.

This community occurs in the small gully flowing from east to west in the lower rocky hills, with brown sand with granite stones.

Condition: Impacts from cattle grazing are moderate. No weeds were recorded in 2022, the environmental weed *Aerva javanica* (kapok) was recorded in low numbers in 2016. The condition of this vegetation is Very Good.

Detailed sites: This vegetation type was described by MMWC Environmental as vegetation type 6a and was described from 7 detailed sites. No Detailed sites were allocated for the current study. Visual inspection in the field confirmed the vegetation was as described by MMWC Environmental (2016).

Introduced/exotic taxa: None recorded

Conservation significant species: None recorded

Landform – Valley Flat

Vegetation Type: 7a Low *Corymbia hamersleyana* and *Acacia inaequilatera* isolated trees over *Acacia colei, Acacia ancistrocarpa,* and *Acacia bivenosa* sparse mid shrubland and *Triodia epactia, Triodia angusta* and **Cenchrus setiger* mid open hummock grassland.

The ground layer is the dominant vegetation stratum and is characterised by *Triodia epactia* and *Triodia angusta* hummock grasses. Tussock grasses such as **Cenchrus setiger*, **Cenchrus ciliaris*, *Cymbopogon obtectus*, and *Aristida holathera* also occur within this vegetation community. *Cenchrus* spp. are heavily grazed. A diversity of forbs is present in the groundcover, with the most encountered species being *Rhynchosia minima*, *Goodenia lamprosperma*, *Stemodia grossa*, *Cajanus cinereus* and *Euphorbia mitchelliana*.

This community occurs on a broad valley flat, with red sandy loam soils and granite and quartz surface pebbles and gravels. The valley flat is downstream of the gullies in the upper reaches of the Study Area, that fan out when arriving at the plain.

Condition: Impacts from cattle grazing are moderate, and agricultural weeds **Cenchrus setiger* and **C. ciliaris* are present, but in low densities and heavily grazed. The condition of this vegetation is Very Good.

Detailed sites: PQ2, PQ3, PQ5

Total richness: 38 species. Average richness: 21 species

Introduced/exotic taxa: Small isolated occurrences of the exotic grasses *Cenchrus setiger* and *Cenchrus ciliaris* (Buffel Grass) were recorded within this vegetation type.

Conservation significant species: None recorded

Landform – First order creeklines and drainage gullies

Vegetation Type: 8a Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Grevillea wickhamii,* and *Acacia inaequilatera* open mid shrubland and *Triodia epactia, Triodia wiseana and Triodia chichesterensis* (P3) mid open hummock grassland.

The ground layer is characterised by *Triodia epactia* and *Triodia wiseana* hummock grasses with the P3 *Triodia chichesterensis* sometimes present at up to 5% cover. Tussock grasses such as *Themeda triandra, Paraneurachne muelleri, Eriachne mucronata, Chrysopogon fallax*, *Cymbopogon obtectus* and *Eriachne benthamii* are also present within this vegetation community and are moderately grazed.

The shrub layer is the dominant stratum, including a diversity of low shrubs. The most commonly encountered shrub species are *Acacia colei, Grevillea wickhamii, Acacia inaequilatera, Dampiera candicans, *Aerva javanica, Melhania oblongifolia, Tephrosia clementii, Corchorus incanus, Isotropis atropurpurea, Petalostylis labicheoides* and *Scaevola amblyanthera* var. *centralis*.

This community occurs in small first order creek lines, with red sandy loam to sandy gravel soils. This community is upstream of the 7a valley flat vegetation type and ceases where the channels diminish at the eastern edge of the rocky hill country.

Condition: Impacts from cattle grazing are moderate, and the environmental weed **Aerva javanica* is present, but in low density. The condition of this vegetation is Very Good.

Detailed sites: PQ9, PQ10, PR5

Total richness: 40 species. Average richness: 18 species

Introduced/exotic taxa: A small, isolated occurrence of the exotic **Aerva javanica* (Kapok) was recorded within PR5.

Conservation significant species: *Triodia chichesterensis* (P3) was recorded at 5% cover in PQ10 and 0.5% cover in PQ9.

Landform – Creekline

Vegetation Type: 8b Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Grevillea wickhamii,* and *Acacia inaequilatera* sparse mid shrubland and *Triodia wiseana Triodia angusta* and *Cajanus cinereus* mid open hummock grassland/forbland.

The ground layer is the dominant vegetation stratum and is characterised by *Triodia wiseana* and *Triodia angusta* hummock grasses. Tussock grasses such as *Eriachne mucronata, Cymbopogon obtectus* occasionally occur.

A diversity of low shrubs is present, with the most encountered species being *Acacia stellaticeps, Nellica maderaspatensis, Dampiera candicans, Goodenia stobbsiana, Isotropis atropurpurea, Scaevola amblyanthera* var. *centralis* and *Stemodia grossa.*

This community occurs in small creek lines flowing east of the rocky range, with red to orange loamy sands with granite stones.

Condition: Impacts from cattle grazing are low. No weeds were recorded. The condition of this vegetation is Very Good.

Detailed sites: PR3, PR4

Total richness: 31 species. Average richness: 22.5 species

Introduced/exotic taxa: None recorded

Conservation significant species: None recorded

Landform – Stony plains

Vegetation Type: 9a Low *Corymbia hamersleyana* isolated trees over *Acacia colei, Acacia ancistrocarpa,* and *Grevillea wickhamii* sparse mid shrubland and *Triodia wiseana Triodia epactia* and *Triodia chichesterensis* (P3) mid hummock grassland.

The ground layer is the dominant vegetation stratum and is characterised by *Triodia wiseana* and *Triodia epactia* hummock grasses with the P3 *Triodia chichesterensis* sometimes present at up to 5% cover. Tussock grasses such as *Chrysopogon fallax, Eragrostis eriopoda, Paraneurachne muelleri* occasionally occur and are heavily grazed where they do occur.

A diversity of low shrubs is present in the ground layer, with the most encountered species being *Corchorus incanus, Ptilotus austrolasius, Tephrosia arenicola, Arivela uncifera* subsp. *uncifera, Indigofera monophylla, Ptilotus calostachyus and Afrohybanthis aurantiacus.*

This community occurs on stony plains east of the rocky range, with red sandy loam with granite and quartz pebbles at the surface.

Condition: Impacts from cattle grazing are moderate. The exotic grass *Cenchrus ciliaris* (Buffel Grass) was recorded within this vegetation type, heavily grazed. The condition of this vegetation is Good.

Detailed sites: PR1, PQ1, PQ11, PQ16

Total richness: 41 species. Average richness: 19 species

Introduced/exotic taxa: *Cenchrus ciliaris*

Conservation significant species: *Triodia chichesterensis* (P3) was recorded at 5% cover in PQ1 and 0.1% cover in PR1.

Landform – Stony plains

Vegetation Type: 9b *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia inaequilatera* mid open shrubland and *Triodia wiseana, Alysicarpus muelleri* and *Aristida holathera* mid hummock grassland/forbland/tussock grassland.

The shrub layer is the dominant vegetation stratum and is characterised by the taller shrubs *Acacia ancistrocarpa, Acacia bivenosa, Acacia inaequilatera, Grevillea wickhamii*

A diversity of low shrubs is also present in the ground layer, with the most encountered species being *Bonamia erecta, Bonamia linearis, Nellica maderaspatensis, Pterocaulon spaeranthoidess, Rhynchosia minima, Scaevola amblyanthera* var. *centralis, Senna notabilis, Streptaglossa decurrens* and *Tephrosia arenicola.*

This community occurs on stony plains east of the rocky range, with red sandy loam with granite and quartz pebbles at the surface.

Condition: Impacts from cattle grazing are moderate, with tussock grasses sparse to absent. The condition of this vegetation is Good.

Detailed sites: PQ14

Total richness: 20 species

Introduced/exotic taxa: None recorded

Conservation significant species: None recorded

Landform – Ridge

Vegetation Type: 10a Tall isolated shrubs of *Acacia inaequilatera, Atalaya hemiglauca* and *Acacia colei* over a low sparse shrubland of *Hibiscus sturtii, Acacia acradenia, *Aerva javanica*, and *Triodia wiseana, Triodia brizoides* and *Triodia chichesterensis* (P3) mid open hummock grassland.

The ground layer is the dominant vegetation stratum and is characterised by the *Triodia wiseana* and *Triodia brizoides* hummock grasses with the P3 *Triodia chichesterensis* occasionally present at up to 2% cover.

A diversity of low shrubs, forbs and tussock grasses is also present in the ground layer, with the most encountered species being *Cymbopogon ambiguous, Melhania oblongifolia, Cassytha filliformis, Euphorbia mitchelliana, Tribukus platypterus, Afrohybanthus aurantiacus, Amaranthus mitchellii, Indigofera monophylla, Rhynchosia minima* and *Solanum horridum.*

One fig tree (*Ficus aculeata* var. *indecora*) was recorded in this vegetation type as an opportunistic collection.

This community occurs on the crest of the rocky range, with skeletal red sandy soils among boulders and large angular rocks.

Condition: The environmental weed **Aerva javanica* is common. The condition is Very Good.

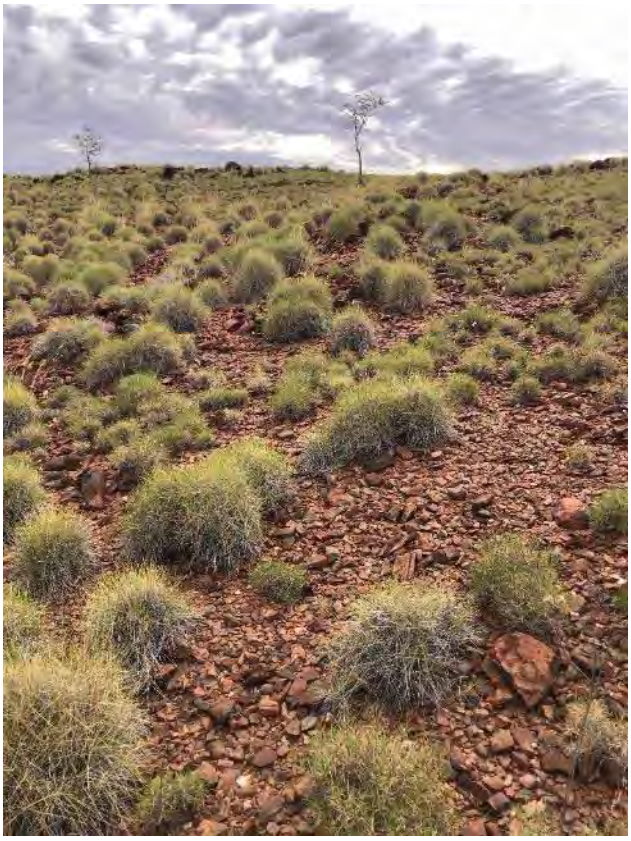
Detailed sites: PR2, PR6, PR7

Total richness: 35 species, average species richness is 18

Introduced/exotic taxa: **Aerva javanica*

Conservation significant species: *Triodia chichesterensis* (P3) at 2% cover in PR2, and *Rothia indica* (P3) at PR 2 at 0.1% cover.

Landform – Hill



Vegetation Type: 11a Tall isolated shrubs of *Acacia inaequilatera, Acacia colei* and *Acacia acradenia* over *Triodia brizoides, Triodia wiseana,* and *Triodia epactia* mid hummock grassland.

The ground layer is the dominant vegetation stratum and is characterised by the *Triodia brizoides* and *Triodia wiseana* and hummock grasses with *Triodia epactia* present in lower numbers.

A diversity of low shrubs, forbs and tussock grasses is also present in the ground layer, with the most encountered species being *Dampiera candicans, Corchorus incanus, Indigofera hirsuta, Boerhaevia gardneri, Trigastrotheca molluginea, Aristida holathera, Bonamia erecta, Corchorus lanifolius* and *Cymbopogon ambiguous.*

This community occurs on the rocky uplands of the central section of the range, in a shallow red loamy soil with a cover of angular rocks of granite and quartz at the surface. It is bounded to the east by the plains, to the west by the ridge.

Condition: No weeds were recorded in this vegetation type and the evidence of grazing was low. Occasional tracks occur. The condition is Very Good.

Detailed sites: PQ4, PQ8, PQ15

Total richness: 28 species, average species richness is 14

Introduced/exotic taxa: None recorded

Conservation significant species: Database record for the P3 *Euphorbia clementii* occurs within this vegetation type. None recorded in the 2022 survey.

Landform – Hill

Vegetation Type: 11b Low isolated trees of *Corymbia hamersleyana* over tall, isolated shrubs of *Acacia colei, Acacia inaequilatera,* and *Senna glutinosa* subsp. *glutinosa* over *Triodia wiseana, Triodia chichesterensis* (P3), and *Triodia brizoides* mid hummock grassland.

The ground layer is the dominant vegetation stratum and is characterised by *Triodia wiseana* hummock grasses the with *Triodia chichesterensis* (P3) as a sub-dominant at up to 15% cover in some places and *Triodia brizoides* present in lower numbers.

A diversity of low shrubs, forbs and tussock grasses is also present in the ground layer, with the most encountered species being *Stemodia grossa, Cymbopogon ambiguous, Eriachne mucronata Corchorus incanus, Ptilotus austrolasius, Scaevola amblyanthera* var. *centralis, Afrohybanthus aurantiacus, Boerhaevia gardneri, Enneopogon lindleyanus, Euphorbia careyi, Euphorbia tannensis* and *Gomphrena cunninghamii.*

This community occurs on the rocky hills, in a shallow red or yellow loamy sandy soil with a cover of angular rocks of granite and schist at the surface.

Condition: The environmental weed **Aerva javanica* was recorded infrequently in this vegetation type and the evidence of grazing was low. Occasional tracks occur. The condition is Very Good.

Detailed sites: PQ46 PQ7, PQ12, PQ13

Total richness: 48 species, average species richness is 21

Introduced/exotic taxa: **Aerva javanica*

Conservation significant species: *Triodia chichesterensis* (P3) at 15% cover in PQ12 and PQ13, and *Rothia indica* (P3) at PQ13 at 0.1% cover.

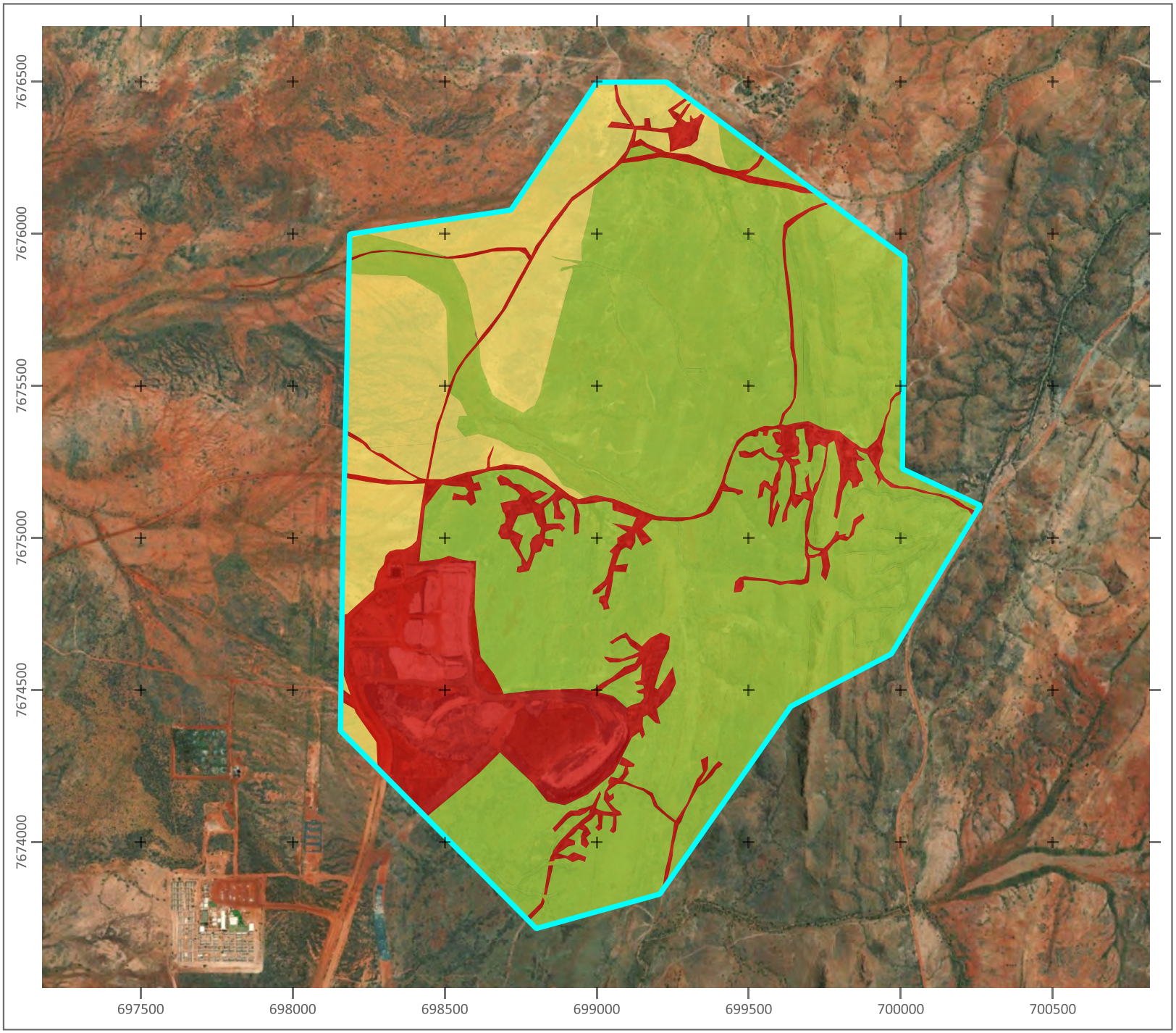
4.2.3 Vegetation Condition

Vegetation condition across the Study Area was within the categories Very Good, Good and Completely Degraded, with most of the Study Area in Very Good condition (Table 4-4; Figure 4-4). The primary sources of disturbance on site are associated with historical and current mining related disturbances (numerous vehicle tracks, drill pads, active mining area on the eastern boundary). In addition, several weed species occur throughout the site, primarily through the creek lines in the plains area and in the rocky ridge landform. A moderate grazing impact from cattle is present in the plains and a low grazing impact in the hills.

Table 4-4. Vegetation condition within the Study Area

Vegetation Condition	Area (ha)	Area (%)
Very Good	254.48	64.6
Good	66.75	16.9
Completely Degraded	72.96	18.5

The Study Area has Moderate (burnt 4-8 years previously) to Very Old fire age, with a large portion of the site being burned in 2017/18, and a small portion on the eastern edge being burned in 2013/14 (DBCA 2022).

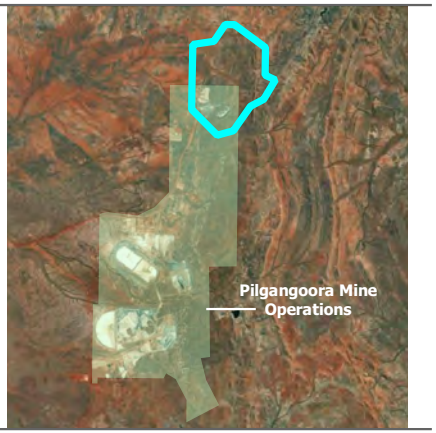


Legend

- Study Area

Vegetation Condition

- Very Good
- Good
- Completely Degraded



Scale: @ A4
1: 18000

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 07/10/2022

Vegetation Condition

Prepared for:
Pilbara Minerals

Figure: 4-4

4.2.4 Significant Flora

No species listed as T under the EPBC Act or BC Act were recorded during the survey.

Two P3 species were recorded.

Triodia chichesterensis is described by Anderson *et al*. (2017). It is characterised by being a short-leaved species, distinguished by the combination of diminutive stature, glabrous leaf sheaths, relatively unbranched inflorescence, often short pedicels, and pubescent lemma midlobe. The short pedicels and pubescent lemma midlobe contrast with the typically longer pedicels and glabrous lemma midlobes of other short-leaved species in the complex (*T. nana*, *T. scintillans*, *T. vanleeuwenii*). It is distinguished from the closely related and often co-occurring *Triodia lanigera* by its shorter and less hairy leaves and less branched inflorescence.

The species has a limited distribution and has been found only in a narrow area in the central Chichester region of the Pilbara of WA (Figure 4-5). The areas immediately to the west and east of its known distribution are poorly explored, but it is likely to be restricted to an area <100 km beyond current collections, given intensive collecting efforts in the Pilbara (Anderson *et al*. 2017).

The Lynas Find deposit is in the central part of the range of this species, which is significant from the perspective of determining it from the closely related *Triodia lanigera* (Anderson *et al*. 2017). Where the two co-occur in the south it can be difficult to determine them based on morphological and distributional parameters. Where the two co-occur in the north, there is a subtle but consistent substrate change that marks the shift in species, with *T. lanigera* occurring on sandier soils and *T. chichesterensis* on rockier soils with quartzite pieces. In the northern species range, it can usually be morphologically distinguished from *T. lanigera* by its shorter and less hairy leaves and less branched inflorescences.

In the Study Area the species was recorded on rocky soils with quartzite. Collection records indicate that florets are observed between February–April and in August. At the time of survey in August, flowering material was available, and the species was able to be determined using the taxonomic key published by Anderson *et al*. (2017).

Triodia chichesterensis was recorded in four vegetation types - 8a, 9a, 10a and 11b at up to 15% cover, but more commonly at or below 5% cover.

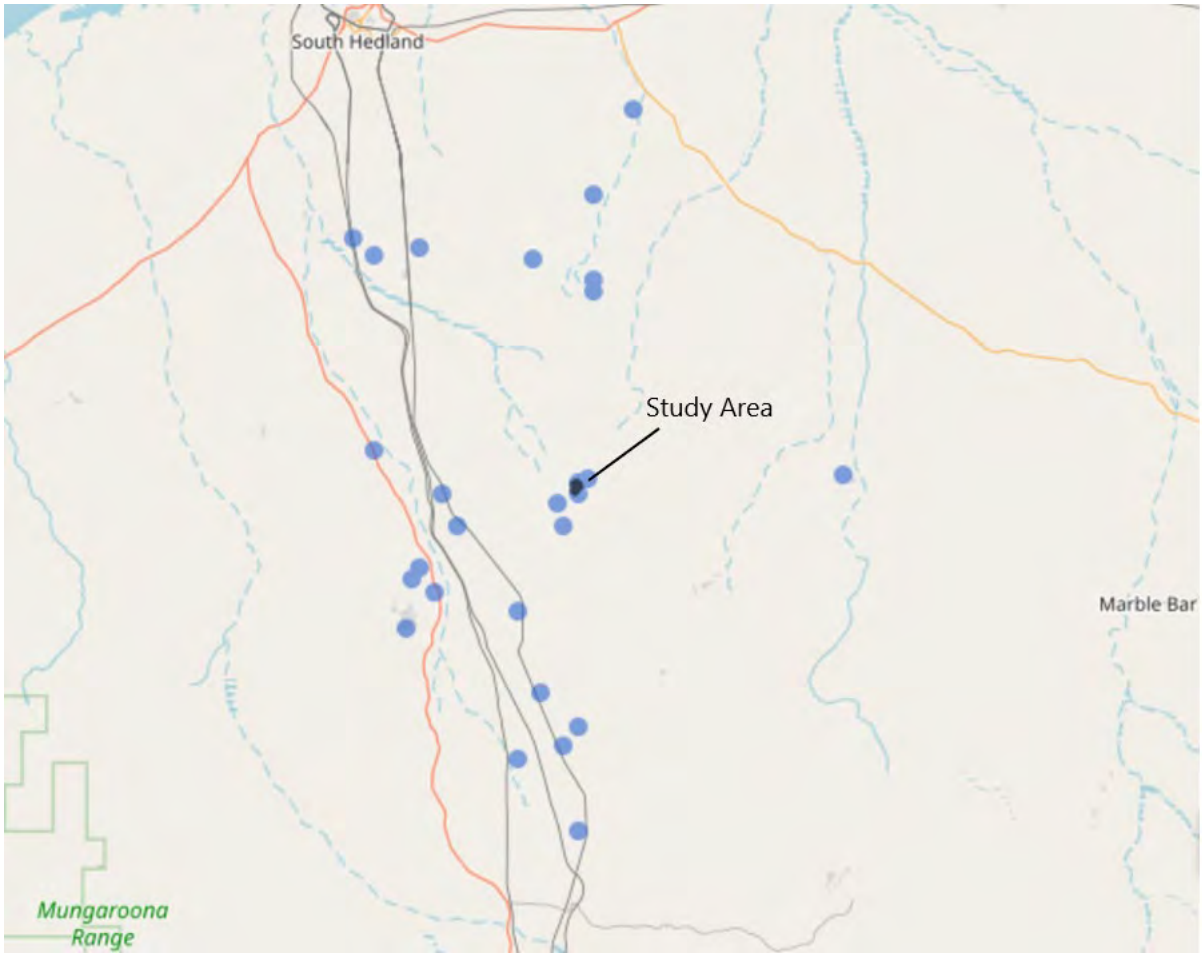


Figure 4-5. Regional records for *Triodia chichesterensis*
Source: Atlas of Living Australia

Rothia indica subsp. *australis* is a prostrate annual herb, to 0.3 m high, densely covered in spreading hairs. Flowering occurs from April to August. It is known from sandy soils in sandhills and sandy flats.

It is known to occur across the northern third of Australia (Figure 4-6), however records are sparsely distributed. A comparatively large number of records have been made in the Chichester subregion of the Pilbara, likely as a consequence of a large survey effort in the subregion. The Study Area is within the known range of the species, however there are no previous records for the species within the locality.

In the Study Area it was recorded in vegetation types 10a and 11b as scattered and infrequent individuals.

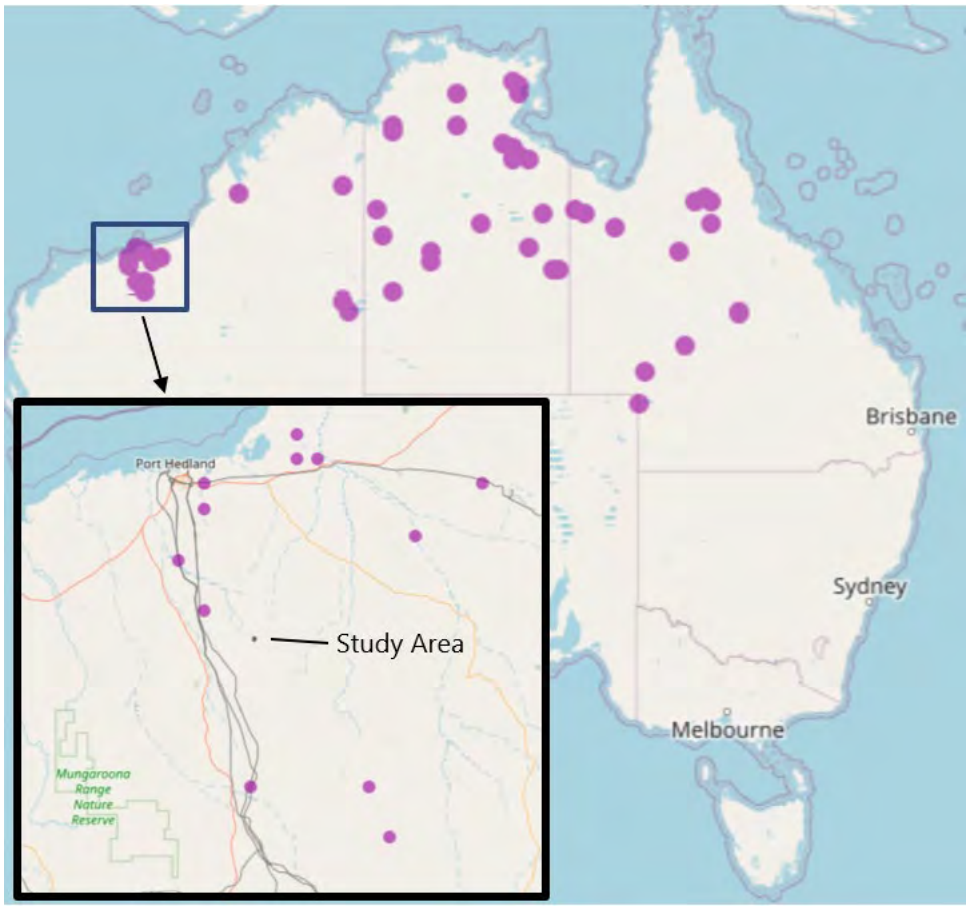


Figure 4-6. Australian and regional records of *Rothia indica* subsp. *australis*
Source: Atlas of Living Australia

An additional P1 species was recorded in the local area during the MMWC Environmental (2016) survey but was not recorded in the current survey. At the time of the MMWC Environmental (2016) survey the species was known as *Heliotropium muticum* and was considered to be a Priority 1 species. Taxonomic revision for the species has led to the revision of the name to *Euploca mutica* (Frohlich *et al*. 2020) and targeted searches resulting in increased known population size has led to a revision of the status to Priority 3.

Euploca mutica is a small, perennial herb/shrub that grows to approximately 0.3 m. In the previous local survey, it was recorded in the sand plain habitat in vegetation association 1a.

Atlas of Living Australia collection records for the species identify that flowering specimens are often collected in August, and that habitat includes sandy or calcareous plains, often on granite geology, with a sandy or loamy surface often with ironstone and quartz. In the Study Area the suitable habitat was assessed as being vegetation type 9a. Targeted searches were conducted throughout vegetation type 9a using traverses at intervals of approximately 25 m. No *Euploca mutica* were recorded. As seasonal conditions were suitable and the survey was conducted within the known flowering period, the species absence is determined with a high level of certainty.

An additional P3 species *Euphorbia clementii* was returned from the database searches as occurring within the Study Area but was not recorded during the survey. *Euphorbia clementii is* an erect herb,

growing up to 0.6 m high. It is known from gravelly hillsides and stony grounds. Suitable habitat in the Study Area is the 11a vegetation type.

4.2.5 Significant Vegetation

No vegetation types occurring within the Study Area are analogous to any known TEC's or PEC's.

No species known to be associated with groundwater dependant ecosystems were recorded in the Study Area.

4.2.6 Introduced Flora

Three introduced flora species were recorded in the Study Area and are listed in Table 4-5. No Declared Weeds or WONS were recorded.

Table 4-5. Introduced Flora Recorded in the Study Area

Species	Common name	Description (Florabase 2022).
BAM Act S11 - Permitted		
Aerva javanica	Kapok	Erect, much-branched perennial herb, 0.4-1.6 m high. Flowers white from January to October. Often found growing on sandy soils and along drainage lines.
Cenchrus ciliaris	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.
Cenchrus setiger	Birdwood grass	Erect, tussocky, stoloniferous perennial, herb or grass-like. Grows to 0.5 m high. Flowers cream to purple from April to May. Grows on brown sands, red loam, or pindan soils on sand dunes, plains, rangelands, stony hillsides, or floodplains.

The agricultural weeds *Cenchrus ciliaris* and *C. setiger* were recorded in the plains on the western side of the Study Area where cattle grazing occurs at a high intensity, and tracks are frequent. Where found, these weeds were heavily grazed.

The environmental weed *Aerva javanica* was most common on the high ridge line and infrequent in the rocky hills.

5 TERRESTRIAL VERTEBRATE FAUNA RESULTS

5.1 DESKTOP STUDY

5.1.1 Significant Fauna

The DBCA database returned 14 species of significant fauna that have previously been recorded within 30 km of the Study Area. Of these, three are listed as migratory bird species (**MI**) and one as Other Specifically Protected (**OS**). Record locations of T and P fauna in relation the Study Area are shown in Figure 5-1.

One endangered (**EN**), one vulnerable (**VU**) and two P fauna species have previously been recorded within the Study Area.

The PMST returned 12 additional species, six T and six MI. These are species that do not have records within 30 km but where modelling has identified that suitable habitat is known to occur or may occur.

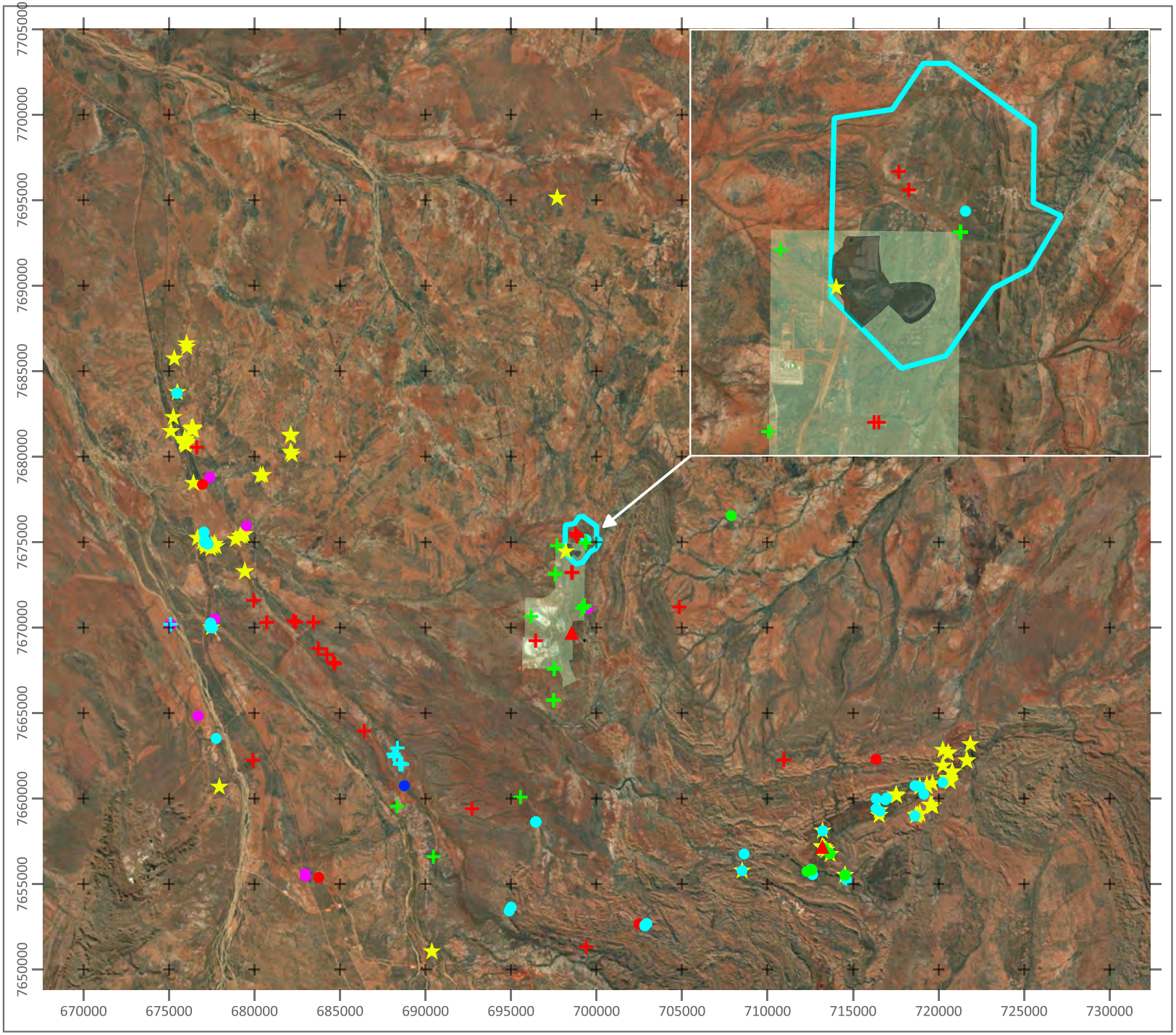
The Literature review returned additional information about the locations and abundance of Pilbara leaf-nosed bat and Northern quoll records.

Database search results of T, P and MI fauna within 30 km of the Study Area are listed in Table 5-1, with the outcome of the likelihood of occurrence assessment. The complete assessment including the preferred habitat relative to those available in the Study Area and records in the local area is included in Appendix G.

5.1.2 Introduced Fauna

NatureMap records for eight introduced fauna recorded within 30 km of the Study Area were returned and are listed below:

- Camel (*Camelus dromedarius*);
- Cat (*Felis cattus*);
- Cattle (*Bos taurus*);
- Dog (*Canis lupus*);
- Donkey (*Equus asinus*)
- Fox (*Vulpes vulpes*)
- Horse (*Equus caballus*); and
- House Mouse (*Mus musculus*).



Legend

- Study Area
- Cleared
- Pilgangoora Mine Operations

Endangered

- Northern quoll

Vulnerable

- Bilby
- Ghost bat
- Grey falcon
- Pilbara leaf-nosed bat
- Pilbara olive python

Priority 1

- Gane's blind snake (Pilbara)

Priority 4

- Brush-tailed mulgara
- Spectacled hare-wallaby (mainland)
- Western pebble-mound mouse

Scale: @ A4
1: 32,000

0 5 10 km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 18/08/2022

Threatened and Priority Fauna Records

Prepared for:
Pilbara Minerals

Figure: 5-1

Table 5-1. Significant fauna database records and likelihood of occurrence

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
Actitis hypoleucos	Common Sandpiper	MI	MI	Unlikely. No habitat occurs in the Study Area. No saline or coastal habitats available. Freshwater habitats are limited to drainage lines that are ephemeral, fast flowing, first and second order streams with no permanent or semi-permanent pools. The sandy plain fauna habitat is in a valley floor and would receive run-on following significant rainfall, however substrate is sandy therefore unlikely to retain water and provide wading habitat.
Arenaria interpres	Ruddy Turnstone	MI	MI	
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	
Calidris ferruginea	Curlew Sandpiper	CR	CR, MI	
Calidris melanotos	Pectoral Sandpiper		MI	
Calidris ruficollis	Red-necked Stint	MI	MI	
Numenius madagascariensis	Eastern Curlew	CR	CR, MI	
Pluvialis fulva	Pacific Golden Plover	MI	MI	
Thalasseus bergii	Crested Tern	MI	MI	
Tringa brevipes	Grey-tailed Tattler	MI, P4	MI	
Tringa glareola	Wood Sandpiper	MI	MI	
Tringa nebularia	Common Greenshank	MI	MI	
Fregata ariel	Lesser Frigatebird	MI	MI	

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
Apus pacificus	Fork-tailed Swift	MI	MI	Possible. Not habitat dependent.
Charadrius veredus	Oriental Plover	MI	MI	Unlikely. No suitable habitat available for this species.
Erythrotriorchis radiatus	Red Goshawk	VU	VU	Unlikely. No habitat occurs in the Study Area.
Falco hypoleucos	Grey Falcon	VU	VU	Possible. Suitable foraging habitat in the plains. No nesting habitat is present.
Falco peregrinus	Peregrine Falcon	OS	-	Unlikely. No habitat occurs in the Study Area.
Hirundo rustica	Barn Swallow	MI	MI	Unlikely. No habitat occurs in the Study Area.
Motacilla cinerea	Grey Wagtail	MI	MI	Unlikely. No habitat occurs in the Study Area.
Motacilla flava	Yellow Wagtail	MI	MI	Unlikely. No habitat occurs in the Study Area.
Pandion cristatus	Eastern Osprey	MI	MI	Unlikely. No habitat occurs in the Study Area.
Pezoporus occidentalis	Night Parrot	CR	EN	Possible. Some suitable spinifex, however foraging resources are limited.
Rostratula australis	Australian Painted-Snipe	EN	EN	Unlikely. No habitat occurs in the Study Area.
Dasycercus blythi	Brush-tailed Mulgara	P4	-	Possible. Sandy plains habitat is suitable.
Dasyurus hallucatus	Northern Quoll	EN	EN	Present. Denning and foraging habitats present, camera records and scats previously recorded.
Hipposideros stenotis	Northern Leaf-nosed Bat	P2		Unlikely. Species not known to occur in the Pilbara, generally being confined to more northern areas.

Species	Common Name	Conservation Code		Assessment of Occurrence
		BC Act	EPBC Act	
Lagorchestes conspicillatus leichardti	Spectacled Hare-wallaby	P4	-	Present. Historic records and suitable habitat across the Study Area.
Leggadina lakedownensis	Lakeland Downs Mouse	P4		Unlikely. No suitable habitat.
Macroderma gigas	Ghost Bat	VU	VU	Possible. Foraging habitat available across the Study Area. No roosting habitat available.
Macrotis lagotis	Greater Bilby	VU	VU	Possible. Suitable habitat includes the plains and low hills habitats.
Pseudomys chapmani	Western Pebble-mound Mouse	P4	-	Present. Mounds located in the low rolling hills.
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	VU	Present. No roosting habitat available. Foraging habitat of low quality.
Sminthopsis longicaudata	Long-tailed Dunnart	P4		Possible. Suitable habitat in the low hills, boulder rock outcrops and platy rock outcrops.
Anilios ganei	Gane's Blind Snake (Pilbara)	P1		Unlikely. Suitable habitat unlikely to be present as drainage lines small and highly ephemeral. Very few termite mounds present for foraging resource.
Ctenotus nigrilineatus	Pin-striped Finesnout Ctenotus	P1		Possible. Suitable habitat occurs in the low hills and outcrops.
Liasis olivaceus subsp. *baronni*	Pilbara Olive Python	VU	VU	Unlikely. There are no gorges or significant water filled gullies in the Study Area.
Liopholis kintorei	Great Desert Skink		VU	Unlikely. Suitable habitat may occur 15 km to the southeast.

5.2 FIELD SURVEY

5.2.1 Fauna Habitats

The Study Area is characterised by rocky hills throughout the eastern half and into stony plains in the western half.

Drainage lines originate in the rocky eastern half and flow west towards the sandplains where formed channels cease and wash out areas are present and water moves as sheetflow. East of the high ground, small rocky first order streams join and flow to the northeast.

Six fauna habitats are described for the Study Area and are summarised in Table 5-2 below. The distribution of fauna habitats is shown in Figure 5-2. Photos of the habitat assessment locations are shown in Appendix D.

Table 5-2. Fauna Habitats within the Study Area

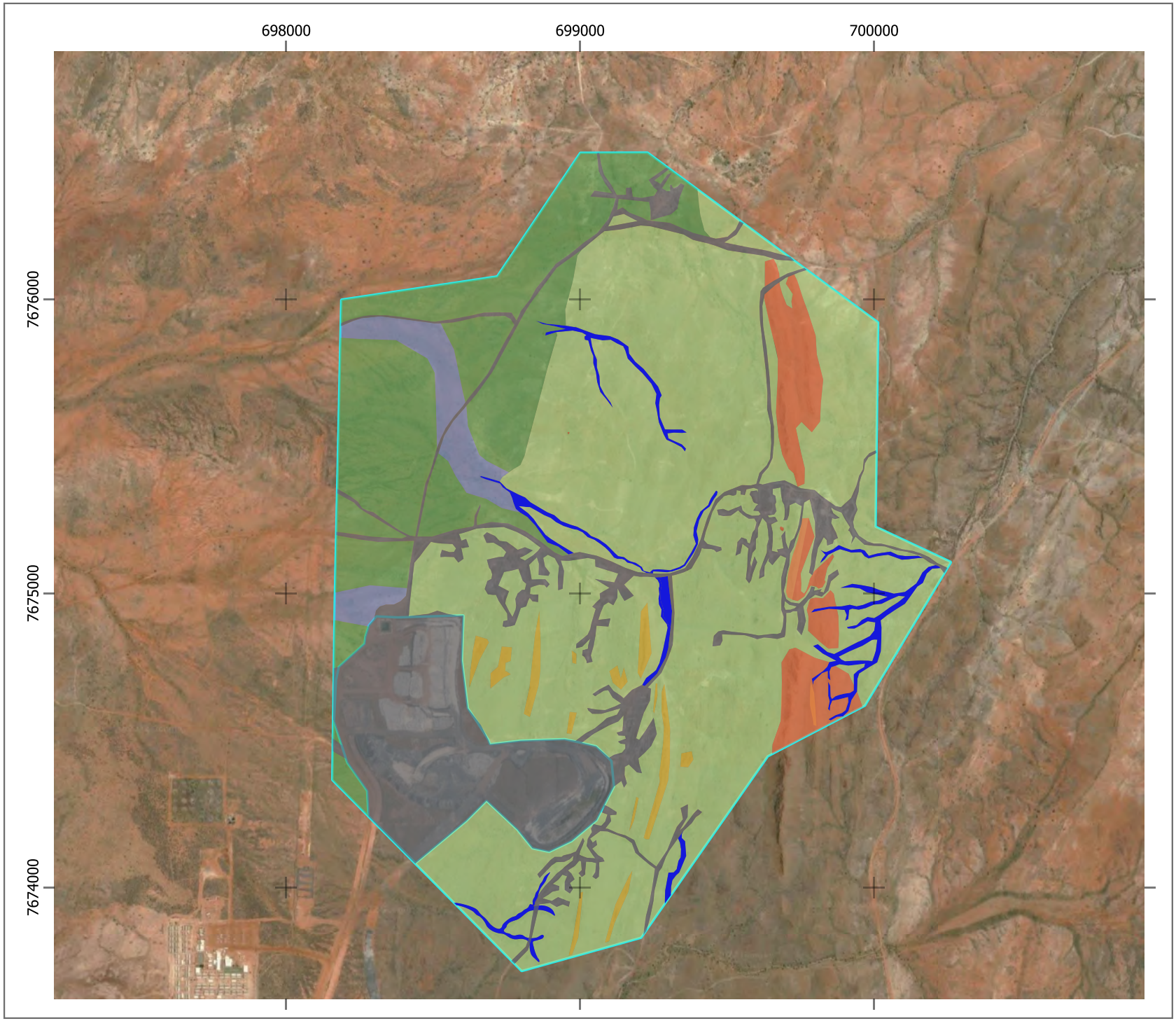
Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)
FH1	Boulder Rock Outcrops	MSC01, MSC08, MSC09, MSC13, MSC15	Rocky outcrops and ridges composed of angular, red granite boulders with >75% cover. Exposed bedrock provided cracks and crevices as important shelter sites for small and large reptiles such as goannas and snakes, and mammals such as the Northern Quoll. Soils were hard and unsuitable for burrowing species due to the surface rock cover. This habitat type is considered to have the highest habitat value relative to the others in the Study Area. The vegetation consists of tall, isolated shrubs of *Acacia inaequilatera, Atalaya hemiglauca* and *Acacia colei* over a low sparse shrubland of *Hibiscus sturtii, Acacia acradenia, *Aerva javanica*, and *Triodia wiseana, Triodia brizoides* and *Triodia chichesterensis* (P3) mid open hummock grassland. One individual *Ficus aculeata* var. *indecora* (Fig tree) occurred.		17.21

Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)
FH2	Platy Rock Outcrops	MSC02	Rocky outcrops and ridges composed of platy, sharp, red granite or schist with >75% cover. Exposed bedrock provided cracks and crevices as important shelter sites for small ground dwelling reptiles and small mammals. Soils were hard and unsuitable for burrowing species due to the surface rock cover. The habitat value is moderate. The vegetation consists of low isolated trees of *Corymbia hamersleyana* over tall, isolated shrubs of *Acacia colei, Acacia inaequilatera,* and *Senna glutinosa* subsp. *glutinosa* over *Triodia wiseana, Triodia chichesterensis* (P3), and *Triodia brizoides* mid hummock grassland.		5.44
FH3	Low Hills		This habitat type is characterised by rolling hills with an elevation of up to 250 m. The surface is generally stony and composed of quartzite and granite pebbles on red, loam soils. This habitat has a low diversity of microhabitats. Soils were hard and unsuitable for burrowing species due to the surface rock cover. No cracks and crevices are available for shelter sites for small or large animals. No trees are available to provide standing or fallen hollow logs. This habitat is suitable for small species of reptile (such as skinks and dragons) and small mammal species, such as the Western Pebble-mouse as they construct shelter mounds from small stones. Other than where conservation significant fauna occurs, this habitat provides limited value to fauna and given the lack of structure and microhabitats, is considered to have a low habitat value.		214.43

Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)
			The vegetation consists of tall, isolated shrubs of *Acacia inaequilatera, Acacia colei* and *Acacia acradenia* over *Triodia brizoides, Triodia wiseana,* and *Triodia epactia* mid hummock grassland.		
FH4	Sandy Plains	AS642022, NP002, NP04, AS450085, MSC12 MSC05	This habitat type is characterised by its red sandy loam soils with very little surface rock/pebble cover. It occurs on the valley floors as wide, linear corridors. The sandy substrate is suitable for burrowing species and in some places the spinifex hummocks are large, which can provide shelter for fauna. Availability of microhabitats in a sparse canopy, and in the groundcover of spinifex and soft substrate mean the habitat value is moderate. The vegetation consists of low *Corymbia hamersleyana* and *Acacia inaequilatera* isolated trees over *Acacia colei, Acacia ancistrocarpa,* and *Acacia bivenosa* sparse mid shrubland and *Triodia epactia, Triodia angusta* and **Cenchrus setiger* mid open hummock grassland.		11.13

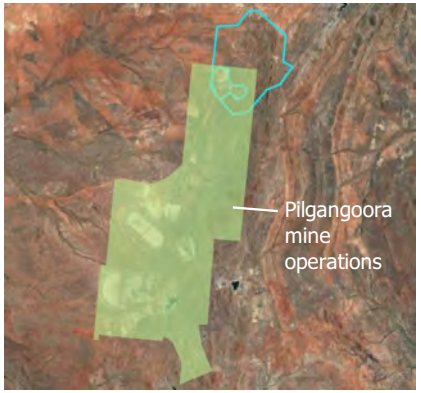
Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)
FH5	Stony Gullies	AS45007, AS642029, MSC03, MSC04, MSC06, MSC07, MSC10, MSC11, MSC14	Narrow to wide, shallow drainage lines and gullies with red, stony surfaces of quartzite and granite. Occasionally exposed rock including some rock walls, rock piles, crevices and cracks are present. Occasionally soft sandy soil in the stream beds due to deposition. Where softer soils in stream beds occur, they may be suitable for burrowing species. Occasional trees but generally of insufficient size to have hollows and no fallen hollow branches observed. This habitat may act as a wildlife corridor for birds, bats, mammals, and reptiles. The habitat value is high. The vegetation consists of isolated low trees of *Corymbia hamersleyana* over high open shrubland of *Grevillea wickhamii* subsp. *hispidula, Acacia acradenia, Acacia inaequilatera* and *Acacia colei* over scattered shrubs of *Acacia bivenosa* and *Cajanus cinereus* over open hummock grassland of *Triodia epactia, Triodia wiseana* and *Triodia angusta* over very open tussock grassland of *Eriachne mucronata* and *Cymbopogon ambiguousx.*		7.61

Habitat Code	Name	Sites	Description	Photo	Extent in Study Area (ha)
FH6	Stony Plains	AS450085, MSC12, MSC16, NP01, NP03	Gently undulating stony surfaces of quartzite or granite on red sandy loam soils. This habitat is suitable for small species that construct shelters from small stones. This habitat type contains limited microhabitats providing limited vegetation with no midstory, very few, small tree hollows, few to no logs and limited leaf litter. This habitat provides limited value to fauna and given the lack of structure and microhabitats, is considered to have a low habitat value. Low *Corymbia hamersleyana* isolated trees over, *Acacia ancistrocarpa*, *Acacia colei*, *Acacia bivenosa*, *Acacia inaequilatera* and *Grevillea wickhamii* sparse to open mid shrubland and *Triodia wiseana, Triodia epactia* and *Triodia chichesterensis* (P3) mid hummock grassland with *Alysicarpus muelleri* forbs and *Aristida holathera* tussock grasses.		65.89
D	Disturbed		Completely Degraded – cleared land including areas that have been rehabilitated but where vegetation has not yet re-established.		72.96



Legend

- FH1
- FH2
- FH3
- FH4
- FH5
- FH6
- D
- Study Area



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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Fauna Habitats

Prepared for:
Pilbara Minerals

Figure: 5-2

5.2.2 Acoustic bat recorders

The recording dataset comprised a total of 51 recording nights from four bat detector units.

Acoustic processing of the bat detector recordings was conducted separately for each of Ghost bat Pilbara leaf-nosed bat and Northern leaf-nosed bat using methods optimised for the detection of their unique echolocation call types.

Five call sequences of the Pilbara leaf-nosed bat were detected and are listed in Table 5-3.

Table 5-3. Acoustic recording results

Species	Detector serial #	Date	Time (hh:mm:ss)
Pilbara leaf-nosed bat	450007	14-08-2022	00:06:38
Pilbara leaf-nosed bat	450007	17-08-2022	00:39:22
Pilbara leaf-nosed bat	450085	21-08-2022	21:20:51
Pilbara leaf-nosed bat	642029	15-08-2022	21:28:01
Pilbara leaf-nosed bat	642029	16-08-2022	22:33:42

All call sequences of the Pilbara leaf-nosed bat were recorded well after sunset and therefore when the individual was out foraging away from a diurnal roost.

No calls of the Ghost bat were observed in the recordings.

No calls of the Northern leaf-nosed bat were detected.

5.2.3 Motion triggered cameras

Motion-triggered cameras returned 62 captures of individuals, where records from the same species were separated by more than one hour. The complete list of captures is included in Appendix H. The sub-sections below discuss captures in two groups, target significant species and incidental records.

5.2.3.1 Target significant species

Targeted significant species comprised two individuals. These were one Northern quoll at MSC01 and one at MSC09. The MSC09 capture was just of the tail. Images from these two captures are shown in Plate 5-1 and Plate 5-2.

Plate 5-1. Northern quoll captured on MSC01

Plate 5-2. Northern quoll captured by MSC09 (tail only)

5.2.3.2 Incidental records

Non-target captures returned a diversity of species, including Introduced fauna. Table 5-4 lists the incidental records from the motion-triggered cameras.

Table 5-4. Non-target captures

Common name	Species name	Number of captures
	Birds	
Bush Stone-curlew	*Burhinus grallarius*	1
Common Bronzewing	*Phaps chalcoptera*	2
Crested Pigeon	*Ocyphaps lophotes*	1
Diamond Dove	*Geopelia cuneata*	1
Magpie-lark	*Grallina cyanoleuca*	3
Painted Finch	*Emblema pictum*	1
Red-capped Plover	*Charadrius ruficapillus*	2
Singing Honeyeater	*Gavicalis virescens*	1
Spinifex Pigeon	*Geophaps plumifera*	4
Stubble Quail	*Coturnix pectoralis*	5
Willie Wagtail	*Rhipidura leucophrys*	1
Yellow-throated Miner	*Manorina flavigula*	1
Zebra Finch	*Taeniopygia castanotis*	1
	Mammals	
Common Rock-rat	*Zyzomys argurus*	10
Cattle	*Bos taurus*	5
Dingo	*Canis familiaris dingo*	2
Euro	*Osphranter robustus*	3
Fat-tailed Pseudantechinus	*Pseudantechinus macdonnellensis*	3
	Reptiles	
Coarse Sands Ctenotus	*Ctenotus piankai*	3
Lined Fire-Tailed Skink	*Morethia ruficauda*	2
Panther Skink	*Ctenotus pantherinus*	1
Perentie	*Varanus giganteus*	2
Northern Pilbara Rock Goanna	*Varanus pilbarensis*	3

All captures were of good image quality and were able to be identified.

Five captures were of cattle, which is expected as the land is within Wallareenya and Strelly Stations and pastoralism is the active land use within all the surveyed areas. No other introduced fauna were captured.

Two bird species, the Red-capped plover and Stubble quail have not previously been recorded for the Pilgangoora Project.

5.2.4 Acoustic bird recording devices

No Night parrot calls were recorded in the 56 hours of assessed recordings.

5.2.5 Traverses

During traverses, the following fauna signs were identified:

- Three Northern quoll scats; and
- 11 Western pebble mouse mounds (four active, four intermediate and three inactive).

No signs of Greater bilby, Night parrot, Brush-tailed mulgara, Spectacled hare-wallaby or Long-tailed dunnart were observed.

No T bird species were observed.

Notes were taken on habitat quality, disturbances, and the availability/unavailability of habitat micro-niches.

5.2.6 Conservation Significant Fauna

5.2.6.1 Northern Quoll

In the Pilbara region, the species tends to prefer the Rocklea, Macroy and Robe land systems (Biota Environmental Services 2008). These land systems are comprised of basalt hills, mesas (and buttes of limonites), high and low plateaux, lower slopes, occasional tor fields and stony plains supporting either hard or soft spinifex grasslands (van Vreeswyk *et al*. 2004).

The Northern quoll has also been recorded in other land systems which are comprised of sandstone and dolomite hills and ridges, shrublands, sandy plains, clay plans and tussock grasslands and coastal fringes including dunes, islands and beaches (Biota Environmental Services 2008).

This species has been located on several occasions within the Lynas Find Study Area and south into the Pilgangoora project area (DBCA Database record, Ecologia Environmental 2018; Terrestrial Ecosystems 2020). Locally this species seems to be most encountered in the boulder hill tops (FH1) of the north/south tending ridgeline running along the eastern half of the Study Area. This is the most rugged landform in the Study Area, at the highest elevations. Boulders on the ridge tops form a mosaic of cracks and crevices large enough to provide denning habitat for the quoll. Two camera records and three quoll scats were recorded in this area in the present study. Ecologia Environmental (2018) recorded 5 scats and Terrestrial Ecosystems (2020) made captures on 12 cameras within this habitat type.

The lithology of the other lower hills and breakaways in the remainder of the Study Area differs significantly. These schists are more plate like and provide no denning opportunity. Trees within the Study Area were generally small and did not provide hollows for denning opportunities. No quoll scats were recorded in gullies.

Foraging or dispersal habitat is recognised to be any land comprising predominantly native vegetation in the immediate area (*i.e.* within 1 km) of shelter habitat, quoll records or land comprising predominately native vegetation that is connected to shelter habitat within the range of the species (CoA 2016).

Habitat critical to the survival of the Northern quoll and populations important for the long-term survival of the Northern quoll are defined in CoA (2016). The Northern quoll within FH1 are a population important for the long-term survival of the Northern quoll as it is a population occurring in habitat that

is free of cane toads and unlikely to support cane toads upon arrival *i.e.* granite habitats in WA, populations surrounded by desert and without permanent water.

Habitat critical to the survival of the Northern quoll is present in the Study Area and includes:

- habitat FH1;
- areas of native vegetation within 1 km of FH1; and
- dispersal and foraging habitat associated with or connecting the population within FH1 to other nearby populations or foraging habitats.

The FH1 habitat is contained within the A-KEe-xmws-mus; Euro Basalt; Mafic and ultramafic schists geological unit (Geological Survey of Western Australia 2014). Examination of aerial imagery in conjunction with the geological units indicates that the best local denning and foraging habitats would be within this unit, based upon the expectation of denning suitable outcrops occurring within the same geological formation.

Within the Study Area, creek lines are small, fast flowing and have only sporadic small trees of *Corymbia hamersleyana*. These provide little to no denning and foraging opportunities as no standing or fallen hollow logs are available and very sparse litter is present. No quoll records or signs were recorded in the creeks. Whilst in other environs creek lines would be a dispersal and foraging habitat for northern quoll, in the Study Area this habitat type does not appear to be frequented by the species.

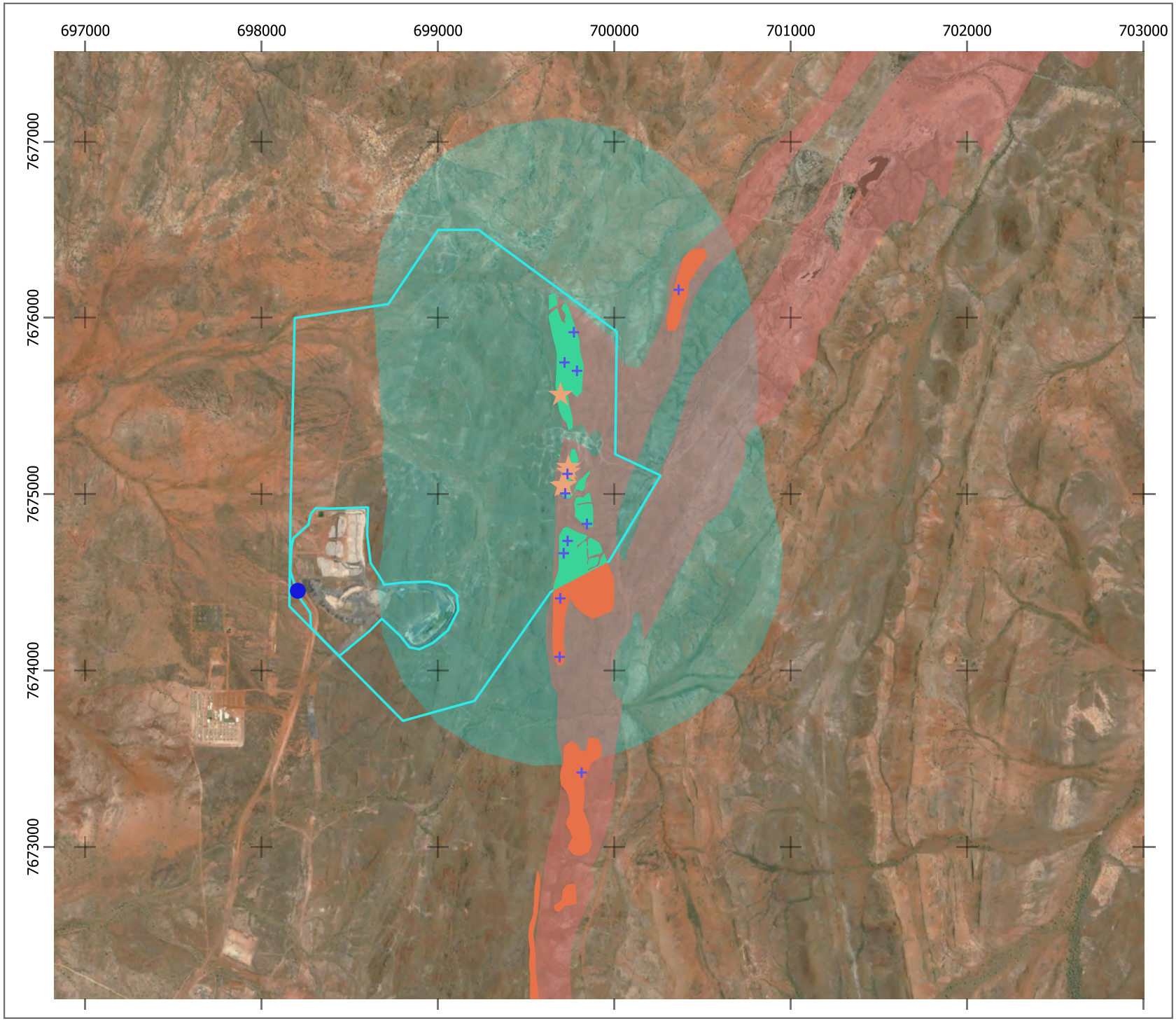
All habitats occurring within the Study Area may be utilised by the species, at some time, to forage and or during dispersal activities; however, their significance to the species will vary depending on resource availability and connectivity. An opportunistic sighting of northern quoll was made in 2018 within the Study Area near to the entrance of the active mining area, demonstrating the species moves reasonable distances from the core shelter habitat, including into disturbed areas. Open surface water – a turkey's nest constructed for the mining operations - is currently present near to the location of sighting. It is not known whether the surface water was present at the time of the quoll sighting but if so, the open water may attract the quoll searching for food and water.

Foraging habitat within the Study Area is likely to vary depending on resource availability, which may be seasonally dependant.

Figure 5-3 shows the location of Northern quoll records, F1 habitat, areas within 1km of the FH1 habitat and the A-KEe-xmws-mus geological unit.

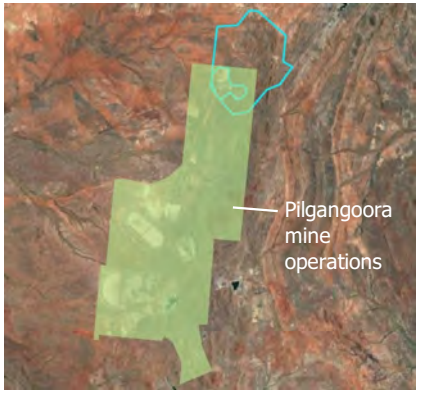
Three quoll scats were recorded during the traverses, within 30 to 113 m south of camera MSC01 (the southern of the two camera records). Quoll scat locations are (GDA 1994, MGA Zone 50):

- 699741, 7675127;
- 699703, 7675048; and
- 699719, 7675052.



Legend

- Camera captures and scat locations - present study
- Camera captures Terrestrial Ecosystems (2020)
- Database record (2018)
- FH1 - Critical Habitat
- Rocky Hills Habitat identified by Terrestrial Ecosystems (2020) outside of Lynas Find Study Area
- A-KEe-xmws-mus Geological unit -likely dispersal habitat
- 1 km critical habitat buffer
- Study Area



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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Northern Quoll

Prepared for:
Pilbara Minerals

Figure: 5-3

5.2.6.2 Ghost Bat

A recent review of Ghost bat (Bat Call WA 2021a) updates the knowledge base on ecology, threats, and survey requirements for the species.

Ghost bats move between a number of caves seasonally or as dictated by weather conditions and/or foraging opportunities, so they require a range of cave sites (Richards *et al*. 2008). They disperse widely when not breeding but may concentrate in relatively few roost sites when breeding. In the Pilbara, except for the large, abandoned mine colonies, Ghost bats are often present either singly or in small groups (usually less than 15). These have been shown to move periodically, either seasonally or as dictated by prey availability. Their vagrant foraging strategy relates to patchy, locally unreliable rainfall events (and prey biomass) across much of its foraging habitat in the Pilbara and elsewhere in other semi-arid parts of its broader Australian range. Hence the relatively small groups that must move from roost to roost to access their ephemeral patchy food resource.

Extensive survey activity in the last decade has led to the proposal of 4 categories of roosting habitat used by Ghost bats in the Pilbara region (Bullen 2021):

- Category 1 maternity/diurnal roost sites with permanent Ghost bat occupancy;
- Category 2 maternity/diurnal roost caves with regular occupancy;
- Category 3 diurnal roost caves with occasional occupancy; and
- Category 4 nocturnal roost caves with opportunistic usage.

Within the Study Area there are no Category 1, 2 or 3 sites/caves available to this species. The largest crevices/fissures located within the Study Area would not provide the required temperature and humidity regulation or any security from predators, such as cats. At best, the FH1 habitat may provide Category 4 nocturnal roost caves with opportunistic usage.

Numerous observations suggest that most shallow caves, shelters and deep overhangs in the Pilbara are used in at least an opportunistic manner by itinerant Ghost bats. This may be anything from a single foraging visit to a longer visit, with a resting period or possibly a feeding session. Evidence of such visits is the widespread presence of small numbers of scats and/or food scraps found, or occasional echolocation calls recorded during surveys. These visits may or may not be repeated, depending on whether the bat is passing through a district or is a more permanent resident nearby. These are not considered critical habitat.

In the Pilbara, Ghost bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (Triodia spp.) on sand or stony ground. Isolated trees and trees on the edge of thin thickets on the plains, or trees along the edges of watercourse woodlands, appear to be preferred vantage points (Bullen unpublished data). In the Study Area there are scattered *Corymbia hamersleyana* trees available for perching.

No Ghost bats were recorded during the acoustic survey, however acoustic recorders are not suited to Ghost bat detection as the species seldom uses its echolocation away from caves. Visual inspection of the FH1 habitat was made and no scats or food scraps were recorded.

The Ghost bat is listed in the PMST as known to occur within the local area and the DBCA database has records for the species within a 30 km radius. Ghost bats are known to travel up to 15 km from a roost

site for foraging and up to 30 km in one night to alternative roosting sites, indicating the Study Area may be within range of Category 1, 2 or 3 habitat.

It is possible that the Study Area offers foraging habitat to Ghost bat across all habitats and Category 4 nocturnal roosts in habitat FH1.

5.2.6.3 Pilbara Leaf-Nosed Bat

A recent review of Pilbara leaf-nosed bat (Bat Call WA 2022) updates the knowledge base on ecology, threats, and survey requirements for the species. It is generally encountered in rocky areas that provide opportunity for roosting, in particular the ironstone Hamersley Range, the ridgelines granite boulder piles and disused mines of the eastern Pilbara, and also along medium and major drainage lines that radiate away from rocky uplands.

Pilbara leaf-nosed bat roost during the day beyond the twilight zone in caves and underground mines with stable, warm and humid microclimates because of its poor ability to maintain its heat and water balance (Kulzer *et al*. 1970; Churchill *et al*. 1988; Jolly 1988; Churchill 1991; Baudinette *et al*. 2000; Armstrong 2001). There is a possibility that some roosts exist in the deeper spaces amongst granite tor rockpiles in the eastern Pilbara, (Armstrong and Anstee 2000; Armstrong 2001) although recent survey work is yet to identify any (Bat Call WA 2022). The Pilbara leaf-nosed bat does not roost in overhangs (shallow structures where the rear wall can be observed from the entrance), as these do not support warm, humid microclimates (TSSC, 2016). A suggestion that this species becomes 'forest dwelling' in the wet season of the monsoonal northern areas (Churchill 1991, 1995) has not been supported, and is very unlikely in the Pilbara region (Armstrong 2001).

Roosts have been categorised according to importance to the survival of the species into four categories (TSSC 2016):

- Category 1 - Permanent diurnal maternity roosts where seasonal presence of young is proven;
- Category 2 - Permanent diurnal roosts where presence of young is unproven;
- Category 3 - Semi-permanent diurnal roosts; and
- Category 4 - Nocturnal refuge.

The Pilbara leaf-nosed bat was recorded locally during Targeted survey for individuals and roosts for the Pilgangoora project. A Category 1 or 2 roost was located, and high-quality foraging habitat was identified at a major water body in an abandoned open cut pit. The roost site is 2.2 km from the Study Area to the north-northeast and the foraging habitat is 1.7 km to the northeast and are shown in Figure 5-4. An estimate of the number of Pilbara leaf-nosed bat at the roost based on ultrasonic calls and video counts ranged between 25-50. There are additional known permanent diurnal category 1 or 2 Pilbara leaf-nosed bat roosts approximately 20 km to the southwest and southeast of the Study Area (Bat Call WA 2022).

Generally, the Pilbara leaf-nosed bat is most encountered within 20 km of its permanent diurnal roosts (Bullen 2013), but in the months where climatic conditions are least challenging for the species (April-May) they have been recorded further afield (Bat Call WA 2022). Echolocation based records indicate that it can complete round trips of 50 km or longer in a night under favourable conditions (Bat Call WA 2022).

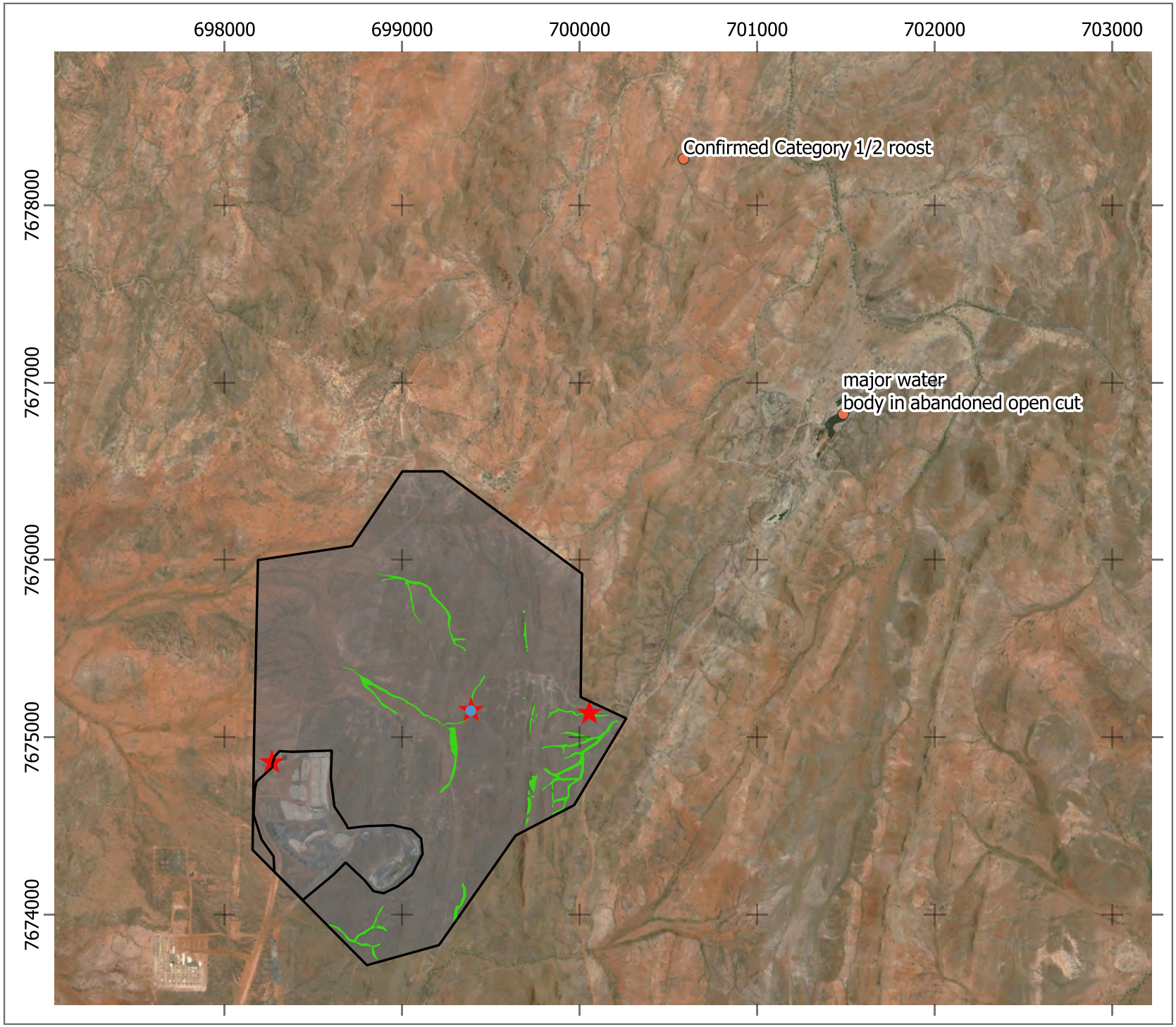
The Study Area does not contain any roosts described as Category 1, 2, 3 or 4. The FH1 habitat offers only shallow overhangs, therefore no roosting habitat is available. The Study Area is within range of three Category 1/2 roosts.

The Pilbara leaf-nosed bat was recorded using acoustic recorders within the site during the Pilgangoora Targeted survey and again in the present study. In August 2022 the Pilbara leaf-nosed bat was recorded on four occasions in stony gullies and one occasion in the stony plains. The stony plains location was near to some open surface water created through the construction of a turkey's nest and associated drainage channels. All call sequences of the Pilbara leaf-nosed bat were recorded well after sunset and therefore when the individual was out foraging away from a diurnal roost (Appendix E).

Habitat types found in the Pilbara have been scaled and a foraging habitat rating applied (Bat Call WA 2022). Plains and low hill habitats in the Study Area conform to the description of *Open plain with one layer of vegetation structure (excluding scattered trees).* These are of low habitat rating. Pilbara leaf-nosed bat are unlikely to forage in the plains and low hills of the Study Area but may traverse while crossing to more productive areas.

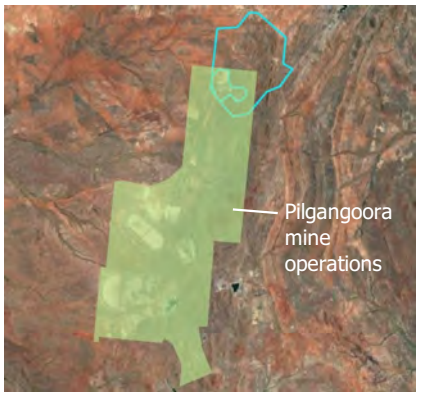
The FH1 and FH5 habitats fall within the description *Mesa side or long ridge line with deeply incised gullies in weathered strata (45° sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby.* These are of moderate habitat rating (Bat Call WA 2022). Pilbara leaf-nosed bat may occasionally forage in these areas due to presence of suitable vegetation, seasonal water and may also use areas as a flyway.

The recorded locations of the Pilbara leaf-nosed bat are consistent with the habitat rating. The FH1 and FH5 habitats are of moderate quality and the remaining habitats are of low quality. Man-made open water such as the turkey's nest may attract suitable prey and therefore attract Pilbara leaf-nosed bat.



Legend

- Acoustic recordings of Pilbara Leaf-nosed Bat
- Moderate habitat rating
- Low habitat rating
- Database record from previous Targeted Survey



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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Pilbara Leaf-nosed Bat

Prepared for:
Pilbara Minerals

Figure: 5-4

5.2.6.4 Grey Falcon

The Grey falcon occurs in most of the drier parts of Australia (Schoenjahn 2018). Its distribution is centred on inland drainage systems where there is an average annual rainfall of less than 500 mm. Its main habitat is timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined watercourses. It generally occurs at low densities across inland Australia (BirdLife International 2019).

The Grey falcon hunts far out into tussock grassland and open woodland. It nests in old nests made by other birds, usually nests in the tallest trees along watercourses, particularly river red gum (TSSC 2020). Prey species include doves, pigeons, small parrots and cockatoos, and finches, but a variety of other bird prey species has been recorded, as well as mammals and lizards (TSSC 2020).

Local records are centred on the Turner River. At its closest point, the Turner River is 23 km from the Study Area. The plains habitat in the Study Area is suitable foraging habitat for this species, and within range of the population likely to be nesting in the Turner River riparian zone. No nesting habitat is present in the Study Area.

5.2.6.5 Night Parrot

The Study Area is within the area where Night parrot are modelled as *may occur*. Very limited information is available on the Night parrot, however some information on habitat characteristics where the species has persisted is available.

DBCA (2017) summarises habitat characteristics. Night parrot roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex (*Triodia*) clumps, but sometimes other vegetation types. Often the vegetation in these habitats will be naturally fragmented and therefore well protected from fire. Little is known about foraging sites, but favoured sites are likely to vary across the range of the species. In Queensland, Night parrots have been shown to feed in areas rich in herbs including forbs, grasses and grass-like plants, and it is likely that such areas may also be important in WA. *Triodia* is likely also to provide a good food resource for Night parrots, in times of mass flowering and seeding, but they also rely heavily on a range of other food species. *Sclerolaena* has been shown to be a source of food and moisture.

The species and growth pattern of the spinifex in the FH6 habitat in the Study Area may be suitable for the Night parrot. There are no samphire or chenopod habitats proximal to the Study Area, therefore foraging habitats are limited locally, however Night parrots have been known to fly up to 40 km or more in a night during foraging expeditions, so foraging habitat is not necessarily within or adjacent to roosting areas.

An interim guideline for preliminary surveys of Night parrot in Western Australia (DPAW 2017) identifies when and where Night parrot surveys may be required. The Study Area is on the northwestern edge of the area classed as a high priority for survey. Due to the inclusion of the site in the high priority survey area and the presence of suitable spinifex habitat passive acoustic survey was conducted at locations where the best spinifex habitat was found. Four devices were deployed for a total of 16 trap nights. No Night parrot calls were recorded.

Foot traverses through the plains habitat where the largest and oldest hummock grasses occur did not encounter any signs of individuals of Night parrot.

While the habitat is potentially suitable, there are no historic records of Night parrot in the area and very few records of extant individuals. While it remains possible that the species could colonise in the future there is no evidence that they are currently present.

5.2.6.6 Greater Bilby

Extant populations of the bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (typically sandy for burrow excavation). It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990). Laterite and rock feature substrates are an important part of Greater bilby habitat, which support shrub species such as Acacia, and Spinifex hummocks which are quite uniform and discrete, providing runways between hummocks, enabling easier movement and foraging (Southgate *et al.* 2007).

The Study Area is within the area where the species is listed in the PMST as known to occur. Database results returned 334 records within a 50 km radius of the Study Area, the closest being one record to the east of Pilgangoora made in 1979. The high number of records are due to monitoring (transect) surveys in association with the construction of rail corridors that pass the Study Area to the west.

Suitable habitat occurs in the Study Area across the sandy plains, stony plains and low hills habitats (FH3, FH4 and FH6). Extensive foot transects were walked across these habitats at 10-20 m intervals. No burrows were located, and no tracks or other traces were recorded. It is unlikely the species is currently present.

This species has the potential to occupy the Study Area in the future as bilbies can be relatively transient across their distribution. However, no historical burrows were observed suggesting they have not occupied the area in recent times.

5.2.6.7 Western Pebble Mound Mouse

The Western pebble-mound mouse is endemic to the Pilbara where it is found on stony hillsides with hummock grassland (Menkhorst and Knight, 2010). This species builds pebble mounds from small stones, which typically cover areas from 0.5-9.0 m^2. The mounds are characteristic of the species. Pebble mounds are restricted to areas with suitable class stones and are usually found on gentle slopes and spurs that are often vegetated by hard spinifex (Ford and Johnson 2007; Van Dyck and Strahan 2008). Active mounds are characterised by the conical shape of the mound with clear, distinct entrance holes (Anstee 1996). Mounds are often sited close to narrow ribbons of Acacia dominated scrub that grow along incised drainage lines (Van Dyck and Strahan 2008).

Targeted searches were performed using foot transects in suitable habitat. Eleven active and inactive mounds were recorded. The status of mounds was assessed according to the method published in Anstee (1996). The Anstee (1996) index is most accurate at predicting the status of mounds with very high (classed as active) or very low (classed as inactive) scores. Mounds with intermediate activity could be either active or inactive, depending on whether they are in the process of being activated or degrading following abandonment. Mound locations and status are listed in Table 5-5.

Table 5-5. Western Pebble-mound Mouse mound status and location

Status	Location (GDA 1994; MGA zone 50)
Active	699553, 7676033
Active	699477, 7676125
Active	699489, 7675818
Active	698929, 7675803
Intermediate	699126, 7676089
Intermediate	698970, 7676056
Intermediate	698995, 7676300
Intermediate	698874, 7675599
Inactive	699073, 7676012
Inactive	699424, 7676228
Inactive	699359, 7676249

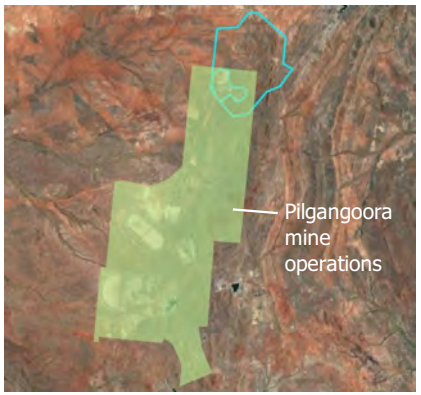
Legend

Pebble Mound status

- Active
- Inactive
- Intermediate
- Transect

Fauna Habitats

- FH3
- FH6



Scale: @ A4
1: 20,000

0 200 400 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Western Pebble-mound Mouse

Prepared for:
Pilbara Minerals

Figure: 5-5

5.2.6.8 Brush-tailed Mulgara

Brush-tailed mulgara is widespread, but patchily distributed in sandy regions of arid central Australia and WA. It inhabits hummock grass plains, sand ridges, and mulga shrubland on loamy soils (Menkhorst and Knight, 2010). It uses the open space between vegetation, a microhabitat that is known to support important prey species and may forage in termite mounds (Molyneux *et al*. 2018).

The Brush-tailed mulgara constructs burrows or utilises those of other species. Burrows may provide access to prey items, protection from predators and have thermoregulation benefits (Molyneux *et al*. 2018).

Local records are to the west of the Study Area with the closest records 15 km to the southwest. Records originate from biological surveys assessing the impact of rail lines servicing the Pilbara region.

Suitable habitat in the Study Area includes Sandy Plain and some areas of Stony Plain, however the preferred sand dune habitat is not present.

Targeted searches were conducted in suitable habitat for signs (tracks and burrow entrances) of the Mulgara but none were detected. Based on somewhat limited habitat, the Mulgara is considered as Possibly occurring in the Study Area.

5.2.6.9 Spectacled Hare-wallaby (mainland)

The Spectacled hare-wallaby inhabits tropical tussock or hummock grassland with mid-dense or sparse tree and shrub cover (Menkhorst and Knight, 2010). In the Pilbara this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grassland has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008).

There are many local records, including within the FH3 habitat of the Study Area and in the surrounding plains habitats to the west. These records are from the early 1990's.

No signs or records of spectacled hare-wallaby were made in the Study Area, despite targeted searches for individuals or signs (*e.g*. scats), motion triggered camera deployment and spotlighting. The species was not recorded during the detailed and reconnaissance fauna surveys for the Pilgangoora Project. The absence of the species is likely a consequence of the broader regional decline.

The presence of suitable habitat and the historic records indicate it is possible for the species to occur. Whilst it has been recorded in the FH3 habitat historically, the largest hummock grasses presenting the highest quality habitat for the species, is currently found in the Sandy Plains (FH4) habitat.

5.2.6.10 Long-tailed Dunnart

The Long-tailed dunnart is a specialist rock dwelling species (Freeland *et al*. 1988). It prefers exposed rock and stony soils with hummock grasses and shrubs, on flat-topped hills, lateritic plateaus, sandstone ranges and breakaways. All sites it is known to frequent are within rugged rocky landscapes that support a low open woodland or shrubland of Acacias (especially Mulga) with an understorey of spinifex hummocks and (occasionally) also perennial grasses and cassias.

Local records occur at two sites approximately 25 km south east and south west of the Study Area. The FH1 habitat is suitable for the Long-tailed dunnart and the species possibly occurs.

5.2.6.11 Pin-striped Finesnout Ctenotus

The Pin-striped finesnout ctenotus has been found on spinifex plains on granitic soils near watercourses (Wilson and Swan 2013). Record locations are near to granite outcrops in the hilly interior of the Pilbara. Very little information is available for the species. It is possible that the FH1 and FH5 habitats are suitable for the species. Local records are remote and are in association with a larger watercourse than are present in the Study Area. It is possible that the species occurs within the Study Area.

6 CONCLUSIONS

6.1 FLORA

The flora and vegetation survey recorded a total of 113 taxa within the Study Area which is comparable to the number of taxa recorded in other previous local surveys: 195 taxa (101 genera and 39 families) recorded by MMWC Environmental (2016) at the Pilgangoora Project, and 122 taxa (67 genera and 38 families) recorded by Outback Ecology (2009) at Wodgina. The current Study Area is smaller than these other local surveys and contains fewer landforms, therefore the lower diversity would be expected.

The flora and vegetation of the Study Area is generally typical of the Pilbara, and of the adjacent lands surrounding the Study Area.

6.2 FLORA OF CONSERVATION SIGNIFICANCE

No Threatened flora was recorded in the Study Area. One Threatened flora species was returned from the database searches, *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar). The species is listed as Endangered under the EPBC Act and Threatened under the BC Act. Preferred habitat is steep, rocky, sandstone conglomerate and granite slopes in skeletal, brown, sandy loam soils of the Capricorn Land System. The Study Area is not within the Capricorn Land System (Figure 2-3), however granite outcropping is present in vegetation type 10a, and a targeted search was undertaken in this vegetation type. *Quoya zonalis* is a distinctive soft, grey, woody, perennial shrub to approximately 1.5 m in height, making it easily detectable and recognisable during targeted search. No records were made.

Two P3 species were recorded. *Triodia chichesterensis* was frequently recorded and no count of individuals was made, due to the high frequency and abundance of the species presence. It is a sub-dominant of the ground cover in four vegetation types - 8a, 9a, 10a and 11b at up to 15% cover, but more commonly at or below 5% cover. *Rothia indica* subsp. *australis* was recorded in two locations as one individual at each location. One location is within the 10a habitat and the other within the 11b habitat. As the species is small and the Study Area containing these vegetation types comparatively large, it is likely there are other individuals within these habitat types.

An additional P3 species was recorded in the local area during the MMWC Environmental (2016) survey but was not recorded in the current survey. Targeted searches were performed and no *Euploca mutica* (formerly *Heliotropium muticum*) were recorded. Seasonal conditions were suitable at the time of survey and the survey was conducted within the known flowering period; therefore, the species absence is determined with a high level of certainty.

Of the 12 Priority species returned from the DBCA database searches, one was assessed as present due to a historic record, and six were considered Possible to occur based on suitable habitat present and previous records from between 15 – 50 km of the Study Area. Of these species, seven are annuals: *Euphorbia clementii* (P3), *Eragrostis crateriformis* (P3), *Gomphrena leptophylla* (P3), *Nicotiana umbratica* (P3) *Bulbostylis burbidgeae* (P4), *Themeda* sp. Panorama (J. Nelson *et al.* NS 102) and *Goodenia nuda* (P4). Given the rainfall in the three months prior to the survey conducted in August 2022 was above average, these annual species are likely to have been present at the time of survey, should they occur in the area. It should be noted that most of that rainfall was received in May 2022 with the survey conducted in August 2022. This length of time may be a factor in absence of the species.

The remaining species considered Possible to occur is perennial and, as such, it can be expected these species would be present, should they occur in the area. The survey was thorough, and it is probable these species would have been recorded should they occur in the area. Given they were not recorded, the likelihood of these species occurring within the Study Area is considered Possible, not Likely.

6.3 INTRODUCED FLORA

No weeds Declared under the BAM Act or classed as a WoNS were recorded in the Study Area. Three weeds were recorded, two species of agricultural grasses in the genus *Cenchrus* and the environmental weed Kapok. *Cenchrus* grasses are valued by pastoralists and as the underlying land use is pastoralism it is not unexpected to record these weedy grasses. Whilst not being attributed any formal classification under weed management legislation, *Cenchrus* grasses are known to adversely alter fire regimes, which is a threatening process for some Threatened fauna in the region.

6.4 VEGETATION OF CONSERVATION SIGNIFICANCE

There are no recognised TECs, PECs or ESAs located within or adjacent to the Study Area.

None of the vegetation types described for the Study Area are analogous to any known TECs, PECs or ESAs. The nearest record of a TEC or PEC to the Study Area is the Gregory Land System (P3 PEC), approximately 50 km away from the Study Area.

The Chichester subregion includes seven Ecosystems at Risk which are subject to a range of threatening processes (Kendrick and McKenzie 2001). None of these ecosystems are relevant to the Study Area.

No species known to be reliant on groundwater were recorded and therefore no Groundwater Dependent Ecosystems occur in the Study Area.

Regional Vegetation Associations within the Study Area as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the Study Area are of 'Least Concern'.

6.5 FAUNA OF CONSERVATION SIGNIFICANCE

The survey identified:

- A population important for the long-term survival of the Northern quoll;
- Habitat critical to the survival of the Northern quoll in three categories:
  - rocky habitat such as ranges (habitat FH1);
  - areas of native vegetation within 1 km of FH1; and
  - dispersal and foraging habitat associated with or connecting the population within FH1 to other nearby populations or foraging habitats, assumed to be defined by geological unit A-KEe-xmws-mus;
- Pilbara leaf-nosed bat is present within the Study Area but the quality of habitat is limited to Moderate value foraging over FH1 and FH5 and Low value elsewhere, with no roosting habitat present;

- Western pebble-mound mouse is present in the Study Area and Targeted Search identified mound locations. Suitable habitat was within the FH3 and FH6 habitats but was confined to the northern central section of the Study Area;
- Foraging habitat suitable for the Grey Falcon populations known to occupy the Turner River area 23 km to the west; and
- Possible habitat for the Night parrot, Greater bilby, Ghost bat, Brush-tailed mulgara, Spectacled hare-wallaby, Long-tailed dunnart and Pin-striped finesnout ctenotus but no evidence of their presence was recorded.

A feature of the Northern quoll critical habitat is the lack of surface water suitable for cane toad breeding. Cane toad are a Threatening process for northern quoll (Hill and Ward 2010). Control and monitoring of surface water within developed areas may be required to prevent future cane toad establishment within foraging and dispersal distance of northern quoll critical habitats. The Cane Toad has not yet become established in the Pilbara, however, has been infrequently recorded.

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APPENDICES

APPENDIX A: CONSERVATION AND DECLARED CATEGORIES

Appendix A: Conservation Categories for Flora, Fauna and Ecological Communities, and Categories for Introduced Flora

Conservation categories for threatened species and communities protected under Federal legislation are defined under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Environment Protection and Biodiversity Conservation Regulations 2000* are listed in Tables A.1. and A.2.

Table A.1: Categories and definitions for threatened flora and fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Conservation Category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: i) the taxa is a species of fish; ii) the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; iii) the management plan is in force under a law of the Commonwealth or of a State or Territory; and iv) Cessation of the management plan would adversely affect the conservation status of the taxa. Fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.

Table A.2: Definitions for Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999*.

Conservation Category	Definition
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

For Section 182 of the EPBC Act and 179 of the EPBC Act Threatened Ecological Communities and Native species are in the Critically Endangered, Endangered or Vulnerable category if they meet any of the criteria for the category mentioned in Table A.3:

Table A.3: Criteria for listing Threatened Species and Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Regulations 2000*

Threatened Species				
Item	**Criterion**	**Category**		
		Critically Endangered	**Endangered**	**Vulnerable**
1	It has undergone, is suspected to have undergone, or is likely to undergo in the immediate future:	A very severe reduction in numbers	A severe reduction in numbers	A substantial reduction in numbers
2	Its geographic distribution is precarious for the survival of the species and is:	Very restricted	Restricted	limited
3	The estimated total number of mature individuals is: And: (a) Evidence suggests that the number will continue to decline at: or (b) The number is likely to continue to decline and its geographic distribution is:	Very low A very high rate Precarious for its survival	Low A high rate Precarious for its survival	limited A substantial rate Precarious for its survival
4	The estimated total number of mature individuals is:	Extremely low	Very low	low
5	The probability of its extinction in the wild is at least:	50% in the immediate future	20% in the near future	10% in the medium term future
Threatened Ecological Communities				
Item	**Criterion**	**Category**		
		Critically Endangered	**Endangered**	**Vulnerable**
1	Its decline in geographic distribution is:	Very severe	Severe	substantial
2	Its geographic distribution is: And the nature of its distribution makes it likely that the action of a threating process could cause it to be lost in:	Very restricted The immediate future	restricted The near future	limited The medium term future
3	For a population of a native species that is likely to play a major role in the community, there is a: To the extent that restoration of the community is not likely to be possible in:	Very severe decline The immediate future	Severe decline The near future	Substantial decline The medium term future
4	The reduction in its integrity across most of its geographic distribution is: As indicated by degradation of the community or its habitat, or disruption of important community processes, that is:	Very severe Very severe	severe severe	substantial substantial
5	The rate of continuing detrimental change is: As indicated by	Very severe	severe	substantial

	(a) A rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is: or	Very severe	severe	serious
	(b) Intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	Very severe	severe	serious
6	A quantitative analysis shows that its probability of extinction, or extreme degradation over all its geographic distribution, is:	At least 50% in the immediate future	At least 20% in the near future	At least 10% in the medium term future

In Western Australia, the *Biodiversity Conservation Act 2016* (BC Act) provides for the statutory listing of Threatened Ecological Communities, under the categories listed in Table A.4.

Table A.4: Definitions and criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities. Department of Environment and Conservation (2013).

PD : Presumed Totally Destroyed
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or** B) All occurrences recorded within the last 50 years have since been destroyed.
CR : Critically Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
En : Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future. An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii): i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); ii) modification throughout its range is continuing such that in the short term future (within approximately

20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.
B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

VU : Vulnerable

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.
An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):
A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

In Western Australia, possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (Table A.4).

Table A.5: Definitions and criteria for Priority Ecological Communities Department of Environment and Conservation (2013).

P1: Priority One – Poorly-known ecological communities
Ecological communities that 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 agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. 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.
P2: Priority Two – Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. 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 threat from known threatening processes.
P3: Priority Three – Poorly-known ecological communities
(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four
Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5: Priority Five – Conservation dependent ecological communities
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

In Western Australia, the Wildlife Conservation (Specially Protected Fauna) Notice 2018 and the Wildlife Conservation (Rare Flora) Notice 2018 have been transitioned under regulations 170, 171 and 172 of the Biodiversity Conservation Regulations 2018 to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are listed in Table A.6.

The definition of flora includes algae, fungi and lichens. The definition of Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

Table A.6: Conservation codes for Western Australian flora and fauna under the *Biodiversity Conservation Act 2016* (DBCA 2019).

Code	Conservation Category	Definition
Threatened species		
Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the Biodiversity Conservation Act 2016 (BC Act). Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.		
CR	**Critically Endangered**	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
EN	**Endangered**	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora
VU	**Vulnerable**	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.
Extinct species		
Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.		

EX	**Extinct**	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
EW	**Extinct in the Wild**	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species		
Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.		
MI	**Migratory Species**	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
CD	**Species of special conservation interest (conservation dependent fauna)**	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
OS	**Other Specially protected species**	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Table A.7: Priority species under Western Australian *Biodiversity Conservation Act 2016*.

P1: Priority One – Poorly known taxa
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2: Priority Two – Poorly known taxa
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3: Priority Three – Poorly known taxa
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
((a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

The management of introduced species in Western Australia is regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act). The BAM Act seeks to establish a biosecurity regulatory scheme to prevent serious animal and plant pests from entering the State and becoming established, and to minimise the spread and impact of any that are already present within the State.

The list of declared pests is provided under the BAM Act. Declared animal and plant pests fall into three categories as Gazetted under the *Biosecurity and Agriculture Management Regulations 2013*. These categories are outlined in Table A.7.

Table A.8: Declared pests control categories as gazetted under the *Biosecurity and Agriculture Management Regulations 2013.*

Category	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

References

Department of Biodiversity Conservation and Attractions (2019) Conservation Codes for Western Australian Flora and Fauna. Last updated 3 January 2019. Accessed 25/04/20. https://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation%20code%20definitions.pdf

Department of Environment and Conservation (2013). Definitions, categories and criteria for threatened and priority ecological communities. Accessed 25/04/20 https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf

APPENDIX B: PMST SEARCH RESULTS

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 19-Jul-2022

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	16
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	4
Key Ecological Features (Marine):	None
Biologically Important Areas:	1
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species			[Resource Information]
Status of Conservation Dependent and Extinct are not MNES under the EPBC Act. Number is the current name ID.			
Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
MAMMAL			
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area	In feature area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macrotis lagotis			
Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhinonicteris aurantia (Pilbara form)			
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area	In feature area
PLANT			
Pityrodia sp. Marble Bar (G.Woodman & D.Coultas GWDC Opp 4)			
[88310]	Endangered	Species or species habitat known to occur within area	In buffer area only
REPTILE			
Liasis olivaceus barroni			
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Liopholis kintorei			
Great Desert Skink, Tjakura, Warrarna, Mulyamiji [83160]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Listed Migratory Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundo rustica			
Barn Swallow [662]		Species or species habitat may occur within area	In feature area
Motacilla cinerea			
Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Bubulcus ibis as Ardea ibis](#) Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Development of iron ore resources in eastern Pilbara region, including port at P	2004/1562	Not Controlled Action	Completed	In buffer area only
Sulphur Springs Copper-Zinc Mining Project, Pilbara Region, WA	2013/6899	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
Additional Rail Infrastructure	2012/6314	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Atlas Boodarie Link Project, WA	2012/6506	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Biologically Important Areas			
Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica			
Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

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

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

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

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

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APPENDIX C: DETAILED FLORA AND VEGETATION SURVEY SITES

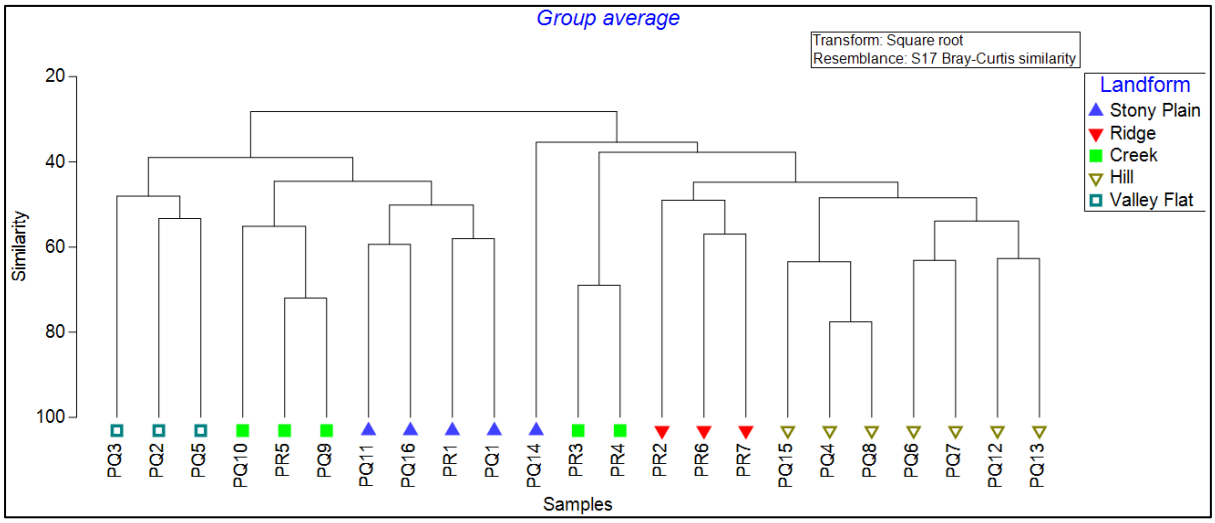
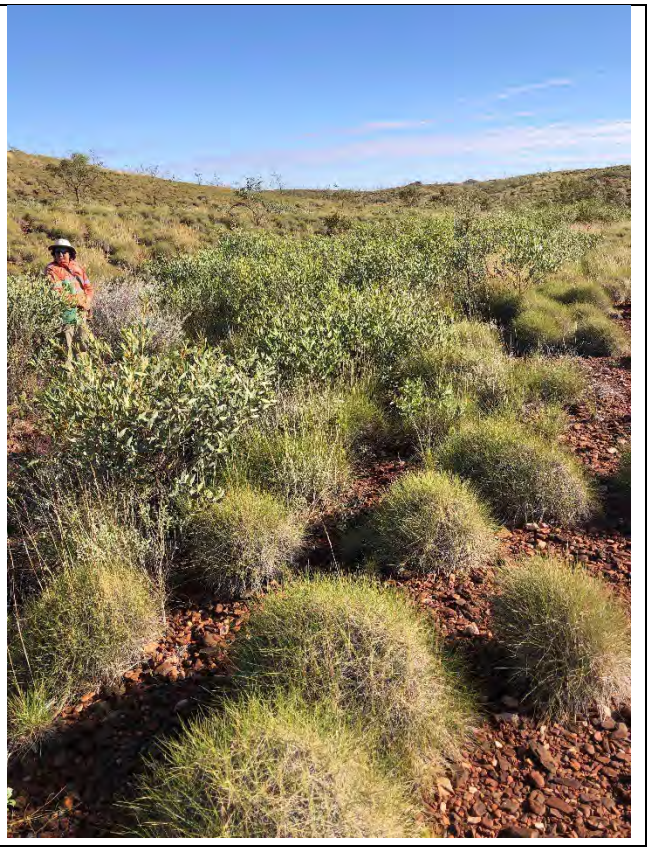


Figure C-1. Dendogram resulting from the cluster analysis of detailed vegetation sites

Job	Lynas Find - Pilgangoora		
PQ2	698562, 7675400		
Date	9/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool dry season		
Rock Type	Granite/Quartz		
Soil Type	Sandy loam		
Soil Colour	Red		
Landform	Valley Flat		
Surface Rocks Size	Rounded, 0.05 - 10 cm		
Surface Rocks Cover	10%		
Slope aspect	Very gentle slope to the west		
Vegetation Description	Low *Acacia* shrubland with *Triodia* understory		
Condition/Disturbances	Very Good. Cenchrus grasses present. Moderate grazing.		
Strata	**Cover (%)**	**Height (m)**	**Species**
Overstorey	2.5	3	*Corymbia hamersleyana*, *Acacia* spp.
Understorey	0.5	1.2	*Tephrosia* sp., *Sida* sp.
Groundstorey	10	1	*Triodia* spp.
Notes	Recent rain wash out area, soil moist		

Job	Lynas Find - Pilgangoora		
PQ3	698525, 7675786		
Date	9/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Dry season, cool		
Rock Type	Granite/Quartz		
Soil Type	Loamy sand		
Soil Colour	Red		
Landform	Valley Flat		
Surface Rocks Size	Angular, 0.1 - 10 cm		
Surface Rocks Cover	50%		
Slope aspect	Flat plain		
Vegetation Description	Low sparse *Acacia* shrubland		
Condition/Disturbances	Very Good. Cenchrus grasses present. Moderate grazing.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3.5	*Acacia pyrifolia*, *Corymbia hamersleyana*
Understorey	0.5	1.5	*Acacia* spp.
Groundstorey	25	0.7	Triodia spp.
Notes	2 km west of mine pit		
	Quadrat		

Job	Lynas Find - Pilgangoora		
PQ5	698799, 7675279		
Date	10/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Dry and cold		
Rock Type	Granite		
Soil Type	Sandy loam		
Soil Colour	Red		
Landform	Valley Flat		
Surface Rocks Size	Angular, 0.1 - 20 cm		
Surface Rocks Cover	20%		
Slope aspect	Very slight slope, draining to West		
Vegetation Description	Low open *Acacia* shrubland with occasional emergent *Corymbia hamersleyana*, *Acacia inequiterra* and understory of hummock grassland		
Condition/Disturbances	*Cenchrus ciliaris* and *C. setiger* weeds, low cover. Moderate grazing. Very Good		
	Cover (%)	**Height (m)**	**Species**
Overstorey	1	4	*A. pyrifolia*, *C. hamersleyana*
Understorey	10	1.8	*Acacia* spp.
Groundstorey	10	0.8	*Triodia* spp. (*epactia*)
Notes	Close to minim gw bore		

Job	Lynas Find - Pilgangoora		
PQ9	**699269, 7675602**		
Date	11/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	5 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite		
Soil Type	Sandy loam		
Soil Colour	Red		
Landform	First order stream, creek line (4m wide) between rocky hills		
Surface Rocks Size	Rounded/angular, 0.2 - 10 cm		
Surface Rocks Cover	40%		
Slope aspect	Very low slope to North/West		
Vegetation Description	Low open *Acacia* shrubland with emergent *Euc*		
Condition	Very good. Moderate grazing, Occasional kapok		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.5	3.5	*Corymbia hamersleyana*
Understorey	10	1.5	*Acacia colei*
Groundstorey	15	0.6	*Triodia* spp.
Notes	Quadrat, 100 x 25 m		

Job	Lynas Find - Pilgangoora		
PQ10	**698954, 7675890**		
Date	11/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite/quartz		
Soil Type	Loamy sand		
Soil Colour	Red		
Landform	Rocky small creek line with granite hills (10 m wide)		
Surface Rocks Size	Angular/rounded, 0.2 - 20 cm		
Surface Rocks Cover	40%		
Slope aspect	Very low slope to North-West		
Vegetation Description	Low open *Acacia* shrubland over hummock grassland with emergent *Corymbia*		
Condition	Very good		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.5	3.5	*Corymbia hamersleyana*
Understorey	10	1.5	*Acacia colei*
Groundstorey	20	0.6	*Triodia* sp.
Notes	Quadrat, 25 x 100 m		

Job	Lynas Find - Pilgangoora		
PR5	**699271, 7675040**		
Date	10/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Dry, cool		
Rock Type	Granite		
Soil Type	Gravelly sand		
Soil Colour	Red		
Landform	Stony dry creekline, 10 m wide		
Surface Rocks Size	Angular, 0.5 - 10 cm		
Surface Rocks Cover	60%		
Slope aspect	Creek flowing west		
Vegetation Description	Low open shrubland with some emergent *Corymbia hamersleyana*, and understory of *Triodia* sp.		
Condition	Very Good. Mod grazing.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	2	3.5	*Corymbia hamersleyana*
Understorey	10	1.2	*Acacia* spp., Fabaceae shrubs
Groundstorey	15	0.8	*Triodia* spp.
Notes	Relevé, 100 x 25 m		

Job	Lynas Find - Pilgangoora		
PR3	**700154, 7675032**		
Date	10/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Recent rain, soil moisture		
Rock Type	Granite		
Soil Type	Loamy sand		
Soil Colour	Red		
Landform	Creek line (10 m wide) on back slopes of ridges		
Surface Rocks Size	Sharply angular plates, 0.5 - 20 cm		
Surface Rocks Cover	45%		
Slope aspect	Gentle north facing		
Vegetation Description	Low *Acacia* shrubland with hummock understory		
Condition	Very Good		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3	*Acacia pyrifolia*
Understorey	0.5	1.5	Mixed shrubs
Groundstorey	10	1.2	*Triodia* hairy glumes
Notes	Relevé		

Job	Lynas Find - Pilgangoora		
PR4	700011, 7674788		
Date	10/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Recent rainfall, soil moisture		
Rock Type	Granite		
Soil Type	Loamy sand		
Soil Colour	Orange		
Landform	Creekline (10 m wide) flowing from back-slope of hill		
Surface Rocks Size	Sharp, angular, platy, 0.5 - 20 cm		
Surface Rocks Cover	50%		
Slope aspect	-		
Vegetation Description	Low *Acacia* shrubland with hummock grass understory		
Condition	Very good		
	Cover (%)	**Height (m)**	**Species**
Overstorey	1	3.5	*Corymbia hamersleyana*
Understorey	5	1.6	*Acacia* spp.
Groundstorey	30	1.2	*Triodia* sp.
Notes	Relevé		

Job	Lynas Find - Pilgangoora		
PR1	**698202, 7674383**		
Date	8/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool and dry, recent rain, soil moist		
Rock Type	Granite		
Soil Type	Loam		
Soil Colour	Red		
Landform	Flat stony plain		
Surface Rocks Size	Angular, 0.1 - 10 cm		
Surface Rocks Cover	40%		
Slope aspect	Flat		
Vegetation Description	Spinifex grassland with emergent *Acacia* shrubs		
Condition	Good. Buffel grass and moderate grazing.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	1	3	*Corymbia hamersleyana*, *Acacia pyrifolia*
Understorey	2	1.5	*Acacia* sp.
Groundstorey	10	1.2	*Triodia* sp.
Notes	Adjacent road and mine spoil pit		
	Relevé		

Job	Lynas Find - Pilgangoora		
PQ1	**698260, 7675271**		
Date	9/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Cool dry season		
Rock Type	Granite/quartz		
Soil Type	Sandy loam		
Soil Colour	Red		
Landform	Stony sandplain		
Surface Rocks Size	Rounded, 0.05 - 5 cm		
Surface Rocks Cover	30%		
Slope aspect	Flat ground		
Vegetation Description	Low open shrubland with *Triodia* understory		
Condition	Good. Moderate grazing and Buffel grass.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3.5	*Acacia pyrifolia*
Understorey	2	1.8	*Acacia* spp.
Groundstorey	30	0.8	*Triodia* spp.
Notes	Numerous drill pads nearby, close proximity to mine pit		
	Quadrat, 50 x 50 m		

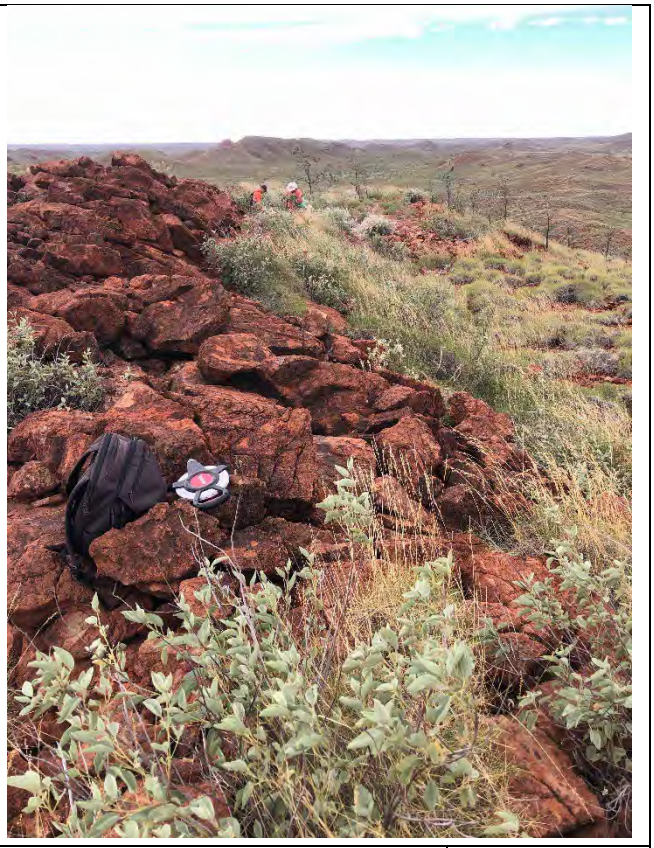
Job	Lynas Find - Pilgangoora		
PQ11	**6958881, 7676138**		
Date	11/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite		
Soil Type	Loam		
Soil Colour	Red		
Landform	Flat, open stony sandplain; water run-on area		
Surface Rocks Size	Rounded, 0.05 - 3 cm		
Surface Rocks Cover	1%		
Slope aspect	Flat plain, no slope		
Vegetation Description	Triodia hummock grassland with scattered emergent *Corymbia hamersleyana*, *Acacia inequiterra*		
Condition	Good. Cenchrus and moderate grazing.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.5	3.5	*C. hamersleyana*, *Acacia pyrifolia*
Understorey	0.5	1	*A. tumida*
Groundstorey	60	0.8	*Triodia* sp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora
PQ16	**698231, 7675047**
Date	12/08/2022
Botanist:	Neil Pettit / Danah Blache
Age since fire	3 - 4 years
Seasonal Conditions	Cool and dry
Rock Type	Granite
Soil Type	Loamy sand
Soil Colour	Red
Landform	Stony sand plain
Surface Rocks Size	Rounded/angular, 0.1 - 10 cm
Surface Rocks Cover	15%
Slope aspect	Flat plain, no slope
Vegetation Description	Open *Acacia* woodland with *Triodia* hummock grass understory
Condition	Good

	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3	*Acacia pyrifolia*, *Corymbia hamersleyana*
Understorey	2	1.5	*Acacia* spp., *Grevillea wickhamii*
Groundstorey	55	0.6	*Triodia* spp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora
PQ14	**698247, 7675418**
Date	12/08/2022
Botanist:	Neil Pettit / Danah Blache
Age since fire	>5 years
Seasonal Conditions	Cool and dry
Rock Type	Granite/Quartzite
Soil Type	Loam
Soil Colour	Red
Landform	Stony, sandplain
Surface Rocks Size	Rounded/angular, 0.05 - 15 cm
Surface Rocks Cover	15%
Slope aspect	Flat ground
Vegetation Description	Low *Acacia* shrubland with *Triodia* hummock grass understory
Condition	Good. Moderate grazing

	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3	*Acacia pyrifolia*
Understorey	15	1.6	*Acacia* sp.
Groundstorey	30	0.6	*Triodia* sp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora		
PR2	**699742, 7675131**		
Date	9/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Dry and cool, dry season with same recent rain		
Rock Type	Granite		
Soil Type	Sand		
Soil Colour	Red		
Landform	Rock hilltop ridge		
Surface Rocks Size	Angular and large, 5 - 100 cm		
Surface Rocks Cover	90%		
Slope aspect	-		
Vegetation Description	Very sparse open hummock grassland with emergent *Acacia*		
Condition	Very good. Kapok.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	2.5	*Acacia pyrifolia*
Understorey	1	0.6	Kapok bush
Groundstorey	20	0.5	*Triodia* sp.
Notes	Relevé		

Job	Lynas Find - Pilgangoora
PR6	**699724, 7676012**
Date	12/08/2022
Botanist:	Neil Pettit / Danah Blache
Age since fire	>5 years
Seasonal Conditions	Cool and dry
Rock Type	Granite
Soil Type	Sandy loam
Soil Colour	Red
Landform	Hilltop ridge of granite angular boulders
Surface Rocks Size	Angular, 5 to 80 cm
Surface Rocks Cover	100%
Slope aspect	Hilltop, all aspects surveyed
Vegetation Description	*Triodia* hummock grassland
Condition	Very good. Kapok.

	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	2	*Acacia pyrifolia*
Understorey	-	-	
Groundstorey	20	0.6	*Triodia* sp.
Notes	Relevé, 100 x 25 m		

Job	Lynas Find - Pilgangoora		
PR7	**699695, 7675688**		
Date	12/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite		
Soil Type	Sandy loam		
Soil Colour	Red		
Landform	Rocky hilltop ridge		
Surface Rocks Size	Angular, 0.5 - 100 cm		
Surface Rocks Cover	100%		
Slope aspect	Top of ridge, all aspects surveyed		
Vegetation Description	*Triodia* hummock grasslands with emergent *A. inequiterra*		
Condition	Very good. Kapok.		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	2.5	*Acacia pyrifolia*
Understorey	2	1.5	*Acacia* spp
Groundstorey	35	0.6	*Triodia* spp.
Notes	Relevé, 100 x 25 m		

Job	Lynas Find - Pilgangoora		
PQ4	**699507, 7675425**		
Date	9/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Recent rain		
Rock Type	Granite		
Soil Type	Sandy		
Soil Colour	Red		
Landform	Rocky hilltop		
Surface Rocks Size	Sharp & angular, 0.5 - 50 cm		
Surface Rocks Cover	85%		
Slope aspect	Steep slope, facing South		
Vegetation Description	Hummock grassland with occasional evergreen tall shrub		
Condition	Very good. Occasional tracks		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3.5	*Acacia pyrifolia*
Understorey	40	0.5	*Triodia* spp.
Groundstorey	-	-	-
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora		
PQ8	**699144, 7675635**		
Date	11/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite/quartz		
Soil Type	Loam		
Soil Colour	Red		
Landform	Rocky hilltop		
Surface Rocks Size	Sharp, angular		
Surface Rocks Cover	85%		
Slope aspect	Very slight slope to the North-West		
Vegetation Description	Low hummock grassland (*Triodia*) with scattered emergent *Acacia* low trees		
Condition	Very Good. Occasional tracks		
	Cover (%)	**Height (m)**	**Species**
Overstorey	1	3	*Acacia pyrifolia*
Understorey	-	-	-
Groundstorey	50	0.8	*Triodia* spp.
Notes	Quadrat, 50 x 50 m		

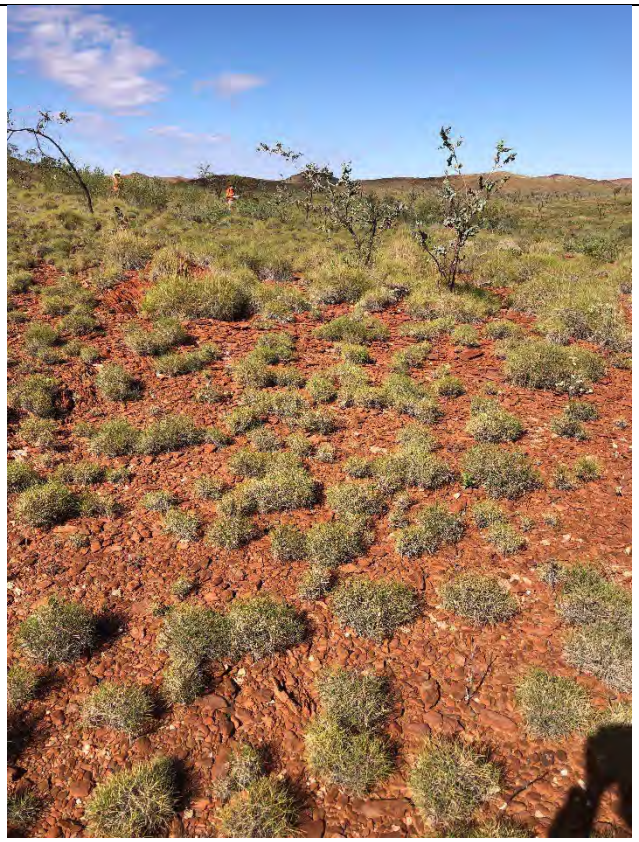
Job	Lynas Find - Pilgangoora		
PQ15	**699521, 7676016**		
Date	12/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	2 - 3 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite/Quartzite		
Soil Type	Loamy sand		
Soil Colour	Red		
Landform	Stony foot slope below hills		
Surface Rocks Size	Angular, 0.1 - 30 cm		
Surface Rocks Cover	80%		
Slope aspect	Very gentle slope to west		
Vegetation Description	*Triodia* hummock grassland with scattered *Acacia inequiterra*		
Condition	Very good. Occasional tracks		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.1	3.5	*Acacia pyrifolia*
Understorey	-	-	-
Groundstorey	60	0.6	*Triodia* spp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora
PQ6	**698994, 7674786**
Date	10/08/2022
Botanist:	Neil Pettit / Danah Blache
Age since fire	>5 years
Seasonal Conditions	Cool and dry
Rock Type	Granite/schist
Soil Type	Sandy
Soil Colour	Yellow
Landform	Rocky hilltop, West facing
Surface Rocks Size	Platy sharply angular, 0.5 - 100 cm
Surface Rocks Cover	85%
Slope aspect	West
Vegetation Description	Low hummock grassland (*Triodia*) with emergent Acacia inequiterra
Condition	Very good. Tracks

	Cover (%)	**Height (m)**	**Species**
Overstorey	1	3	*Acacia pyrifolia*
Understorey	0.5	1.5	*Acacia* sp.
Groundstorey	45	1.2	*Triodia* sp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora		
PQ7	**699197, 7674741**		
Date	10/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	3 - 4 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite/schist		
Soil Type	Sandy		
Soil Colour	Red		
Landform	Hillside slope		
Surface Rocks Size	Angular, 0.5 - 200 cm		
Surface Rocks Cover	85%		
Slope aspect	Steep stope, facing East		
Vegetation Description	Low hummock grassland (*Triodia* spp.) with emergent *Acacia inequiterra*		
Condition	Very good		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.5	3	*A. pyrifolia*
Understorey	2	1.2	*Acacia* spp.
Groundstorey	25	1	*Triodia* sp.
Notes	Survey trade through quadrat		
	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora
PQ12	**699438, 7676300**
Date	11/08/2022
Botanist:	Neil Pettit / Danah Blache
Age since fire	3 - 4 years
Seasonal Conditions	Cool and dry
Rock Type	Granite
Soil Type	Loam
Soil Colour	Red
Landform	Gravelly lower slopes of hillslope
Surface Rocks Size	Angular, 0.5 - 10 cm
Surface Rocks Cover	90%
Slope aspect	Moderate slope, facing South
Vegetation Description	Low Triodia hummock grassland with emergent *Acacia inequiterra*
Condition	Very good. Occasional tracks



	Cover (%)	**Height (m)**	**Species**
Overstorey	1	3	*A. pyrifolia*, *Corymbia hamesleyana*
Understorey	2	1.1	*A. tumida*
Groundstorey	60	1	*Triodia* sp.
Notes	Quadrat, 50 x 50 m		

Job	Lynas Find - Pilgangoora		
PQ13	**698668, 7673987**		
Date	11/08/2022		
Botanist:	Neil Pettit / Danah Blache		
Age since fire	>5 years		
Seasonal Conditions	Cool and dry		
Rock Type	Granite		
Soil Type	Loam		
Soil Colour	Red		
Landform	Rocky hillslope (upper-slope); boulder strewn on upper slope		
Surface Rocks Size	Angular, 0.5 - 50 cm		
Surface Rocks Cover	85%		
Slope aspect	Steep slope to South-West		
Vegetation Description	*Triodia* hummock grassland with emergent *Acacia*		
Condition	Very good. Occasional tracks		
	Cover (%)	**Height (m)**	**Species**
Overstorey	0.5	4	*Acacia pyrifolia*
Understorey	0.5	1.5	*Acacia tumida*
Groundstorey	60	0.8	*Triodia* spp.
Notes	Quadrat, 50 x 50 m		

APPENDIX D: FAUNA HABITAT PHOTOS

Plate 1. AS45007 (699389, 7675152)

Plate 2. AS642022 (698157, 7674859)

Plate 3. AS450085 (698266, 7674859)

Plate 4. AS450085 (698266, 7674859)

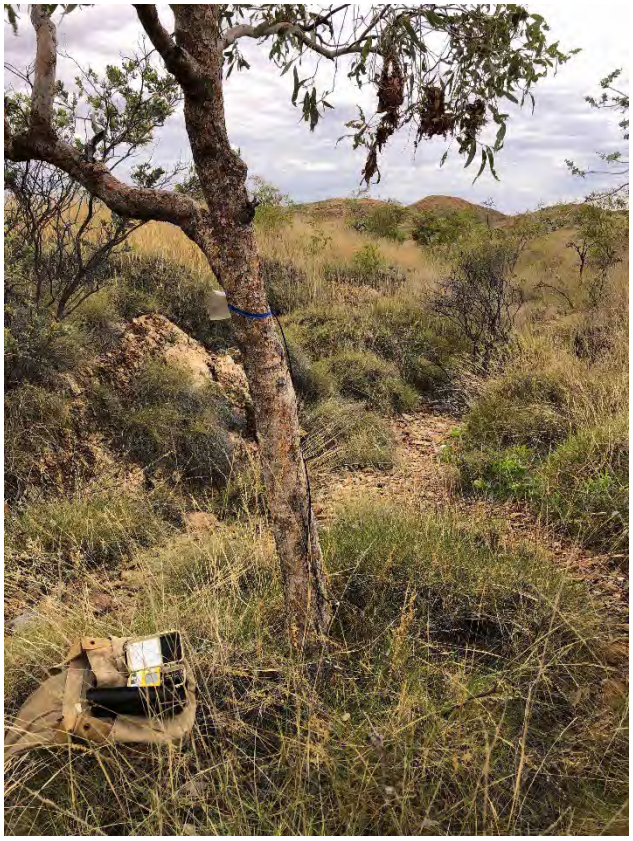


Plate 5. AS642029 (700055, 7675137)

Plate 6. MSC01 and MSC01TR (699741, 7675155)

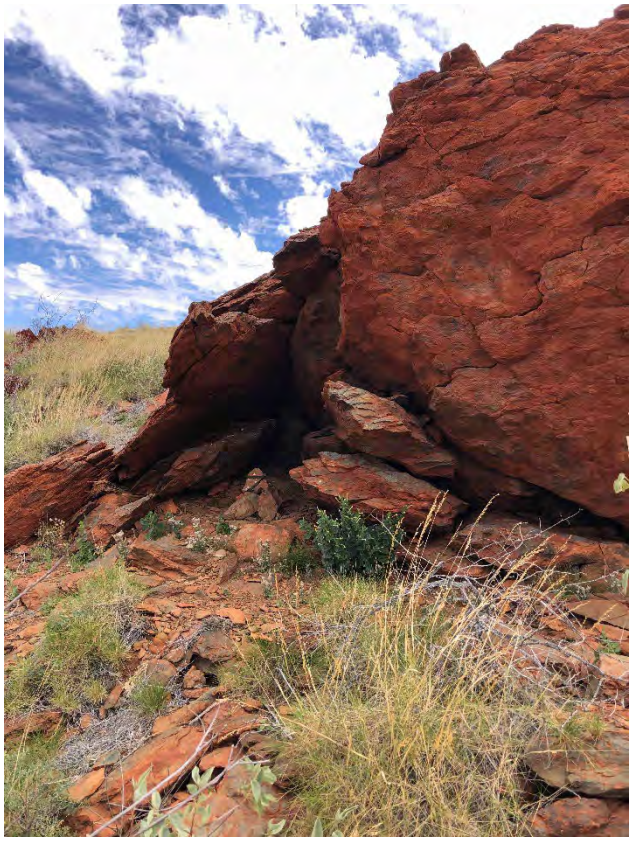


Plate 7. MSC02 (698870, 7674862)

Plate 8. MSC03 (699273, 7675040)

Plate 9. MSC04 (699387, 7675147)

Plate 10. MSC05 (698061, 7675864)

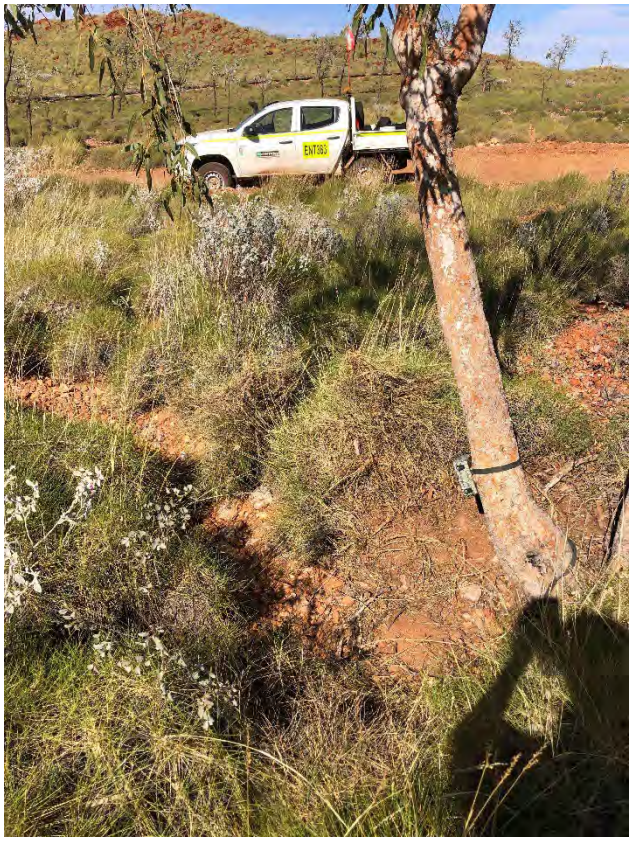


Plate 11. MSC06 (699757, 7676149)

Plate 12. MSC07 (699239, 7674711)

Plate 13. MSC08 (699681, 7675702)

Plate 14. MSC08 (699637, 7675721)

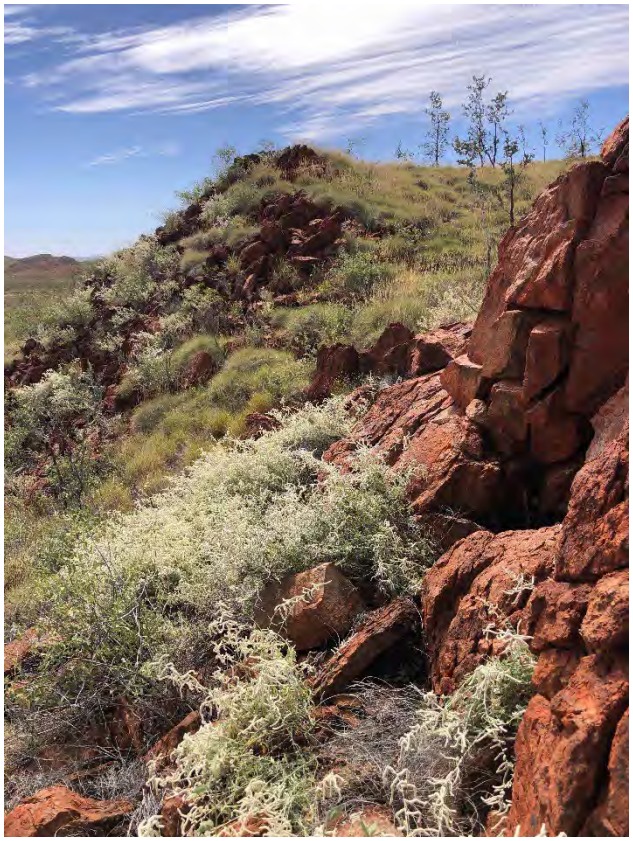


Plate 15. MSC09 (699695, 7675564)

Plate 16. MSC10 and EastCreekTR1 (699954, 7674832)

Plate 17. MSC11 and EastCreekTR2 (700056, 7675134)

Plate 18. MSC12 (698173, 7674865)

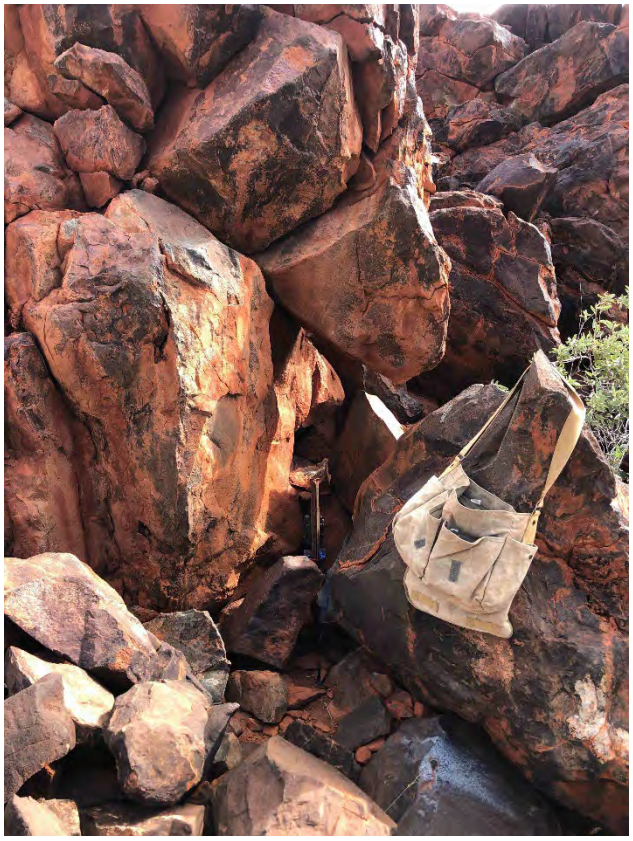


Plate 19. MSC13 (699687, 7675218)

Plate 20. MSC14 (698959, 7675233)

Plate 21. MSC15 (698961, 7675547)

Plate 22. MSC16 (698355, 7674908)

Plate 23. NP01 (698135, 7674606)

Plate 24. NP02 and NP004TR (698175, 7675211)

Plate 25. NP03 (698230, 7675941)

Plate 26. NP04 (689653, 7675944)

Plate 27. BilbyTR2 (699057, 7676233)

Plate 28. BilbyTR3 and NP003 (698413, 7675171)

Plate 29. PMoundTR1 (699104, 7675496)

Plate 30. PMoundTR2 (699087, 7675496)

Plate 31. PMoundTR3 (699032, 7676284)

Plate 32. QuollTR1 (north) (699688, 7676075)

Plate 33. QuollTR1 (south) (699833, 7674829)

Plate 34. NoQuollTR1 (699009, 7674729)

Plate 35. NoQuollTR2 (699239, 7674711)

Plate 36. NoQuollTR3 (north) (698649, 7673917)

Plate 37. NoQuollTR3 (south) (698963, 7673748)

Plate 38. SouthCreekTR1 (699898, 7673749)

Plate 39. NP001TR (698474, 7676005)

Plate 40. BilbyPMMTR1 (6699476, 7676123)

APPENDIX E: SPECIALISED ZOOLOGICAL TECHNICAL REPORT

Acoustic analysis and bat call identification from Lynas Find, Western Australia

Prepared for **Animal Plant Mineral Pty Ltd**

Version **20 October 2022**

SZ project reference **SZ627**

Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2022). Acoustic analysis and bat call identification from Lynas Find, Western Australia. Unpublished report by Specialised Zoological for Animal Plant Mineral Pty Ltd, 20 October 2022, project reference SZ627.

Summary

The outcome is provided of the analysis of acoustic (bat detector) recordings made at Lynas Find, in the Pilbara region of Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics.

The scope of the analysis was limited to the detection of the Threatened-listed Ghost Bat *Macroderma gigas* (Megadermatidae) and Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Rhinonycteridae). Attention was also given to determining if the Northern Leaf-nosed Bat *Hipposideros stenotis* (Hipposideridae) based on an acoustics-based record as part of a previous biological survey (report and further details unavailable).

Acoustic processing of the bat detector recordings was conducted separately for each of these three species using methods optimised for the detection of their unique echolocation call types. The recording dataset comprised a total of 51 recording nights from four bat detector units (**Table 1**).

Five call sequences of the Pilbara Leaf-nosed Bat were detected (bat detector serial, date and time):

- 450007_2022-08-14_00-06-38.wav (illustrated in **Figure 1**)
- 450007_2022-08-17_00-39-22.wav
- 450085_2022-08-21_21-20-51.wav
- 642029_2022-08-15_21-28-01.wav
- 642029_2022-08-16_22-33-42.wav

All call sequences of the Pilbara Leaf-nosed Bat were recorded were well after sunset and therefore when the individual was out foraging away from a diurnal roost.

No calls of the Ghost Bat were observed in the recordings.

No calls of the Northern Leaf-nosed Bat were detected. The accepted distribution of this species does not include in the Pilbara region (e.g., Churchill 2008). While I have not seen the bat detector recording associated with a past record of detection, I suggest that this identification is more likely the result of an over-enthusiastic attribution.

Further details are available should verification be required.

Methods

The data provided were recorded in full spectrum WAV format with Titley Scientific Anabat Swift bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong et al. 2021a,b) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

1. undertook a Discriminant Function Analysis on training datasets from representative echolocation calls of Pilbara cave-roosting bat species, the Pilbara Leaf-nosed Bat and other northern Australian bat species;

2. from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over ellipses representing one standard deviation of the variation for the defined call types; and

3. facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 22.

Species were identified based on information in Armstrong and Coles (2007) and the author's own unpublished material.

References

Armstrong, K.N. and Coles, R.B. (2007). Echolocation call frequency differences between geographic isolates of *Rhinonicteris aurantia* (Chiroptera: Hipposideridae): implications of nasal chamber size. *Journal of Mammalogy* 88: 94–104. http://dx.doi.org/10.1644/06-MAMM-A-115R1.1

Armstrong K.N., Broken-Brow J., Hoye G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68: 346–363. https://doi.org/10.1071/ZO20044

Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. https://doi.org/10.1071/ZO20051

Churchill, S.K. (2008). *Australian bats.* 2nd ed. Allen and Unwin, Crows Nest, NSW.

DEWHA (2010). Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of the Environment, Water, Heritage and the Arts, Canberra.

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of three target bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.
9. The most reliable way of detecting the Ghost Bat with bat detectors is to place the equipment with the microphone facing into a potential cave roosting site. The echolocation calls of this species are of low amplitude, and therefore most detectable when a Ghost Bat flies close to the bat detector as it exits the underground structure. If there is uncertainty about whether Ghost Bats are present in a cave, then video recordings can be a useful addition to the survey. The detection of Ghost Bats with bat detectors away from cave entrances is less reliable.
10. Predictions about whether the Pilbara Leaf-nosed Bat roosts within a particular surveyed cave (where a bat detector was placed at the entrance), or somewhere nearby, based on the time of first detection should be considered indicative only. If unambiguous information of diurnal roosting of this species is required, diurnal roosting should be confirmed using the entrance sheeting method described in DEWHA (2010).

Table 1. Summary of bat detector recordings analysed, with the number of passes for the Pilbara Leaf-nosed Bat shown (*continued next page*).

Unit	Night of	Location	PLNB
450007	9/08/2022	21.013703 S, 118.918538 E	
450007	10/08/2022	21.013703 S, 118.918538 E	
450007	11/08/2022	21.013703 S, 118.918538 E	
450007	12/08/2022	21.013613 S, 118.918518 E	
450007	13/08/2022	21.013613 S, 118.918518 E	1
450007	14/08/2022	21.013613 S, 118.918518 E	
450007	15/08/2022	21.013613 S, 118.918518 E	
450007	16/08/2022	21.013650 S, 118.918343 E	1
450007	17/08/2022	21.013600 S, 118.918433 E	
450007	18/08/2022	21.013600 S, 118.918433 E	
450007	19/08/2022	21.013600 S, 118.918433 E	
450007	20/08/2022	21.013398 S, 118.918028 E	
450007	21/08/2022	21.013527 S, 118.918248 E	
450007	22/08/2022	21.013548 S, 118.918325 E	
450007	23/08/2022	21.013415 S, 118.918447 E	
450007	24/08/2022	21.013563 S, 118.918380 E	
450085	8/08/2022	31.931842 S, 115.961795 E	
450085	9/08/2022	21.016350 S, 118.907525 E	
450085	10/08/2022	21.016357 S, 118.907628 E	
450085	11/08/2022	21.016355 S, 118.907640 E	
450085	12/08/2022	21.016350 S, 118.907615 E	
450085	13/08/2022	21.016350 S, 118.907638 E	
450085	14/08/2022	21.016348 S, 118.907650 E	
450085	15/08/2022	21.016328 S, 118.907643 E	
450085	16/08/2022	21.016365 S, 118.907635 E	
450085	17/08/2022	21.016373 S, 118.907667 E	
450085	18/08/2022	21.016358 S, 118.907623 E	
450085	19/08/2022	21.016367 S, 118.907658 E	
450085	20/08/2022	21.016360 S, 118.907623 E	
450085	21/08/2022	21.016343 S, 118.907633 E	1
450085	22/08/2022	21.016352 S, 118.907650 E	
450085	23/08/2022	21.016347 S, 118.907678 E	
450085	24/08/2022	21.016245 S, 118.907665 E	
642022	8/08/2022	21.006960 S, 118.906462 E	
642022	9/08/2022	21.006998 S, 118.906477 E	
642022	10/08/2022	21.007003 S, 118.906468 E	
642022	11/08/2022	21.007028 S, 118.906475 E	
642022	12/08/2022	21.007015 S, 118.906458 E	
642022	13/08/2022	21.007025 S, 118.906455 E	
642022	14/08/2022	21.007000 S, 118.906470 E	
642022	15/08/2022	21.007015 S, 118.906452 E	

Unit	Night of	Location	PLNB
642022	16/08/2022	21.007002 S, 118.906428 E	
642022	17/08/2022	21.006958 S, 118.906415 E	
642029	10/08/2022	21.013600 S, 118.924833 E	
642029	11/08/2022	21.013643 S, 118.924897 E	
642029	12/08/2022	21.013602 S, 118.924853 E	
642029	13/08/2022	21.013573 S, 118.924833 E	
642029	14/08/2022	21.013063 S, 118.924385 E	
642029	15/08/2022	21.013577 S, 118.924852 E	1
642029	16/08/2022	21.013568 S, 118.924837 E	1
642029	17/08/2022	21.013582 S, 118.924837 E	

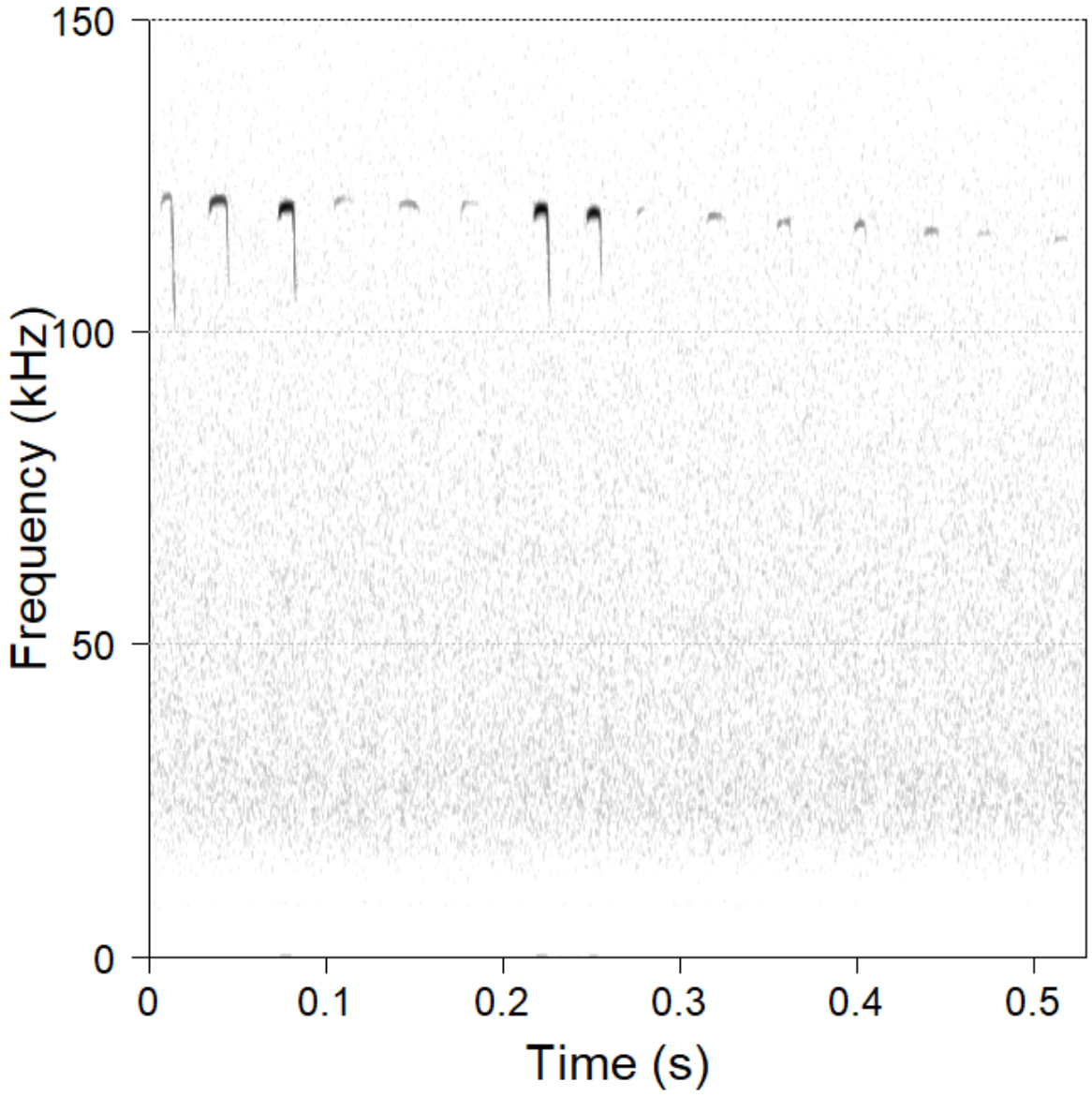

Figure 1. Example of an echolocation call sequence of the Pilbara Leaf-nosed Bat (file 450007_2022-08-14_00-06-38.wav; cropped).

APPENDIX F: SPECIES BY SITE MATRIX - FLORA

Species	Status	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16	Opp Coll
Amaranthaceae																									
Aerva javanica	INT		0.5			0.5		0.5						0.1											
Amaranthus mitchellii			0.1					0.1																	
Gomphrena cunninghamii			0.1											0.1	0.1										
Ptilotus astrolasius		0.1							0.1		0.1			0.1	0.1		0.1		0.1	0.1				0.1	
Ptilotus auriculifolius						0.1							0.1	0.1			0.1		0.1	0.1			0.1		
Ptilotus axillaris							0.1												0.1						
Ptilotus calostachyus		0.1		0.1																0.1			0.1	0.1	
Ptilotus exaltatus																					0.1				
Ptilotus helipteroides																							0.1		
Asteraceae																									
Pluchea tetranthera					0.1																				
Pterocaulon sphaeranthoides																						0.1			
Streptoglossa decurrens										0.1												0.1			
Boraginaceae																									
Euploca chrysocarpa																		0.1							
Trichodesma zeylanicum														0.1				0.1							
Brassicaceae																									
Lepidium pedicellosum				0.1																					
Caryophyllaceae																									
Polycarpaea corymbosa															0.1						0.1				
Chenopodiaceae																									
Dysphania rhadinostachya			0.1												0.1										
Salsola australis																							0.1		
Cleomaceae																									
Arivela uncifera subsp. *uncifera*									0.1															0.1	
Arivela viscosa			0.1	0.1																	0.1				
Convolvulaceae																									
Bonamia erecta							0.1															0.5	0.1	0.1	
Bonamia linearis											0.1											0.1			
Bonamia pannosa																					0.1				
Bonamia rosea																	0.1								
Polymeria ambigua																			0.1						

Species	Status	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16	Opp Coll
Cucurbitaceae																									
Cucumis variabilis																						0.1			
Euphorbiaceae																									
Euphorbia careyi			0.1		0.1									0.1							0.1				
Euphorbia mitchelliana								0.5		0.1			0.1	0.1								0.1		0.1	
Euphorbia tannensis							0.1					0.1		0.1	0.1										
Fabaceae																									
Acacia acradenia							0.5	0.5				0.1													
Acacia ancistrocapa									1	1	2				0.1				0.1			10		1	
Acacia bivenosa		0.1		0.1				0.1	0.1	2			0.6						0.1		0.1	5		0.5	
Acacia colei		1		1	2	5	1		0.5	10	0.1		2	0.5	1	0.1	10	10	0.5	0.5	0.5		0.5	0.5	
Acacia cowleana																			0.1						
Acacia inaequilatera		0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.5	1	0.5	0.1	0.1	1	0.5	0.1	0.2	0.1	
Acacia stellaticeps				0.5																					
Alysicarpus muelleri																			0.1			0.1			
Cajanus cinereus				0.5	1	0.5							0.2				0.1	0.1							
Crotalaria medicaginea																			0.1		0.1				
Cullen stipulaceum																					0.1				
Indigofera hirsuta												0.1				0.1		0.1	0.1				0.1		
Indigofera monophylla			0.1					0.1	0.1					0.1			0.1	0.1	0.1				0.1		
Indigofera trita								0.1																	
Isotropis atropurpurea				0.1	0.1	0.1						0.1					0.1	0.1							
Petalostylis labicheoides				0.1		0.1											0.1	0.1							
Rhynchosia minima			0.1				0.1			0.5			0.1						0.1			0.1			
Rothia indica subsp. *australis*	P3		0.1																		0.1				
Senna artemisioides																				0.1					
Senna ferraria													0.1												
Senna glutinosa subsp. *glutinosa*						0.1	0.1						0.1	0.1	0.2		0.1	0.1	0.1		0.5				
Senna glutinosa subsp. *luerssenii*										0.1													0.1		
Senna notabilis										0.1								0.1	0.1			0.1			
Swainsona formosa		0.1											0.1												
Tephrosia arenicola		0.1							0.1		0.1								0.1			0.1		0.1	
Tephrosia clementii						0.5				0.5		0.1	0.5							0.1					

Species	Status	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16	Opp Coll
Tephrosia densa														0.1							0.1				
Tephrosia rosea																	0.1	0.1							
Goodeniaceae																									
Dampiera candicans				0.1	0.1	0.1						0.5				0.1	0.5	0.1							
Goodenia cusackiana					0.1																				
Goodenia lamprosperma										0.1	0.1		0.1												
Goodenia microptera															0.1				0.1						
Goodenia stobbsiana				0.1	0.1																				
Scaevola amblyanthera var. *centralis*				0.1	0.1	0.1		0.1		0.1	0.1			0.1	0.1		0.1	0.1	0.1	0.1		0.1	0.1		
Lauraceae																									
Cassytha filiformis				0.1				0.5	0.1	0.1							0.1	0.1			0.1				
Malvaceae																									
?Abutilon lepidum										0.1															
?Melhania oblongifolia											0.1														
Abutilon lepidum														0.1											
Corchorus incanus		0.5			0.1	0.1			0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1		0.1	0.1	
Corchorus laniflorus																							0.1		
Hibiscus sturtii			1		0.1	0.1	0.1	0.5		0.1	0.1								0.1						
Melhania oblongifolia			0.5		0.1			0.1						0.1				0.5							
Sida arenicola													0.1						0.1						
Sida cardiophylla					0.1	0.1								0.1	0.1										
Sida fibulifera													0.1												
Sida macropoda																								0.1	
Triumfetta appendiculata					0.1	0.1								0.1							0.1				
Molluginaceae																									
Trigastrotheca molluginea												0.1			0.1	0.1		0.1	0.1	0.1					
Moraceae																									
Ficus aculeata var *indecora*																									10a
Myrtaceae																									
Corymbia hamersleyana		1		0.1	0.1	2				0.5	0.1		0.5				0.5		0.5	0.5				0.1	
Nyctaginaceae																									
Boerhavia gardneri						0.1						0.1		0.1	0.1			0.1					0.1		
Phyllanthaceae																									

Species	Status	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16	Opp Coll
Nellica maderaspatensis				0.2	0.1					0.1												0.1			
Plantaginaceae																									
Stemodia grossa				0.1	0.1						0.1		0.2	0.1	0.1		0.2	0.1		0.5					
Poaceae																									
Aristida holathera											0.1											0.1	0.1		
Cenchrus ciliaris	INT																		0.1						
Cenchrus setiger	INT									0.1	0.1		0.5												
Chrysopogon fallax																		0.1	2						
Cymbopogon ambiguus			0.1				0.5	0.1				0.1			0.1						0.5				
Cymbopogon obtectus				0.1	0.1	0.1				0.1	0.1														
Enneapogon lindleyanus								0.1						0.1	0.1										
Eragrostis eriopoda		0.1							0.1															0.1	
Eriachne aristidea																						0.1			
Eriachne benthamii																		0.1							
Eriachne mucronata					0.5										0.5		0.1	0.1							
Eriachne obtusa							0.5	5																	
Paraneurachne muelleri						0.1			0.1								0.1	0.1							
Paspalidium clementii			0.1																						
Sporobolus sp. PQ14																						0.1			
Themeda trianda																		2							
Triodia ?angusta											5														
Triodia angusta				5	5					2	5														
Triodia brizoides							5	5				15		5		30					10		40		
Triodia chichesterensis	P3	0.1					2		5								0.5	5		15	15				
Triodia epactia		4				10			5	5	10		10				10	2	40				5	15	
Triodia wiseana		6	20	10	25	2	15	20	2			25		40	25	20	2	15	20	45	35	30	15	40	
Portulaceae																									
Portulaca ?oleracea	Mixed										0.1		0.1												
Proteaceae																									
Grevillea pyramidalis				0.1			0.1																		
Grevillea wickhamii				0.5	0.1	0.5			1	0.1					0.1	0.1	0.5	0.1			0.1	0.1		0.1	
Sapindaceae																									
Atalaya hemiglauca								0.5																	

Species	Status	PR1	PR2	PR3	PR4	PR5	PR6	PR7	PQ1	PQ2	PQ3	PQ4	PQ5	PQ6	PQ7	PQ8	PQ9	PQ10	PQ11	PQ12	PQ13	PQ14	PQ15	PQ16	Opp Coll
Solanaceae																									
Solanum horridum			0.1					0.1						0.1											
Solanum phlomoides														0.1	0.1								0.1		
Violaceae																									
Afrohybanthus aurantiacus							0.1	0.1						0.1				0.1	0.1	0.1					
Zygophyllaceae																									
Tribulus hirsutus																			0.1				0.1		
Tribulus platypterus								0.5																	
INT: Introduced. Mixed: Native to pat of range, naturalised ot part of range.																									
Highlighted: additional species for the Pilgangoora project																									

APPENDIX G: FAUNA LIKELIHOOD OF OCCURRENCE ASSESSMENT - FAUNA

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				-- Birds --	
Actitis hypoleucos	Common Sandpiper	MI	MI	Edge of sheltered waters salt or fresh (*e.g.* estuaries, mangrove creeks, rocky coasts, near-coastal saltlakes (including saltwork ponds), river pools, lagoons, claypans, drying swamps, flood waters, dams and sewage ponds. Preferring situations where low perches are available (Johnstone and Storr, 1998). Shallow, pebbly, muddy or sandy edges of rivers and streams coastal to far inland; dams, lakes, sewage ponds; margins of tidal rivers, waterways in mangroves or saltmarshes; mudflats: rocky or sand beaches; causeways, riverside lawns, drains, street gutters. (Pizzey and Knight, 2012).	Unlikely. No suitable habitat available for this species. Drainage lines in the Study Area are ephemeral, fast flowing first and second order streams with no permanent or semi-permanent pools.
Apus pacificus	Fork-tailed Swift	MI	MI	Broadly distributed aerial species that is not specifically limited to any particular habitat type. Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. (Pizzey and Knight, 2012). Occurs over dry or open habitats comprising of riparian woodland, low scrub, heathland, or saltmarsh, also grasslands and sandplains with spinifex. (Morcombe, 2011).	Possible. No local records but listed by the PMST as Likely to occur. Ten records are reported from 1998 – 2014 over a wide variety of habitats, from open plains to very abrupt rocky ridges. This species is distributed across Australia. It is an aerial species that rarely comes to land. Individuals would not

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
					be specifically dependant on any habitats present in the Study Area.
Arenaria interpres	Ruddy Turnstone	IA	IA	Tidal mud and reef flats, sheltered rocky coasts, stony and sea-weedy beaches and sandpits, dry coral ridges (Abrolhos) and pebbly shores of near-coastal saltlakes (including saltwork ponds). (Johnstone and Storr, 1998).	Unlikely. No habitat occurs in the Study Area. A coastal or near coastal species preferring saline environments.
Calidris acuminata	Sharp-tailed Sandpiper	IA	IA, M	Scarce to moderately common (much more plentiful near coasts than in interior). (Johnstone and Storr, 1998). Tidal mudflats, saltmarshes, mangroves; shallow fresh, brackish or saline inland wetlands; floodwaters, irrigated pastures and crops; sewage ponds, saltfields. Widespread summer migrant to coastal and inland Australia. (Pizzey and Knight, 2012).	Unlikely. No habitat occurs in the Study Area. All the drainage lines in the Study Area are highly ephemeral, fast flowing high order streams with no permanent or semi-permanent pools.
Calidris ferruginea	Curlew Sandpiper	CR	CR, IA, M	Mainly shallows of estuaries and near-coastal saltlakes (including saltwork ponds) and drying near-coastal freshwater lakes and swamps. Also beaches and near-coastal sewage ponds. (Johnstone and Storr, 1998) Tidal mudflats; saltmarsh, saltfields; fresh, brackish or saline wetlands; sewage ponds. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. No records within 25 km.
Calidris melanotos	Pectoral Sandpiper		IA, M	Mainly fresh waters (swamps, lagoons, river pools, irrigation channels and sewage ponds); also, samphire flats around estuaries and saltlakes. (Johnstone and Storr, 1998)	Unlikely. No habitat occurs in the Study Area. No records within 25 km.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				Shallow fresh waters, often with low grass or other herbage; swamp margins, flooded pastures, sewage ponds, occasionally tidal areas, saltmarshes. (Pizzey and Knight, 2012)	
Calidris ruficollis	Red-necked Stint	IA	IA, M	Edge of sheltered salt, brackish or fresh waters; mainly estuaries, beaches, near-coastal saltlakes (including saltwork ponds) and freshwater swamps and lakes (especially when drying); also inland saltlakes and fresh waters, sewage ponds and bore overflows. (Johnstone and Storr, 1998) Tidal mudflats, saltmarshes; sandy or shelly beaches; saline and freshwater wetlands, coastal and inland; saltfields, sewage ponds. (Pizzy and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. This species was recorded near the Turner River, 44 km north-west, in 1979.
Charadrius veredus	Oriental Plover	MI	MI	Open plains; bare, rolling country, often far from water; ploughed land; muddy or sandy wastes near inland swamps or tidal mudflats; bare claypans; margins of coastal marshes; grassy fields and lawns. (Pizzey and Knight, 2012).	Unlikely. No suitable habitat available for this species. One individual was recorded in 1999, less than 3 km from the Study Area. At the time this was a major broad drainage line that likely had heavily grassed flood plains and adjacent low rolling hills. This location is now the site of the Pilgangoora mine.
Erythrotriorchis radiatus	Red Goshawk	VU	VU	Well-wooded country. (Johnstone and Storr, 1998) Open forests, woodlands, especially near rivers, wetlands; rainforest fringes. (Pizzy and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. No records within 25 km.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
Falco hypoleucos	Grey Falcon	VU	VU	Mainly lightly wooded and coastal riverine flats. (Johnstone and Storr, 1998) Lightly treed and inland plains; gibber deserts, sandridges, pastoral lands, timbered watercourses; seldom in driest deserts (Pizzey and Knight, 2012).	Listed by EPBC as Known to Occur in the search radius due to seven records since 2012 near the Turner River. At its closest point, the Turner River is 23 km from the Study Area. The plains habitat in the Study Area is suitable foraging habitat for this species. No nesting habitat is present.
Falco peregrinus	Peregrine Falcon	OS	-	Mainly about cliffs along coasts, rivers and ranges, and about wooded watercourses and lakes (Johnstone and Storr, 1998). Cliffs, gorges, timbered watercourses, environs of rivers, wetlands, plains, open woodlands, pylons, spires, buildings. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. One record from 2002 is less than 3 km from the Study Area. At the time this was a major broad drainage line that would have supported large flooded gums, suitable for nesting. This location is now the site of the Pilgangoora mine.
Fregata ariel	Lesser frigatebird	MI	MI	Northern seas south to Dampier Archipelago, extending from coasts to beyond continental shelf. Moderately common in blue-water seas (more plentiful in the Kimberley than the Pilbara) (Johnstone and Storr, 1998)	Unlikely. No habitat occurs in the Study Area.
Glareola maldivarum	Oriental pratincole	IA	IA, M	Feeding in air and roosting on bare ground beside water, *e.g.* tidal flats and floodwaters (Johnstone and Storr, 1998). Plains; shallow wet and dry edges of open bare wetlands; tidal mudflats, beaches (Pizzey and Knight, 2012).	Unlikely. No habitat occurs in the Study Area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
Hirundo rustica	Barn swallow	IA	IA, M	Mainly towns and wetlands (sewage and saltworks ponds, river pools, swamps, tidal creeks and reservoirs). (Johnstone and Storr, 2004) Open country; agricultural land, especially near water; railyards, towns, overhead wires. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area.
Motacilla cinerea	Grey Wagtail	IA	IA, M	Mainly banks and rocks in fast-running fresh water habitats; rivers, creeks, streams and around waterfalls, both in forest and open country; but occurs almost anywhere during migration. Flits from rock to rock, and often enters water after insects (or performs flycatcher sallies after them). (Johnstone and Storr, 2004) In Australia, near running water in disused quarries; sandy, rocky streams in escarpments and rainforests; sewage ponds, ploughed fields, airfields. (Pizzey and Knight, 2012)	Unlikely. The drainage lines in the Study Area are highly ephemeral and would only flow for brief period of time. There are no previous records in the local area and the species is uncommonly recorded in Australia.
Motacilla flava	Yellow Wagtail	IA	IA, M	Damp short-grass flats: rice stubbles and edge of swamps, sewage ponds, bore overflows, grazed or mowed grass and irrigated areas. (Johnstone and Storr, 2004)	Unlikely. No habitat occurs in the Study Area.
Numenius madagascariensis	Eastern Curlew	CR	IA	Mainly tidal mudflats; also reef flats, sandy beaches and rarely near-coastal lakes (including saltwork ponds). (Johnstone and Storr, 1998)	Unlikely. No habitat occurs in the Study Area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				Estuaries, tidal mudflats, sandspits, saltmarshes, mangroves; occasionally fresh or brackish lakes; bare grasslands near water. (Pizzey and Knight, 2012)	
Pandion cristatus	Eastern Osprey	IA	IA, M	Moderately common to very common in sheltered seas around north and west-coast islands south to 31°S; uncommon to common on mainland coasts, estuaries and larger rivers north of tropic; rare to uncommon elsewhere. Usually single, occasionally in twos. Young birds banded on Rottnest I. have been recovered up to 600 km away. (Johnstone and Storr, 1998) Coasts, estuaries, bays, inlets; islands and surrounding waters; coral atolls, reefs, lagoons, rock cliffs, stacks. Ascends larger rivers particularly in north, but also Murray R., SA; ventures far inland (Finke R., NT). (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area.
Pezoporus occidentalis	Night Parrot	CR	EN	Treeless or sparsely wooded spinifex *Triodia* spp. near water (including artesian bores) (Johnstone and Storr, 1998). Seeding spinifex on stony rises, breakaway country, sandy lowlands; shrubby glasswort, chenopods; succulents on flats around salt lakes; flooded claypans saltbush, bluebush, bassia associations (Pizzey and Knight, 2012).	Possible. No local records. Habitat modelling includes the Study Area at the extremity of the species potential extent and foraging resources are limited.
Pluvialis fulva	Pacific golden plover	IA	IA, M	Mainly salt or brackish marshes about estuaries and near-coastal saltlakes. Also near-coastal grassy flats, tidal	Unlikely. No habitat occurs in the Study Area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				mudflats, beaches, sewage and saltwork ponds and bore overflows. (Johnstone and Storr, 1998) Estuaries, mudflats, saltmarshes, mangroves; rocky reefs and stranded seaweed on ocean shores; margins of shallow open inland swamps; sewage ponds, short-grass paddocks, sportsgrounds, airfields, ploughed land. (Pizzey and Knight, 2012)	Where it occupies freshwater habitats, it is generally in association with open grasslands.
Rostratula australis	Australian Painted-Snipe	EN	EN	Evidently not uncommon in south and north-east Kimberley swampy plains before their degradation by cattle, but only five records since 1909. Only a rare summer visitor to North-west, single birds recorded at man-made ponds in the Hamersley and Ophthalmia Ranges in December and January and a male collected at Carnarvon in November. In arid interior a female about to lay collected at Brockman Creek in August 1896. In south west evidently common in swamps of Swan Coastal Plain last century, but now only a very rare summer visitor (November to January); last breeding record in 1923 (near Moora). (Johnstone and Storr, 1998) Well-vegetated shallows and margins of wetlands, dams, sewage ponds; wet pastures, marshy areas, irrigation systems, lignum, tea-tree scrub, open timber. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. No local records.
Thalasseus bergii	Crested Tern	IA	IA	Mainly blue-water seas (especially within 3 km of land), including southern estuaries in summer and autumn (when free of silt); also tidal creeks in north, but not	Unlikely. No habitat occurs in the Study Area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				penetrating far into larger estuaries (Cambridge Gulf, Prince Regent River, King Sound). (Johnstone and Storr, 1998) Coastal, offshore waters; beaches, bays, inlets, tidal rivers, salt swamps, lakes, larger rivers. (Pizzey and Knight, 2012)	Habitat descriptions note this species seldom ascends water ways beyond the estuarine environment.
Tringa brevipes	Grey-tailed Tattler	IA, P4	IA	Mainly tidal mud and reef flats. Also, estuarine sand flats, beaches and near-coastal fresh and brackish waters. (Johnstone and Storr, 1998) Estuaries, tidal mudflats, mangroves; wave-washed rocks and reefs; shallow river margins, coastal or inland. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area. This species prefers predominantly saline habitats.
Tringa glareola	Wood Sandpiper	IA	IA	Mainly shallow fresh waters (lagoons, swamps, claypans, river pools, dams, bore overflows and sewage ponds); occasionally brackish swamps, rarely saltlakes and estuaries. (Johnstone and Storr, 1998) Muddy margins of wetlands; tidal mangroves; margins of tidal mudflats; saltmarshes, sewage ponds. (Pizzey and Knight, 2012)	Unlikely. No habitat occurs in the Study Area.
Tringa nebularia	Common Greenshank	IA	IA, M	Shallow fresh waters (claypans, lagoons, swamps, river pools, dams and sewage ponds) and salt waters (estuaries, mangrove creeks, lakes, samphire flats, reef flats and saltwork ponds). (Johnstone and Storr, 1998)	Unlikely. No habitat occurs in the Study Area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				Mudflats, estuaries, saltmarshes, margins of lakes; wetlands, claypans, fresh and saline; commercial saltfields, sewage ponds. (Pizzey and Knight, 2012)	
				-- Mammals --	
Dasycercus blythi	Brush-tailed Mulgara	P4	-	Inhabits spinifex grasslands and burrows on the flats between low sand dunes (Van Dyck and Strahan, 2008).	Possible. Sandy plains habitat is suitable.
Dasyurus hallucatus	Northern Quoll	EN	EN	The Northern quoll will usually den in hollow tree trunks (Hill and Ward, 2010) or in small caves and crevices in rocky outcrops.	Present. Denning and foraging habitat present.
Hipposideros stenotis	Northern Leaf-nosed Bat	P2		It is found near the entrance of shallow caves and abandoned mines where they are usually very sensitive to the approach of an observer (Duncan *et al.* 1999). It forages in forest, woodlands and grasslands in close proximity to rocky outcrops and escarpments (Churchill 2008).	Unlikely. Very few records in the Pilbara. Database records from 2012 are a cluster of acoustic recordings, however the location is stated as 'Great Sandy Desert' therefore have low spatial accuracy. The accepted distribution of this species does not include in the Pilbara region (*e.g.*, Churchill 2008). Records may be a result of misidentification of echolocation records (Appendix E).
Lagorchestes conspicillatus leichardti	Spectable Hare-Wallaby	P4	-	Open *Acacia* forests, open woodlands and tall shrubland over tussock or hummock grasslands (Van Dyck and Strahan, 2008).	Present. Historic records and suitable habitat across the Study Area.
Leggadina lakedownensis	Lakeland Downs Mouse	P4		Mostly in moist tussock grassland or tropical savannah, but stony hummock grassland in the Pilbara. (Menkhorst and Knight, 2009). Most habitats are seasonally	Unlikely. Seasonal inundation unlikely, and nearest records are remote.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				inundated areas on red or white sandy-clay soils. (Van Dyck and Strahan, 2008)	
Macroderma gigas	Ghost Bat	VU	VU	Their distribution is influenced by the availability of suitable caves and mines for roost sites (Churchill 2008). In the Pilbara, Ghost bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (Triodia spp.) on sand or stony ground (Bat Call WA 2021a).	Possible. Foraging habitat available across the Study Area. No roosting habitat available.
Macrotis lagotis	Bilby	VU	VU	Occupy a variety of inland habitats including grass and stony downs country on cracking clays, desert sandplains and dune fields of laterite with hummock grassland and massive red earths with *Acacia* shrubland (Van Dyck and Strahan, 2008).	Possible. Suitable habitat includes the plains and low hills habitats.
Pseudomys chapmani	Western Pebble-mound Mouse	P4	-	Found on stony hillsides with hummock grassland (Menkhorst and Knight, 2009)	Present. Mounds located in the low rolling hills.
Rhinonicteris aurantia	Pilbara Leaf-Nosed Bat	VU	VU	Dependant on deep and complex cave systems. Roosting and foraging habitats defined by TSSC (2016) and Bat Call WA (2021b)	Present. No roosting habitat available, foraging quality of habitats in the Study Area is Low. Record is likely of transitory individual.
Sminthopsis longicaudata	Long-tailed Dunnart	P4		A specialist rock dwelling species (Freeland *et al.* 1988). It prefers exposed rock and stony soils with hummock grasses and shrubs, on flat-topped hills, lateritic plateaus, sandstone ranges and breakaways.	Possible. Suitable habitat occurs in the low hills, boulder rock outcrops and platy rock outcrops.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
-- Reptiles --					
Anilios ganei	Gane's blind snake (Pilbara)	P1		Known from widely separated areas between Newman and Pannawonica. Possibly associated with moist gorges and gullies Wilson and Swan, 2008.	Unlikely. Suitable habitat unlikely to be present as drainage lines small and highly ephemeral. Very few termite mounds present for foraging resource.
Ctenotus nigrilineatus	Pin-striped Finesnout Ctenotus	P1		This species is reported as inhabiting spinifex at the base of granite outcrops in the hilly interior of the Pilbara.	Possible. Suitable habitat occurs in the low hills and outcrops.
Liasis olivaceus subsp. *baronni*	Pilbara Olive Python	VU	VU	Recorded in areas with gorges and escarpments in close proximity to water holes (Doughty *et al.* 2011). During the cooler months they will typically hide in caves, crevices and fissures away from water sources. However, in the warmer months they become active and tend to stay near rocky outcrops and water. Their preference for water holes is likely due to resulting abundance of prey, rather than a need for drinking water. This species readily swims in water holes to hunt prey.	Unlikely. This species was not listed in the DBCA database search result, but was listed in the PMST database search result, due to the potential presence of suitable habitat. This species is often recorded in major drainage lines due to the presence of suitable refuges. However, it is not specifically dependant on such habitat, and is more typically associated with gorges and rocky breakaways, associated with water. There are no gorges or significant water filled gullies in the Study Area. No permanent or semi-permanent pools in the creeks.
Liopholis kintorei	Great Desert Skink		VU	A nocturnal burrowing and social lizard, living in family groups and creating extensive burrows that are typically 1 m deep and up to 10 m in diameter with multiple entrances (McAplin 2001).	Unlikely. No local records, but was listed in the PMST database search, as suitable habitat may occur in the buffer area.

Species	Common Name	Conservation Code		Relevant Habitat Preference	Assessment of Occurrence
		BC Act	EPBC Act		
				Typically occupy hummock grass sandplains and some adjacent dunefield swales, though they can occur in a variety of habitats (McAplin 2001). Vegetation usually consists of hummock grassland (*Triodia basedowii*, *T. pungens* and *T. schinzii*), with some scattered shrubs and occasional trees (*e.g.* Acacia spp., Eucalyptus spp., Hakea spp., Grevillea spp. and Allocasuarina decaisneana) (McAlpin 2001). Tend to utilise areas of habitat that have been burnt within the previous 2-15 years (McAplin 2001; Morre *et al.* 2015).	The area where suitable habitat may occur is 15 km to the southeast of the Study Area.

APPENDIX H: MOTION TRIGGERED CAMERA CAPTURES

APPENDIX H: MOTION TRIGGERED CAMERA CAPTURES

Camera ID	Common Name	Species Name	Date	Time	Temp (°C)	Habitat
MSC01	Northern Quoll	*Dasyurus hallucatus*	9/08/2022	1851		FH1
MSC01	Common Rock Rat	*Zyzomys argurus*	11/08/2022	2328		FH1
MSC01	Fat-tailed Pseudantechinus	*Pseudantechinus macdonnellensis*	12/08/2022	1457		FH1
MSC01	Fat-tailed Pseudantechinus	*Pseudantechinus macdonnellensis*	12/08/2022	1540		FH1
MSC01	Common Rock Rat	*Zyzomys argurus*	18/08/2022	1835		FH1
MSC03	Spinifex Pigeon	*Geophaps plumifera*	20/08/2022	0754		FH5
MSC03	Common Bronzewing	*Phaps chalcoptera*	25/08/2022	0715		FH5
MSC04	Perentie	*Varanus giganteus*	11/08/2022	1216		FH5
MSC04	Euro	*Macropus robustus*	15/08/2022	1954		FH5
MSC04	Stubble Quail	*Coturnix pectoralis*	22/08/2022	1457		FH5
MSC05	Dingo	*Canis lupus dingo*				FH4
MSC05	Dingo	*Canis lupus dingo*				FH4
MSC05	Cattle	*Bos taurus*				FH4
MSC05	Cattle	*Bos taurus*				FH4
MSC05	Cattle	*Bos taurus*				FH4
MSC05	Cattle	*Bos taurus*				FH4
MSC05	Cattle	*Bos taurus*				FH4
MSC06	Panther Skink	*Ctenotus pantherinus*	16/08/2022	0817		FH5
MSC07	Stubble Quail	*Coturnix pectoralis*	11/08/2022	1805	22	FH5
MSC07	Lined Fire-Tailed Skink	*Morethia ruficauda*	13/08/2022	0956	37	FH5
MSC07	Common Rock Rat	*Zyzomys argurus*	14/08/2022	1957	24	FH5
MSC07	Euro	*Macropus robustus*	17/08/2022	1320	47	FH5
MSC07	Common Rock Rat	*Zyzomys argurus*	17/08/2022	1953	25	FH5
MSC07	Common Rock Rat	*Zyzomys argurus*	17/08/2022	2111	23	FH5
MSC07	Stubble Quail	*Coturnix pectoralis*	21/08/2022	0728	17	FH5
MSC07	Stubble Quail	*Coturnix pectoralis*	22/08/2022	0656	13	FH5
MSC07	Common Rock Rat	*Zyzomys argurus*	22/08/2022	2357	17	FH5
MSC08	Spotted Dtella	*Gehyra punctata*	14/08/2022	0519	21	FH1
MSC08	Pilbara Rock Monitor	*Varanus pilbarensis*	14/08/2022	1312	50	FH1
MSC08	Pilbara Rock Monitor	*Varanus pilbarensis*	14/08/2022	1344	50	FH1
MSC08	Common Rock Rat	*Zyzomys argurus*	15/08/2022	2313	25	FH1
MSC08	Common Rock Rat	*Zyzomys argurus*	22/08/2022	2352	23	FH1
MSC09	Common Rock Rat	*Zyzomys argurus*	10/08/2022	1809	24	FH1
MSC09	Northern Quoll	*Dasyurus hallucatus*	12/08/2022	2311	22	FH1
MSC09	Spotted Dtella	*Gehyra punctata*	17/08/2022	0002	22	FH1
MSC09	Perentie	*Varanus giganteus*	21/08/2022	1307	33	FH1
MSC09	Pilbara Rock Monitor	*Varanus pilbarensis*	24/08/2022	1504	41	FH1
MSC10	Coarse Sand Ctenotus	*Ctenotus piankai*	10/08/2022	1220	34	FH5
MSC10	Coarse Sand Ctenotus	*Ctenotus piankai*	11/08/2022	1100	41	FH5
MSC10	Coarse Sand Ctenotus	*Ctenotus piankai*	11/08/2022	1626	34	FH5
MSC10	Fat-tailed Pseudantechinus	*Pseudantechinus macdonnellensis*	12/08/2022	0525	14	FH5
MSC11	Stubble Quail	*Coturnix pectoralis*	11/08/2022	0813	14	FH5
MSC11	Euro	*Macropus robustus*	18/08/2022	2139	20	FH5
MSC12	Common Bronzewing	*Phaps chalcoptera*	9/08/2022	0818	27	FH4
MSC12	Spinifex Pigeon	*Geophaps plumifera*	9/08/2022	0952	30	FH4
MSC12	Singing Honey-eater	*Lichenostomus virescens*	9/08/2022	1223	31	FH4
MSC12	Crested Pigeon	*Ocyphaps lophotes*	9/08/2022	1251	33	FH4
MSC12	Magpie Lark	*Grallina cyanoleuca*	9/08/2022	1251	33	FH4
MSC12	Magpie Lark	*Grallina cyanoleuca*	9/08/2022	1351	34	FH4
MSC12	Willie Wagtail	*Rhipidura leucophrys*	9/08/2022	1424	33	FH4
MSC12	Painted Fire-tail Finch	*Emblema pictum*	9/08/2022	1446	30	FH4
MSC12	Magpie Lark	*Grallina cyanoleuca*	10/08/2022	0639	17	FH4
MSC12	Zebra Finch	*Taeniopygia guttata*	10/08/2022	0925	18	FH4
MSC12	Red-capped Plover	*Charadrius ruficapillus*	12/08/2022	0605	14	FH4
MSC12	Red-capped Plover	*Charadrius ruficapillus*	12/08/2022	0713	17	FH4
MSC12	Bush Stone Curlew	*Burhinus grallarius*	23/08/2022	0005	18	FH4
MSC14	Yellow-throated Miner	*Manorina flavigula*	9/08/2022	1658	26	FH5
MSC14	Spinifex Pigeon	*Geophaps plumifera*	20/08/2022	1212	36	FH5
MSC15	Lined Fire-Tailed Skink	*Morethia ruficauda*	11/08/2022	1323	26	FH1
MSC15	Common Rock Rat	*Zyzomys argurus*	11/08/2022	2320	19	FH1
MSC16	Spinifex Pigeon	*Geophaps plumifera*	9/08/2022	1152	37	FH6
MSC16	Diamond Dove	*Geopelia cuneata*	15/08/2022	1346	41	FH6

Completed by: Animal Plant Mineral Pty Ltd

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Disclaimer

APPENDIX D

Northern Quoll Targeted Survey

2019-0085-003-st

28 January 2020

Kathryn Forrest
Senior Environmental Adviser
Pilbara Minerals
Level 2
88 Colin Street
West Perth WA 6005

Re: Northern Quoll survey on mining tenement M45/1266

Dear Kathryn

Terrestrial Ecosystems is pleased to provide the outcomes of a Northern Quoll (*Dasyurus hallucatus*) camera trapping survey on mining tenement M45/1266. The objective of this survey was to determine whether Northern Quoll were present in the mining tenement. It was important to determine whether they were present as this species is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* and *Biodiversity Conservation Act 2016* and potential impacts on the species require additional regulatory assessment and management procedures.

Background

The Northern Quoll is found in east and north Queensland, northern parts of the Northern Territory, the Kimberley and the Pilbara. In the Northern Territory, and to a lesser extent in north-eastern Australia, Northern Quoll populations have declined significantly due to their predation on Cane Toads. Oakwood (2008) suggested that they were most abundant in broken country, rocky areas and open eucalypt forest within 150km of the coast.

Males weigh between 400-900g and females between 300-500g (Oakwood 2008). Northern Quolls' diet consists mostly of invertebrates, but they also eat small reptiles and soft fruits (Dunlop *et al*. 2017). It is thought that most males in savannah areas die after breeding (Braithwaite and Griffiths 1994, Oakwood 2000), but in captivity, if breeding activity is restricted, males will live to breed in subsequent years. Many females also die after raising their first litter, but about a quarter survive to produce a litter in the second year. In rocky areas, Braithwaite and Griffiths (1994) reported the Northern Quoll living for 2-3 years, whereas, in savannah areas they rarely live beyond the first mating. Mating occurs in winter, with young being carried by the female for 8-10 weeks after birth, after which the young stay with their mother until they are able to fend for themselves.

In many parts of their range, the Northern Quoll occurs in small, fragmented populations according to habitat (Pollock 1999, Turpin and Bamford 2015). Core habitat includes rugged rocky areas that follow waterways, ironstone ranges, and uprisings of survey granite outcrops (Molloy *et al*. 2017). Commonly recorded habitats are not evenly spaced through the landscape, and often occur as rocky 'islands' separated by expansive spinifex grasslands. Rocky habitat provides a greater number of denning sites, provides greater refuge from fire, supports greater food resources, productivity and floristic diversity, and typically is not used for livestock grazing (Moro *et al*. 2019).

They are reported to den in hollow tree trunks but will use other spaces such as rock crevices and openings in old termite mounds. In the Pilbara, the geographic distribution of Northern Quolls is considered fragmented (Molloy *et al*. 2015), with its numbers in decline.

King (1989) reported activity areas for Northern Quoll ranged from 5-1109 ha, and the longest movement was 3.5km over seven days in the Pilbara. Home range for females in the savannah areas of Kakadu National Park was about 35ha, with some overlap in foraging areas when population densities were 3-4 females/km^2, but at 1-2 females/km^2 there was no overlap (Oakwood 2002). Male home ranges were similar to females during the non-breeding season, but increased to in excess of 100ha when they are searching for females. Scats are often

placed in prominent positions to mark territories. Terrestrial Ecosystems (unpublished data) have recorded daily movements of radio-tracked individuals greater than 5km between rocky areas in the Pilbara.

Braithwaite and Griffiths (1994) reported their range reduction might be associated with cattle grazing and exotic disease. The Cane Toad may also contribute to their range reduction. Moore *et al*., (2019) also report altered fire regimes and predation as threatening processes responsible for their range reductions.

Rankmore *et al*. (2008) reported on a very successful translocation of Northern Quolls from mainland Northern Territory to Pobassoo Island (74-fold increase from 19 individuals) and Astell Island (142-fold increase from 45 individuals) off north-eastern Arnhem Land. Prior to the translocation, these islands were not inhabited by quolls. These translocated populations showed little loss of genetic diversity in the short-term, and a high survival rate.

Methods

The Commonwealth Government's Northern Quoll referral guidelines (Department of the Environment 2016) indicate:

> Northern Quoll occupies a variety of habitats across its current range including rocky areas, eucalypt forest and woodlands, dry rainforests and vine thickets, sandy lowlands and beaches, shrublands, grasslands and deserts. Habitat usually includes some form of rocky area or structurally diverse woodland or forest used for shelter purposes with surrounding vegetated habitats used for foraging and dispersal. Shelter habitat is important for breeding and refuge from fire and/or predation. Little is understood about the characteristics of foraging or dispersal habitat for the northern quoll.

Ecologia Environment (2019) mapped seven different fauna habitats in the project area. The rocky hills habitat type contained numerous overhangs, crevices and rock piles, but no large boulder piles or deep caves. The rocky hills habitat was mapped as a fragmented habitat type which has a north-south alignment across tenement M45/1266. The most common habitat type in the project area was the low exposed hills. This habitat is characterised by hills that do not feature ridges, water sources, caves or gorges. It is our experience that in the Pilbara, if Northern Quoll are present, then they will be predominantly found on rocky ridges, and outcrops and rises, but they may also occur in a variety of other habitats.

Tenement M45/1266 has a series of rocky ridges/breakaways running approximately north-south through the tenement and this habitat type may provide suitable habitat for Northern Quoll if they are present. As the purpose of the survey was to determine the presence of Northern Quoll, the rocky ridges were selected as the focus of the camera trap survey. A field habitat assessment was used to determine the location of camera traps instead of desktop habitat mapping provided by Ecologia Environment (2019).

Dr Scott Thompson (Terrestrial Ecosystems) with assistance from Kathryn Forrest and Ryan Donegan (Pilbara Minerals) set up 30 Reconyx (HC600) camera traps on 23 and 24 September 2019 across the rocky ridges in M45/1266 (Figure 1). All cameras were set up with non-reward lures made of peanut butter, oats, sardines and fish oil. The camera traps were collected by Pilbara Minerals staff on 11 and 12 November 2019. and images were reviewed by Terrestrial Ecosystems staff.

Results

Twenty-six of the camera traps were positioned in the 'rocky hills' habitat type as mapped by Ecologia Environment (2019). Small areas of rocky habitat were also identified by Dr Scott Thompson in the field that were not mapped by Ecologia Environment (2019). The remaining four camera traps were in the 'low exposed hills' as mapped by Ecologia Environment (2019), however, these were considered rocky habitat by Dr Scott Thompson.

Twelve camera traps recorded Northern Quoll (Table 1) and all of these records were in the rocky hills habitat type along the north-south rocky ridge line. Northern Quoll were the most commonly recorded species followed by Rothchild's Rock-wallaby (*Petrogale rothschildi*) and the Common Rock Rat (*Zyzomys argugus)*. Plates 1-35 show some of the fauna that were recorded. It was not possible to determine the population of Northern Quoll based on spot patterns (Hohnen et al. 2012, Austin et al. 2016), however, it was clear that there were multiple individuals of both sexes and some individuals were recorded on multiple cameras.

Discussion

Northern Quoll are regularly encountered in appropriate habitats in the Pilbara, so it is not surprising that they are present in M45/1266. Northern Quoll have been recorded in multiple locations within 75km of the project area including the Aurizon railway (Terrestrial Ecosystems 2013), FMG railway (ATA Environmental 2007), Roy Hill railway (Terrestrial Ecosystems 2011), Hope Downs railway (Biota Environmental Sciences 2002), Wodgina (Bamford Consulting Ecologists 2008, Outback Ecology Services 2009, 2010, 2012, 2013) and many other projects.

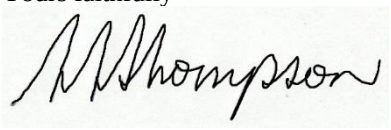
Ecologia Environment (2019) recorded scats from five locations in the rocky hills and one location in a small rocky outcrop in the footslopes habitat type. These scat locations correspond to the location of Northern Quolls in the camera trap images.

The Commonwealth Government's (Department of the Environment 2016) referral guidelines on Northern Quoll indicate habitat critical to the Northern Quolls survival includes ranges, escapements, mesas, gorges, breakaways, boulder fields, major drainage lines, treed creek lines, structurally diverse woodlands or forest area containing large diameter trees, termite mounds or hollow logs. Dispersal and foraging habitat, and habitat that connects area of 'critical habitat' is also considered important. When this interpretation is applied to tenement M45/1266, the rocky ridges, breakaways, treed creek lines and adjoining corridors plus a suitable buffer zone of approximately 500m would constitute important habitat critical to the Northern Quoll survival.

Northern Quoll can be impacted by multiple factors during mining and infrastructure development. These include: habitat fragmentation, altered fire regimes, dust, road fauna deaths, noise, vibration and light spillage, introduced predators and feral animals, uncapped drill holes, putrescible waste, and increased availability of permanent surface water. When mining and infrastructure development plans are available a vertebrate fauna management plan can be developed identifying management and mitigation strategies.

Please do not hesitate to contact the undersigned on 0407 385 239 or Dr Graham Thompson (0438 491 227) should you have any queries.

Yours faithfully



Dr Scott Thompson
Principal Zoologist and Partner

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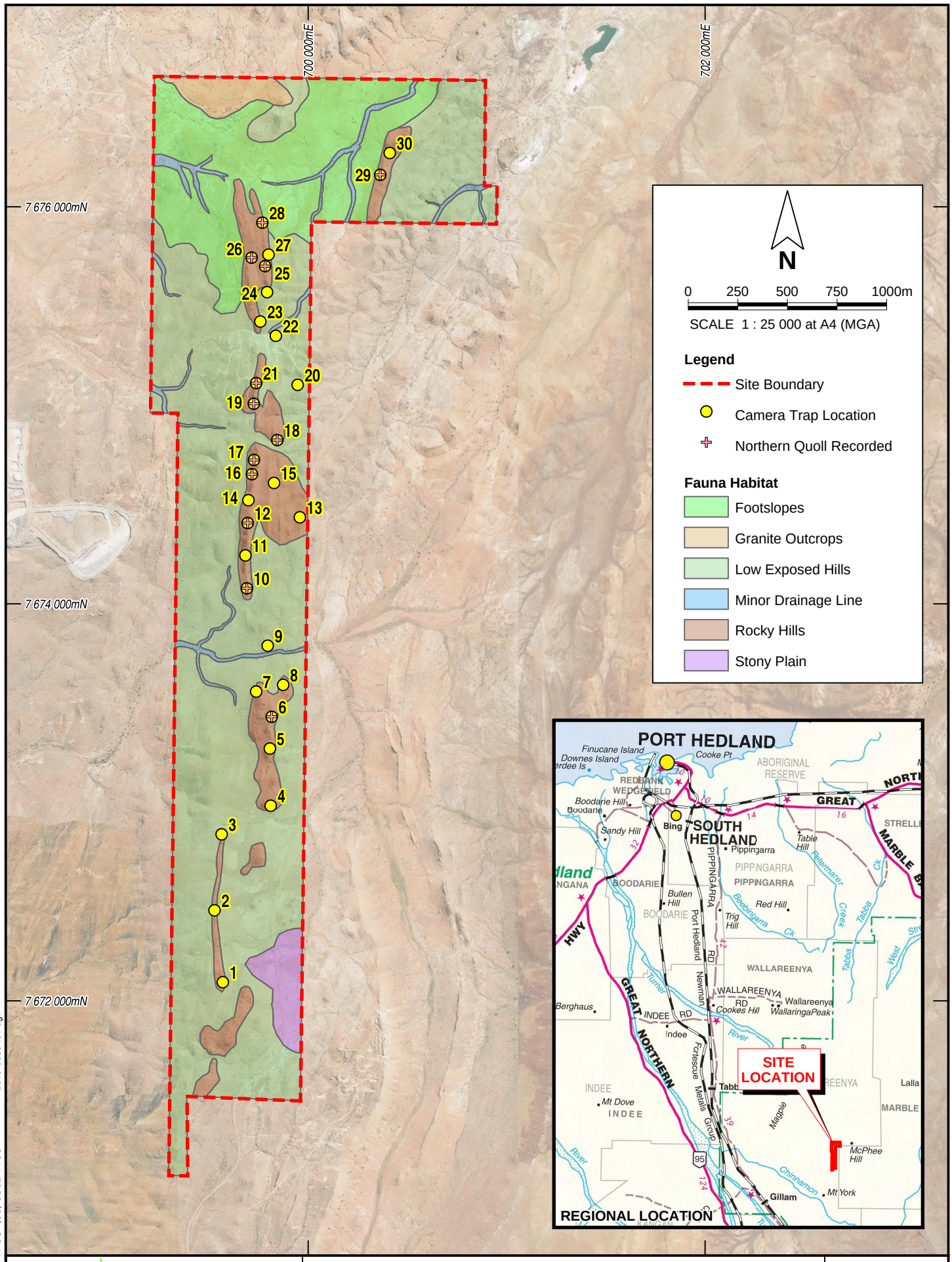

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TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson

Date: 25 Jan 2020

Pilbara Minerals Ltd
PILGANGOORA NORTHERN QUOLL SURVEY
TENEMENT M45/1266

NORTHERN QUOLL SURVEY

Figure 1

Job: 2019-0085

Plate 1 – Pilbara Rock Monitor

Tree No 2 – Spinifex Pigeon

Plate 3 – Dingo/dog

Plate 4– Northern Quoll

Plate 5– Rothchild's Rock-wallaby

Plate 6- Cat

Plate 7 – Pied Butcherbird

Plate 8– Rothchild's Rock-wallaby

Plate 9- Cat

Plate 10 – Rothchild's Rock-wallaby

Plate 11– Northern Quoll

Plate 12– Pied Butcherbird

Plate 13– Northern Quoll

Plate 14 – Dingo/dog

Plate 15– Rothchild's Rock-wallaby

Plate 16– Rothchild's Rock-wallaby

Plate 17– Northern Quoll

Plate 18– Northern Quoll

Plate 19 – Willie Wagtail

Plate 20– Northern Quoll

Plate 21– Northern Quoll

Plate 22 -Euro

Plate 23– Northern Quoll

Plate 24– Rothchild's Rock-wallaby

Plate 25 – Common Rock rat

Plate 26 - Euro

Plate 27– Rothchild's Rock-wallaby

Plate 28 – Northern Quoll

Plate 29 – Pilbara Grasswren

Plate 30 - Perentie

Plate 31 - Cat

Plate 32– Northern Quoll

Plate 33– Northern Quoll (with young)

Table 1. Vertebrate fauna images on camera traps

	Camera number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Species	Common name							nil						nil										nil	nil						nil
Canis lupis	Dingo/Dog																											x	x		
Dasyurus hallucatus	**Northern Quoll**						**x**				**x**		**x**				**x**	**x**	**x**	**x**		**x**				**x**	**x**		**x**	**x**	
Felis catus	Cat	x			x																		x								
Macropus robustus	Euro	x	x		x																										
Petrogale rothschildi	Rothschild Rock-wallaby									x	x	x	x			x	x	x	x	x		x								x	
Zyzomys argugus	Rock Rat			x		x	x			x			x				x			x							x		x	x	
Ctenophorus caudicintus	Ring-tailed Dragon																	x													
Varanus giganteus	Perentie																					x									
Varanus pilbarensis	Pilbara Rock Monitor								x				x																		
Aegotheles cristatus	Owlet Nightjar																													x	
Amytornis whitei	Pilbara Grasswren																			x		x						x		x	
Anthus novaeseelandiae	Australian Pipit	x																													
Cracticus nigrogularis	Pied Butcher bird			x	x																										
Emblema pictum	Painted Firetail (Finch)																													x	
Falco berigora	Brown Falcon												x																		
Geophaps plumifera	Spinifex Pigeon	x			x												x						x				x		x		
Lichenostomus keartlandi	Grey Headed Honeyeater																										x				
Rhipidura leucophrys	Willie Wagtail																					x									

APPENDIX E

Species Occurrence Data

DESCRIPTION	EPBC referral number assigned to a case (if known)	Longitude (Decimal degrees)	Latitude (decimal degrees)	Map datum used for the latitude and longitude	Spatial precision in metres	Year of record or survey start in numeric form (yyyy)	Month of record or survey start in numeric form (mm)	Day of record or survey start in numeric form (dd)	Year of survey end in numeric form (yyyy).	Month of survey end in numeric form (mm)	Day of survey end numeric form (dd)	Scientific name (Genus species subspecies/variety where available)	Common name for the species	Enter the name of the institution or company i(n full where possible) which collected the data e.g. Australian Museum, BHP etc	Unique visit/ survey number	Your specimen /record number	Habitat/vegetation/ecosystem type	Number of taxa counted or trapped; for presence only leave blank	According of an Absence for a species should only be for where a specific search has been conducted for that species	The way the species was detected: e.g.sighting , heard call, evidence - scats, acoutistic recording, thermal imaging, imagery - drone etc	Any special comments, including on weather, type/frequency of survey, plot size, etc.
DATA FORMAT	Text (15)	Double (11,8) i.e. 8 decimal places	Double(11,8)	Text	Integer	Integer (4)	Integer (2)	Integer (2)	Integer (4)	Integer (2)	Integer (2)	Text	Text	Text	Text	Text	Text	Integer	Boolean	Text	Text
	2023-09471	118.9184203	-21.0135796	GDA20	50	2022	8	14	2022	8	26	Rhinonicteris aurantia	Pilbara leaf nosed bat	Animal Plant Mineral Pty Ltd	AS450007	APM		1	TRUE	Acoustic recorder	Not at dusk or dawn, indicates forraging activity
	2023-09472	118.9184203	-21.0135796	GDA20	50	2022	8	17	2022	8	26	Rhinonicteris aurantia	Pilbara leaf nosed bat	Animal Plant Mineral Pty Ltd	AS450007	APM		1	TRUE	Acoustic recorder	Not at dusk or dawn, indicates forraging activity
	2023-09473	118.9076563	-21.0163516	GDA20	50	2022	8	21	2022	8	26	Rhinonicteris aurantia	Pilbara leaf nosed bat	Animal Plant Mineral Pty Ltd	AS450085	APM		1	TRUE	Acoustic recorder	Not at dusk or dawn, indicates forraging activity
	2023-09474	118.9248263	-21.0136486	GDA20	50	2022	8	15	2022	8	26	Rhinonicteris aurantia	Pilbara leaf nosed bat	Animal Plant Mineral Pty Ltd	AS642029	APM		1	TRUE	Acoustic recorder	Not at dusk or dawn, indicates forraging activity
	2023-09475	118.9248263	-21.0136486	GDA20	50	2022	8	16	2022	8	26	Rhinonicteris aurantia	Pilbara leaf nosed bat	Animal Plant Mineral Pty Ltd	AS642029	APM		1	TRUE	Acoustic recorder	Not at dusk or dawn, indicates forraging activity
	2023-09476	118.9218013	-21.0135186	GDA20	50	2022	8	9	2022	8	26	Dasyurus hallucatus	Northern Quoll	Animal Plant Mineral Pty Ltd	MSC01	APM		1	TRUE	Motion triggered camera	
	2023-09477	118.9213163	-21.0098276	GDA20	50	2022	8	12	2022	8	26	Dasyurus hallucatus	Northern Quoll	Animal Plant Mineral Pty Ltd	MSC09	APM		1	TRUE	Motion triggered camera	Capture of tail only
	2023-09478	118.9218053	-21.01377283	GDA20	50	2022	8	12	2022	8	26	Dasyurus hallucatus	Northern Quoll	Animal Plant Mineral Pty Ltd	Traverses	APM				Scat	Scat only, camera capture of animal nearby.
	2023-09479	118.921606	-21.014446	GDA20	50	2022	8	12	2022	8	26	Dasyurus hallucatus	Northern Quoll	Animal Plant Mineral Pty Ltd	Traverses	APM				Scat	Scat only, camera capture of animal nearby.
	2023-09480	118.921455	-21.01448569	GDA20	50	2022	8	12	2022	8	26	Dasyurus hallucatus	Northern Quoll	Animal Plant Mineral Pty Ltd	Traverses	APM				Scat	Scat only, camera capture of animal nearby.
	2023-09481	118.913415	-21.009597	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Intermediate (Anstee 1996)
	2023-09482	118.913922	-21.007752	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Active (Anstee 1996)
	2023-09483	118.914285	-21.00546	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Intermediate (Anstee 1996)
	2023-09484	118.915786	-21.005144	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Intermediate (Anstee 1996)
	2023-09485	118.914495	-21.003256	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Intermediate (Anstee 1996)
	2023-09486	118.919157	-21.004788	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Active (Anstee 1996)
	2023-09487	118.9199	-21.005605	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Active (Anstee 1996)
	2023-09488	118.919303	-21.007555	GDA20	50	2022	8	11	2022	8	26	Pseudomys chapmani	Western Pebble-mound mouse	Animal Plant Mineral Pty Ltd	Traverses	APM				Mound only	Active (Anstee 1996)
	2023-09489	118.9055669	-21.00729491	GDA20	50	2022	8	10	2022	8	26	Bos taurus	Cattle	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09490	118.9055669	-21.00729491	GDA20	50	2022	8	12	2022	8	26	Bos taurus	Cattle	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09491	118.9055669	-21.00729491	GDA20	50	2022	8	15	2022	8	26	Bos taurus	Cattle	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09492	118.9055669	-21.00729491	GDA20	50	2022	8	20	2022	8	26	Bos taurus	Cattle	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09493	118.9055669	-21.00729491	GDA20	50	2022	8	24	2022	8	26	Bos taurus	Cattle	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09494	118.9077205	-21.01629363	GDA20	50	2022	8	23	2022	8	26	Burhinus grallarius	Bush stone-curlew	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09495	118.9055669	-21.00729491	GDA20	50	2022	8	26	2022	8	26	Canis lupus dingo	Dingo	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09496	118.9055669	-21.00729491	GDA20	50	2022	8	21	2022	8	26	Canis lupus dingo	Dingo	Animal Plant Mineral Pty Ltd	MSC05	APM		1	TRUE	Motion sensor camera trap	
	2023-09497	118.9184019	-21.01362651	GDA20	50	2022	8	22	2022	8	26	Centropusaphasianinus	Pheasant	Animal Plant Mineral Pty Ltd	MSC04	APM		1	TRUE	Motion sensor camera trap	
	2023-09498	118.9077205	-21.01629363	GDA20	50	2022	8	12	2022	8	26	Charadrius ruficapillus	Red-capped plover	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09499	118.9077205	-21.01629363	GDA20	50	2022	8	12	2022	8	26	Charadrius ruficapillus	Red-capped plover	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09500	118.9170289	-21.01757988	GDA20	50	2022	8	22	2022	8	26	Coturnix pectoralis	Stubble quail	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09501	118.9170289	-21.01757988	GDA20	50	2022	8	21	2022	8	26	Coturnix pectoralis	Stubble quail	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09502	118.9170289	-21.01757988	GDA20	50	2022	8	11	2022	8	26	Coturnix pectoralis	Stubble quail	Animal Plant Mineral Pty Ltd	MSC07	APM		2	TRUE	Motion sensor camera trap	
	2023-09503	118.9248375	-21.01367122	GDA20	50	2022	8	11	2022	8	26	Coturnix pectoralis	Stubble quail	Animal Plant Mineral Pty Ltd	MSC11	APM		1	TRUE	Motion sensor camera trap	
	2023-09504	118.9218445	-21.00453775	GDA20	50	2022	8	16	2022	8	26	Ctenotus pantherinus		Animal Plant Mineral Pty Ltd	MSC06	APM		1	TRUE	Motion sensor camera trap	
	2023-09505	118.9238915	-21.01640953	GDA20	50	2022	8	11	2022	8	26	Ctenotus piankai		Animal Plant Mineral Pty Ltd	MSC10	APM		1	TRUE	Motion sensor camera trap	
	2023-09506	118.9238915	-21.01640953	GDA20	50	2022	8	11	2022	8	26	Ctenotus piankai		Animal Plant Mineral Pty Ltd	MSC10	APM		1	TRUE	Motion sensor camera trap	
	2023-09507	118.9238915	-21.01640953	GDA20	50	2022	8	10	2022	8	26	Ctenotus piankai		Animal Plant Mineral Pty Ltd	MSC10	APM		1	TRUE	Motion sensor camera trap	
	2023-09508	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Emblema pictum	Painted finch	Animal Plant Mineral Pty Ltd	MSC12	APM		2	TRUE	Motion sensor camera trap	
	2023-09509	118.9213159	-21.00982735	GDA20	50	2022	8	17	2022	8	26	Gehyra punctata		Animal Plant Mineral Pty Ltd	MSC09	APM		1	TRUE	Motion sensor camera trap	
	2023-09510	118.9211653	-21.00858265	GDA20	50	2022	8	14	2022	8	26	Gehyra punctata		Animal Plant Mineral Pty Ltd	MSC08	APM		1	TRUE	Motion sensor camera trap	
	2023-09511	118.9085042	-21.01589647	GDA20	50	2022	8	15	2022	8	26	Geopelia cuneata	Diamond dove	Animal Plant Mineral Pty Ltd	MSC16	APM		1	TRUE	Motion sensor camera trap	
	2023-09512	118.9173179	-21.01460514	GDA20	50	2022	8	20	2022	8	26	Geophaps plumifera	Spinifex pigeon	Animal Plant Mineral Pty Ltd	MSC03	APM		2	TRUE	Motion sensor camera trap	
	2023-09513	118.9142758	-21.01289626	GDA20	50	2022	8	20	2022	8	26	Geophaps plumifera	Spinifex pigeon	Animal Plant Mineral Pty Ltd	MSC14	APM		1	TRUE	Motion sensor camera trap	
	2023-09514	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Geophaps plumifera	Spinifex pigeon	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09515	118.9085042	-21.01589647	GDA20	50	2022	8	9	2022	8	26	Geophaps plumifera	Spinifex pigeon	Animal Plant Mineral Pty Ltd	MSC16	APM		1	TRUE	Motion sensor camera trap	
	2023-09516	118.9077205	-21.01629363	GDA20	50	2022	8	10	2022	8	26	Grallina cyanoleuca	Magpie-lark	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09517	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Grallina cyanoleuca	Magpie-lark	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09518	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Grallina cyanoleuca	Magpie-lark	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09519	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Lichenostomus virescens	Singing honeyeater	Animal Plant Mineral Pty Ltd	MSC12	APM		2	TRUE	Motion sensor camera trap	
	2023-09520	118.9248375	-21.01367122	GDA20	50	2022	8	18	2022	8	26	Macropus robustus	Common wallaroo	Animal Plant Mineral Pty Ltd	MSC11	APM		1	TRUE	Motion sensor camera trap	
	2023-09521	118.9170289	-21.01757988	GDA20	50	2022	8	17	2022	8	26	Macropus robustus	Common wallaroo	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
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	2023-09523	118.9142758	-21.01289626	GDA20	50	2022	8	9	2022	8	26	Manorina flavigula	Yelllow-throated miner	Animal Plant Mineral Pty Ltd	MSC14	APM		2	TRUE	Motion sensor camera trap	
	2023-09524	118.9170289	-21.01757988	GDA20	50	2022	8	13	2022	8	26	Morethia ruficauda	Lined firetail skink	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09525	118.9142588	-21.01006044	GDA20	50	2022	8	11	2022	8	26	Morethia ruficauda	Lined firetail skink	Animal Plant Mineral Pty Ltd	MSC15	APM		1	TRUE	Motion sensor camera trap	
	2023-09526	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Ocyphaps lophotes	Crested pigeon	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09527	118.9173179	-21.01460514	GDA20	50	2022	8	25	2022	8	26	Phapslchalcoptera	Common bronzewing	Animal Plant Mineral Pty Ltd	MSC03	APM		1	TRUE	Motion sensor camera trap	
	2023-09528	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Phapslchalcoptera	Common bronzewing	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09529	118.9218056	-21.01351584	GDA20	50	2022	8	12	2022	8	26	Pseudantechinus roryi	Rory Coopers false antechinus	Animal Plant Mineral Pty Ltd	MSC01	APM		1	TRUE	Motion sensor camera trap	
	2023-09530	118.9218056	-21.01351584	GDA20	50	2022	8	12	2022	8	26	Pseudantechinus roryi	Rory Coopers false antechinus	Animal Plant Mineral Pty Ltd	MSC01	APM		1	TRUE	Motion sensor camera trap	
	2023-09531	118.9238915	-21.01640953	GDA20	50	2022	8	12	2022	8	26	Pseudantechinus roryi	Rory Coopers false antechinus	Animal Plant Mineral Pty Ltd	MSC10	APM		1	TRUE	Motion sensor camera trap	
	2023-09532	118.9077205	-21.01629363	GDA20	50	2022	8	9	2022	8	26	Rhipidura leucophrys	Willie wagtail	Animal Plant Mineral Pty Ltd	MSC12	APM		1	TRUE	Motion sensor camera trap	
	2023-09533	118.9077205	-21.01629363	GDA20	50	2022	8	10	2022	8	26	Taeniopygia guttata	Zebra finch	Animal Plant Mineral Pty Ltd	MSC12	APM		3	TRUE	Motion sensor camera trap	
	2023-09534	118.9213159	-21.00982735	GDA20	50	2022	8	21	2022	8	26	Varanus giganteus	Perentie	Animal Plant Mineral Pty Ltd	MSC09	APM		1	TRUE	Motion sensor camera trap	
	2023-09535	118.9184019	-21.01362651	GDA20	50	2022	8	11	2022	8	26	Varanus giganteus	Perentie	Animal Plant Mineral Pty Ltd	MSC04	APM		1	TRUE	Motion sensor camera trap	
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	2023-09537	118.9211653	-21.00858265	GDA20	50	2022	8	14	2022	8	26	Varanus pilbarensis	Perentie	Animal Plant Mineral Pty Ltd	MSC08	APM		1	TRUE	Motion sensor camera trap	
	2023-09538	118.9211653	-21.00858265	GDA20	50	2022	8	14	2022	8	26	Varanus pilbarensis	Perentie	Animal Plant Mineral Pty Ltd	MSC08	APM		1	TRUE	Motion sensor camera trap	
	2023-09539	118.9170289	-21.01757988	GDA20	50	2022	8	22	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09540	118.9211653	-21.00858265	GDA20	50	2022	8	22	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC08	APM		1	TRUE	Motion sensor camera trap	
	2023-09541	118.9218056	-21.01351584	GDA20	50	2022	8	18	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC01	APM		1	TRUE	Motion sensor camera trap	
	2023-09542	118.9170289	-21.01757988	GDA20	50	2022	8	17	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09543	118.9170289	-21.01757988	GDA20	50	2022	8	17	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09544	118.9211653	-21.00858265	GDA20	50	2022	8	15	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC08	APM		1	TRUE	Motion sensor camera trap	
	2023-09545	118.9170289	-21.01757988	GDA20	50	2022	8	14	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC07	APM		1	TRUE	Motion sensor camera trap	
	2023-09546	118.9218056	-21.01351584	GDA20	50	2022	8	11	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC01	APM		1	TRUE	Motion sensor camera trap	
	2023-09547	118.9142588	-21.01006044	GDA20	50	2022	8	11	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC15	APM		1	TRUE	Motion sensor camera trap	
	2023-09548	118.9213159	-21.00982735	GDA20	50	2022	8	10	2022	8	26	Zyzomys argurus	Common rock rat	Animal Plant Mineral Pty Ltd	MSC09	APM		1	TRUE	Motion sensor camera trap	

APPENDIX F

Environmental Management Plan

Environmental Management Plan

Lynas Find Project – EPBC 2023/09471

Prepared for Pilbara Minerals Limited ABN 95 112 425 788

13 June 2024

Project Number: TE23060

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer	Approver
1.0	First Approved Release	31/10/2023	AJ	JK	AJ
1.0	Changed to EMP - Updated following DCCEEW feedback	13/02/2024	AJ	GB	AJ
2.0	Amended to include details of water monitoring	17/06/2024	AJ	GB	AJ

Approval for Release

Name	Position	File Reference
Ami Jamieson	Senior Environmental Consultant	TE23060_Environmental Management Plan_2.0
Signature		

Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.

Signed: _____

Full name: Eulogio Almanza

Organisation: Pilbara Minerals Limited

Date: _____

Condition Reference Table

EPBC Approval Condition	Relevant Section of Document

Table of Contents

Tables

Figures

1 Introduction

This Environmental Management Plan (EMP) has been developed to support the referral of the Lynas Find Project (the Proposed Action) under the *Environmental Protection and Biodiversity Conservation Act (Cth) 1999* (EPBC). The EMP outlines the risks of the Proposed Action implementation, and management actions that will be undertaken to ensure the risk to conservation significant terrestrial fauna is minimised.

1.1 Project Description

The Proposed Action is a component of a larger project – the Pilgangoora Project, operated by Pilbara Minerals Limited (PML) since 2018. The Proposed Action includes construction of an open pit mine (Lynas Find Pit) and Waste Rock Landform (WRL) (Lynas Find WRL) to the north of the current Pilgangoora operations, as well as necessary supporting infrastructure including access and haul roads, laydown areas, and topsoil stockpiles, as required. A layout plan has been provided as Figure 1-1, and includes the infrastructure to be constructed for the Proposed Action, as well as information on the surrounding areas that may be impacted through implementation of the Proposed Action.

Mining of the Proposed Action area will be undertaken using routine open pit mining methods, including:

- Land clearing and site preparation (including stockpiling of topsoils);
- Drill and blast activities;
- Excavation and haulage of material; and
- Closure and rehabilitation activities.

Waste rock will be transported by haul truck to the Lynas Find WRL, which may also be used to store waste rock from other locations in the broader project area.

Ore will be transported to an existing process plant where it will be crushed and processed to produce lithium and tantalite concentrates for export.

Due to the short life of the Proposed Action, no maintenance works are expected to be required.

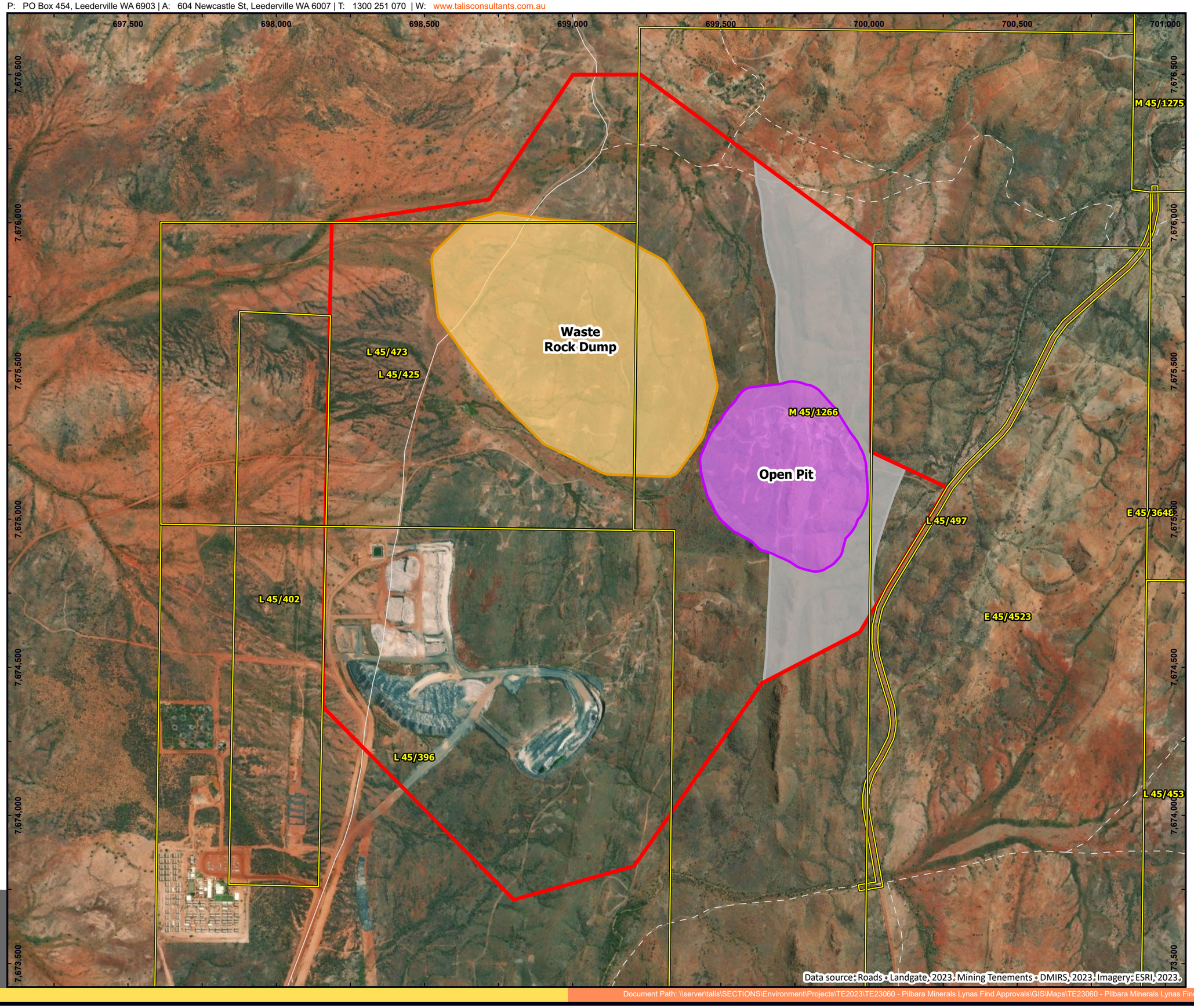
1.1.1 Location

The current Pilgangoora operations are located approximately 80 km SSE of Port Hedland in the Pilbara region of Western Australia, and the Lynas Find deposit is located approximately 5 km to the north of the existing operations. A locality map has been provided as Figure 1-2.

The Proposed Action includes a Development Envelope of 394.86 ha, of which 26.32 ha will comprise of open pit disturbance, and 61.02 ha of disturbance for the WRL, totalling 87.34 ha of total disturbance. Included in the proposed disturbance footprint is a buffer of approximately 23 ha, which allows peripheral disturbance for low impact associated infrastructure such as access roads and topsoil stockpiles.

Within the Development Envelope, 37.54 ha will be classified as an avoidance area, which will not be disturbed by PML mining activities. This area includes rocky ridges that have the potential to be utilised as denning habitat for the nationally threatened species, the Northern Quoll, and as such, all efforts will be taken to preserve this habitat.

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au



LEGEND

- Lynas Find Mine Development Envelope
- Mining Tenements

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

Western Australian Roads

- Minor Road
- Other

LOCALITY

0 200 400 600 800 1,000 km

SITE LAYOUT

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 1-1

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au

660,000 680,000 700,000 720,000 740,000 760,000 780,000 800,000

7,760,000 7,740,000 7,720,000 7,700,000 7,680,000 7,660,000

IBRA REGION: DAMPIERLAND

IBRA Sub-Region: Pindanland

IBRA REGION: GREAT SANDY DESERT

IBRA Sub-Region: McLarty

IBRA Sub-Region: Roebourne

Port Hedland

South Hedland

Marble Bar Rd

Great Northern Hwy

IBRA REGION: PILBARA

IBRA Sub-Region: Chichester

Marble Bar

Data source: Roads, Rail - Landgate, 2023. IBRA Regions - Department of Environment, 2023. Imagery: ESRI, 2023.

LEGEND

- Lynas Find Mine Development Envelope

IBRA Sub-Regions

- Chichester
- McLarty
- Pindanland
- Roebourne

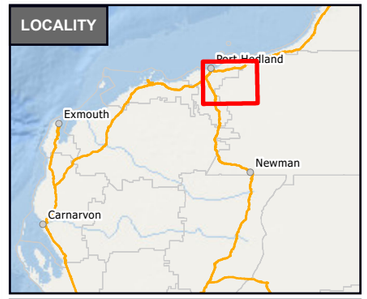
Rail Network

- Railway Stations
- Railway Lines

Western Australian Roads

- Freeway / Highway
- Main Road

LOCALITY



0 200 400 600 800 1,000 km

SITE LOCALITY

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 5 10 15 20 Km

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:500,000

Prepared: E Jackson	Date: 20/09/2023
Reviewed: A Jamieson	Revision: A
Project: TE23060	

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Figure 1-2

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2023\TE23060 - Pilbara Minerals Lynas Find Approvals\GIS\Maps\TE23060 - Pilbara Minerals Lynas Find Approvals\TE23060 - Pilbara Minerals Lynas Find Approvals.aprx

1.2 Objectives

The Objective of the EMP is to avoid direct and indirect impacts to conservation significant terrestrial fauna species present in the Proposed Action area, including the Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed bat (PLNB) (*Rhinonicteris aurantia*). Where impacts are not possible to avoid, the objectives are to minimise impacts and implement mitigation strategies which are then to be monitored and measured to gauge their effectiveness.

The intended outcomes of the EMP are to:

- Avoid the direct and indirect impacts to Conservation Significant (CS) terrestrial fauna species from the Proposed Action where possible;
- Minimise residual impacts on terrestrial fauna and implement mitigation strategies;
- Outline monitoring programs for the effectiveness of mitigation strategies;
- Adopt an adaptive management approach, based on monitoring outcomes, that identifies management responses to be enacted where trigger and threshold values are exceeded.

1.3 Environmental Management Roles and Responsibilities

Overall responsibility for the implementation of this EMP resides with the Registered Mine Manager of the Lynas Find Project. This may be transferred during the construction phases of the Proposed Action to the Project Manager.

Responsibility for specific tasks required under this EMP may be delegated to other site personnel. Any delegation of responsibility must be clearly recorded and communicated to key personnel.

Site Role	Responsibilities
Registered Mine Manager/Project Manager	• Provide adequate resources for the implementation and compliance with the EMP; • Oversee compliance with the provisions of the EMP; and • Communicate delegated tasks required under the EMP.
Site Manager/Supervisor	• Ensure compliance with the EMP; • Provide information for land use certificate (LUC) applications; • Ensure an approved LUC is in place prior to any ground disturbance; • Implement requirements outlined in the approved LUC; • Audit LUC disturbance boundaries against approved areas; and • Communicate requirements of the EMP across site as required.

Site Role	Responsibilities
Site Environmental Manager and Environmental Advisors	• Review LUC applications, ensuring minimisation of impacts to conservation significant fauna habitat; • Enforcement of LUC conditions; • Ensure proposed disturbances are in line with regulatory approvals; • Pre-clearance inspections of proposed disturbance areas; • Communicate LUC and other regulatory requirements to project teams and work crews; • Ensure GIS disturbance data is regularly updated; • Undertake inspections of project areas to ensure compliance with LUC and other regulatory conditions; • Prepare and deliver environmental awareness on site, including at inductions and toolbox meetings; • Promote awareness of presence of CS fauna in the Proposed Action area; • Maintain responsibility for ongoing monitoring and reporting relating to CS fauna; and • Ensure contractors undertaking fauna monitoring on site have the appropriate permits and animal ethics approvals.

1.4 Reporting

Reporting of CS fauna species issues, events, and monitoring results will be undertaken to ensure communication and understanding of the actual measured impacts of the Proposed action on the CS fauna species in the area.

Reporting required includes:

- Regular reporting to regulators as required by project approvals;
- Reporting under the Land Use Certificate system for completion of clearing;
- Internal incident reporting, including all fauna injuries or mortalities as a result of the Proposed Action; and
- External incident reporting, including reporting of all mortalities of CS fauna on site.

1.5 Environmental Training

Environmental training is incorporated across site, raising awareness of the presence of CS fauna on site and the management actions required in order to minimise the impact of the Proposed Action on these species.

Training and awareness programs on site include an induction process for all permanent staff and contractors working across the Pilgangoora Project. This induction includes a fauna component, with a focus on how to identify the CS fauna found in the area and the expected behavioural actions required to minimise impacts to any identified species.

Further training will be undertaken in targeted toolbox meetings and will be mandatory for crews involved in clearing and land disturbance.

In addition, educational materials will be displayed on rotation in crib rooms and other high traffic areas, to include information on reporting sightings and identification of conservation significant fauna species.

1.6 Emergency Contacts and Procedures

The emergency contact on site will be the site General Manager. The General Manager of the Lynas Find site will have the power to stop or otherwise direct works to ensure effective and timely management of any environmental emergencies that may arise.

Where operations are considered likely to have an impact on CS terrestrial fauna species, works are to be stopped until formal assessment of the situation can be undertaken, and any required actions implemented to reduce the risk of continuing operations.

Environmental emergencies often coincide with safety emergencies, relating to severe weather events including cyclones and bushfires. In these situations, safety will be a primary consideration. Where safety concerns have been adequately managed, environmental concerns will be addressed.

2 Potential Environmental Impacts and Risks

2.1 Threats to Matters Protected Under the EPBC Act

Matters of National Environmental Significance (MNES) include threatened species listed under the EPBC Act.

Implementation of the Proposed Action will require vegetation clearing of the proposed areas, as well as removal of a portion of rocky ridge that represents fauna habitat for the Northern Quoll. This habitat may also be used sporadically by other listed threatened species, including the PLNB and the Ghost bat.

The Proposed Action will result in impacts to approximately 4.62 ha of rocky ridge habitat, and a further 82.48 ha of additional vegetation that may be used for foraging by CS species. This EMP has been developed to ensure that measures are taken to avoid or mitigate further impacts to the CS species present in the Proposed Action area.

2.1.1 Northern Quoll

The Northern Quoll is listed as Endangered under the EPBC Threatened species list. A number of surveys have been conducted over the Lynas Find area and broader Pilgangoora area, showing that there are populations of Northern Quoll within the area. The population within this area is considered important for the long-term survival of the Northern Quoll as it occurs in a habitat that is unaffected by cane toads and is unlikely to support cane toads upon arrival (DSEWPC, 2011).

Habitat critical to the survival of the Northern Quoll is present in the Proposed Action area, and includes rocky ridge habitat, as well as the surrounding native vegetation used for foraging and connection with other nearby populations.

2.1.1.1 *Local Population*

Northern Quoll records within the Proposed Action area occur predominately within the rocky ridge habitat, consisting of rocky outcrops, hills and ridgelines. Another Northern Quoll population is known to exist in the Turner River area, approximately 16 km to the west of the Proposed Action area. It has not been established whether the Turner River Northern Quoll population is connected to the Pilgangoora population, however, it is expected that connectivity would occur through the creeks and channels, which provide greater foraging opportunity and shelter. No current evidence of connectivity through scats within the potential connection corridors exists, and the lack of denning habitat within these corridors may be a limiting factor on species dispersal.

2.1.2 Pilbara Leaf Nosed Bat

The PLNB is listed as Vulnerable under the EPBC Threatened species list. The PLNB is an insectivorous species that roosts during the day in caves and underground mines with stable, warm and humid microclimates. This habitat is critical to the PLNB due to the poor ability to maintain body temperature and water balance (Churchill et al 1988).

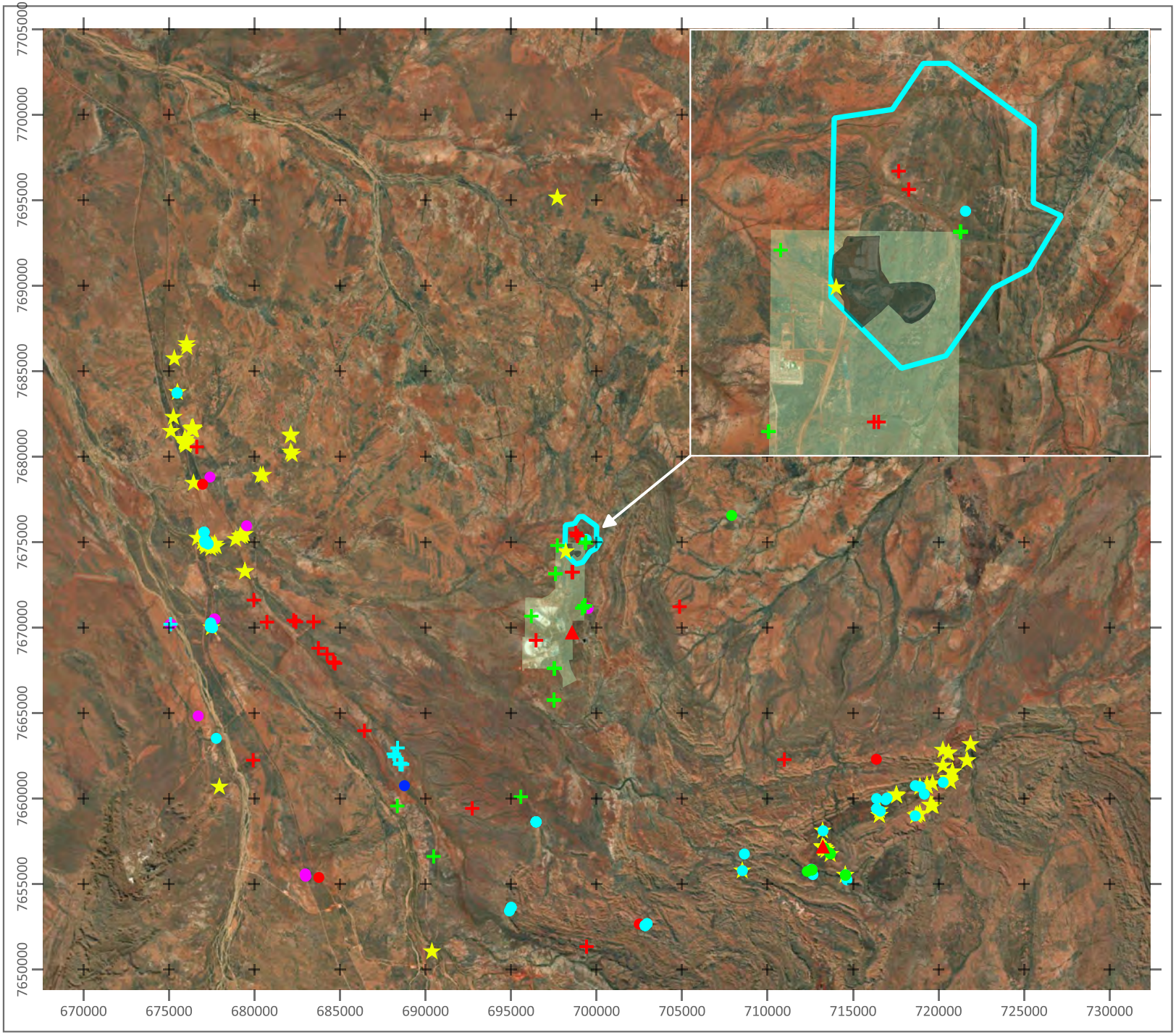
No PLNB roosts have been found within the Proposed Action area, however foraging bats have been recorded at several locations. Due to the timing of the recordings well after sunset, it is likely these bats were out foraging, away from diurnal roosting locations. Foraging habitat for the PLNB includes

open grasslands, open woodland, tall open forest, and monsoon rainforest (Churchill, 2008). They are often encountered in areas containing water sources, given their insectivorous diet.

2.1.3 Ghost Bat

The Ghost bat is listed as Vulnerable under the EPBC Threatened species list. The Ghost bat is an easily disturbed carnivorous species that may abandon sites where human disturbance occurs (TSSC 2016), including minor disturbances by approaching vehicles and people. Fences have also been known to kill substantial numbers of Ghost bats (Armstrong & Anstee, 2000). They generally require a number of cave roosts, as they will move between caves seasonally, and as such, may disperse widely when not breeding. In the Pilbara, Ghost bats are often recorded either singly, or in small groups of less than 15 individuals, however, large colonies can exist in abandoned mines.

Roost sites include caves, rock crevices and disused mine adits. No Ghost bats have been recorded in the Proposed Action area, and the nearest recording of an individual was approximately 2.5 km to the north of the project area. Regardless, given Ghost bats have been recorded foraging in all productive habitats in the Pilbara (Bullen, 2020), the Proposal will likely have an impact on available foraging habitat.



Legend

- Study Area
- Cleared
- Pilgangoora Mine Operations

Endangered

- Northern quoll

Vulnerable

- Bilby
- Ghost bat
- Grey falcon
- Pilbara leaf-nosed bat
- Pilbara olive python

Priority 1

- Gane's blind snake (Pilbara)

Priority 4

- Brush-tailed mulgara
- Spectacled hare-wallaby (mainland)
- Western pebble-mound mouse

Scale: @ A4
1: 32,000

0 5 10 km

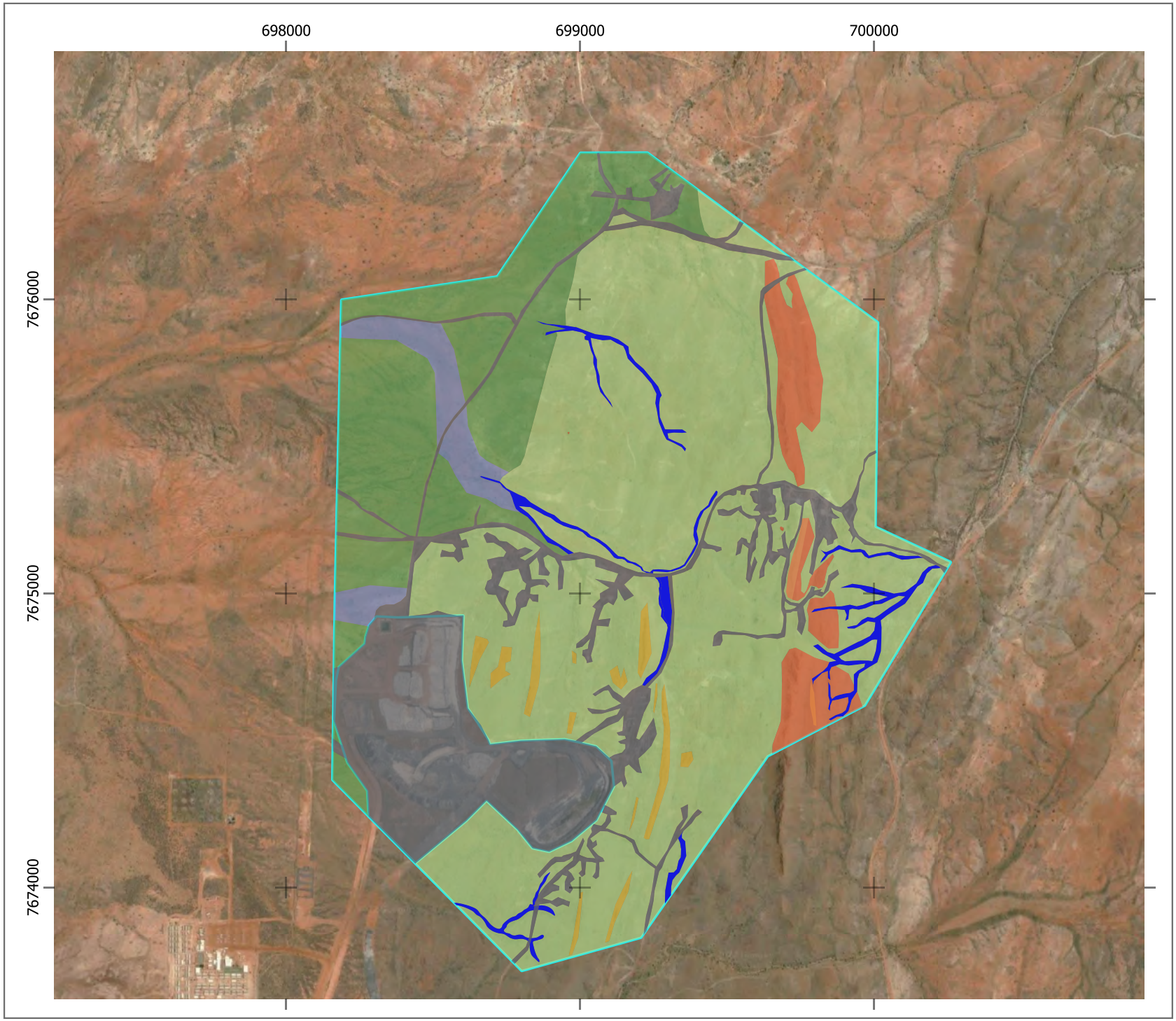
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: TB Approved: EH Date: 18/08/2022

Threatened and Priority Fauna Records

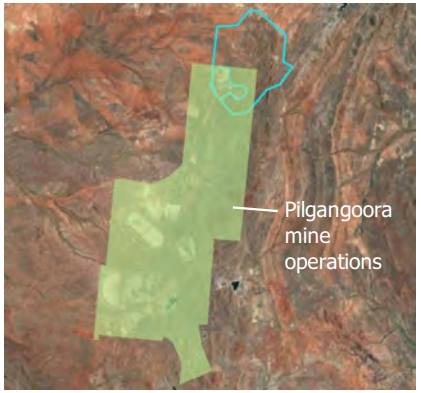
Prepared for:
Pilbara Minerals

Figure: 2-1



Legend

- FH1
- FH2
- FH3
- FH4
- FH5
- FH6
- D
- Study Area



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1: 18,000

0 200 400 m

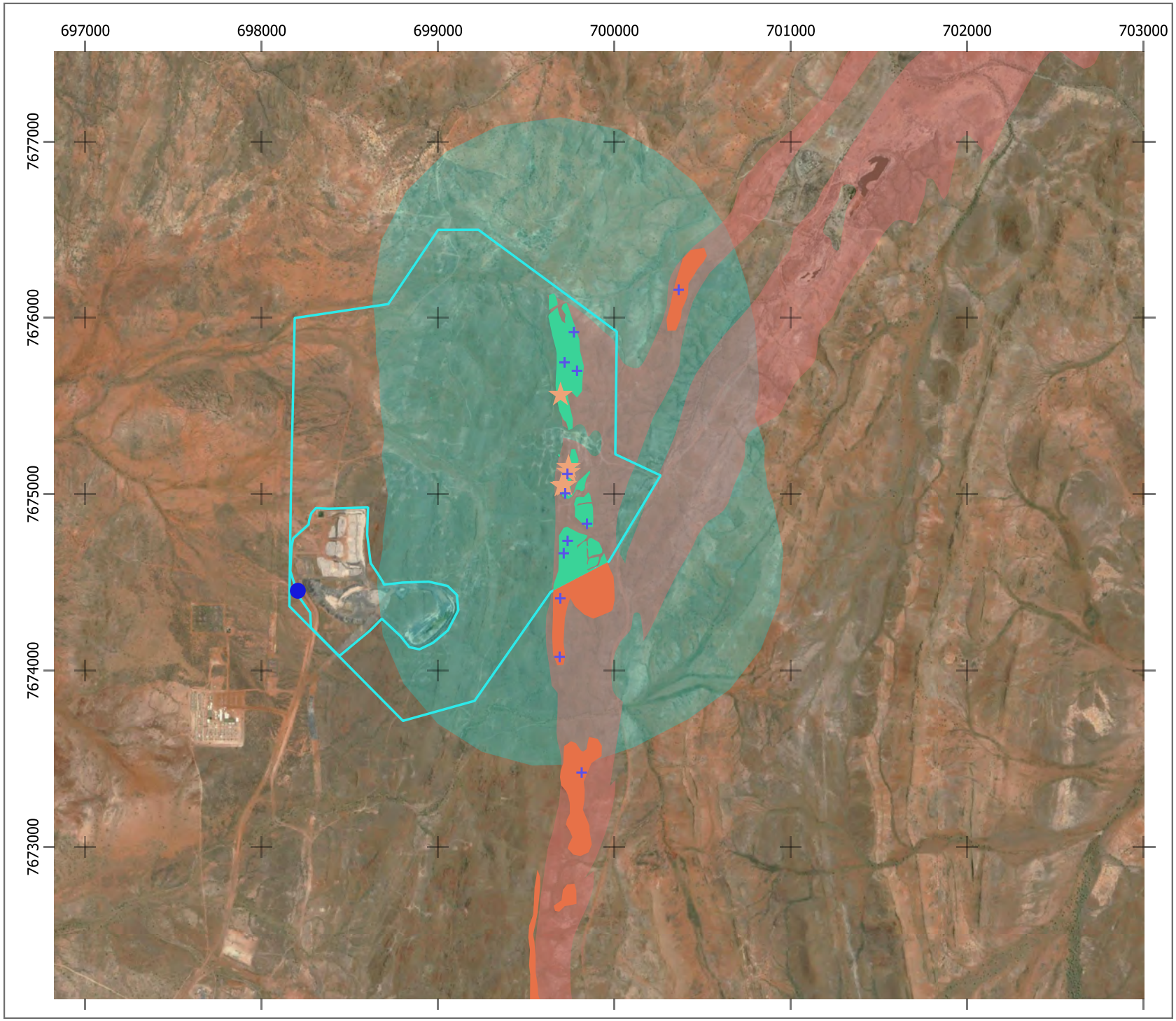
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Fauna Habitats

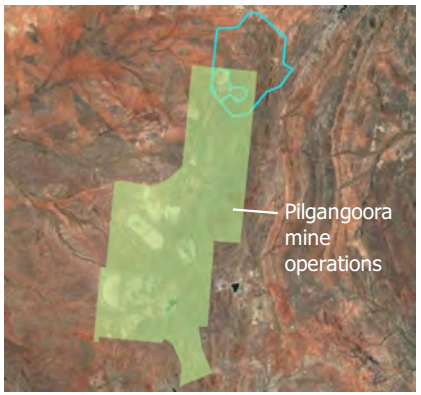
Prepared for:
Pilbara Minerals

Figure: 2-2



Legend

- Camera captures and scat locations - present study
- Camera captures Terrestrial Ecosystems (2020)
- Database record (2018)
- FH1 - Critical Habitat
- Rocky Hills Habitat identified by Terrestrial Ecosystems (2020) outside of Lynas Find Study Area
- A-KEe-xmws-mus Geological unit -likely dispersal habitat
- 1 km critical habitat buffer
- Study Area



Scale: @ A4
1: 30,000

0 250 500 m

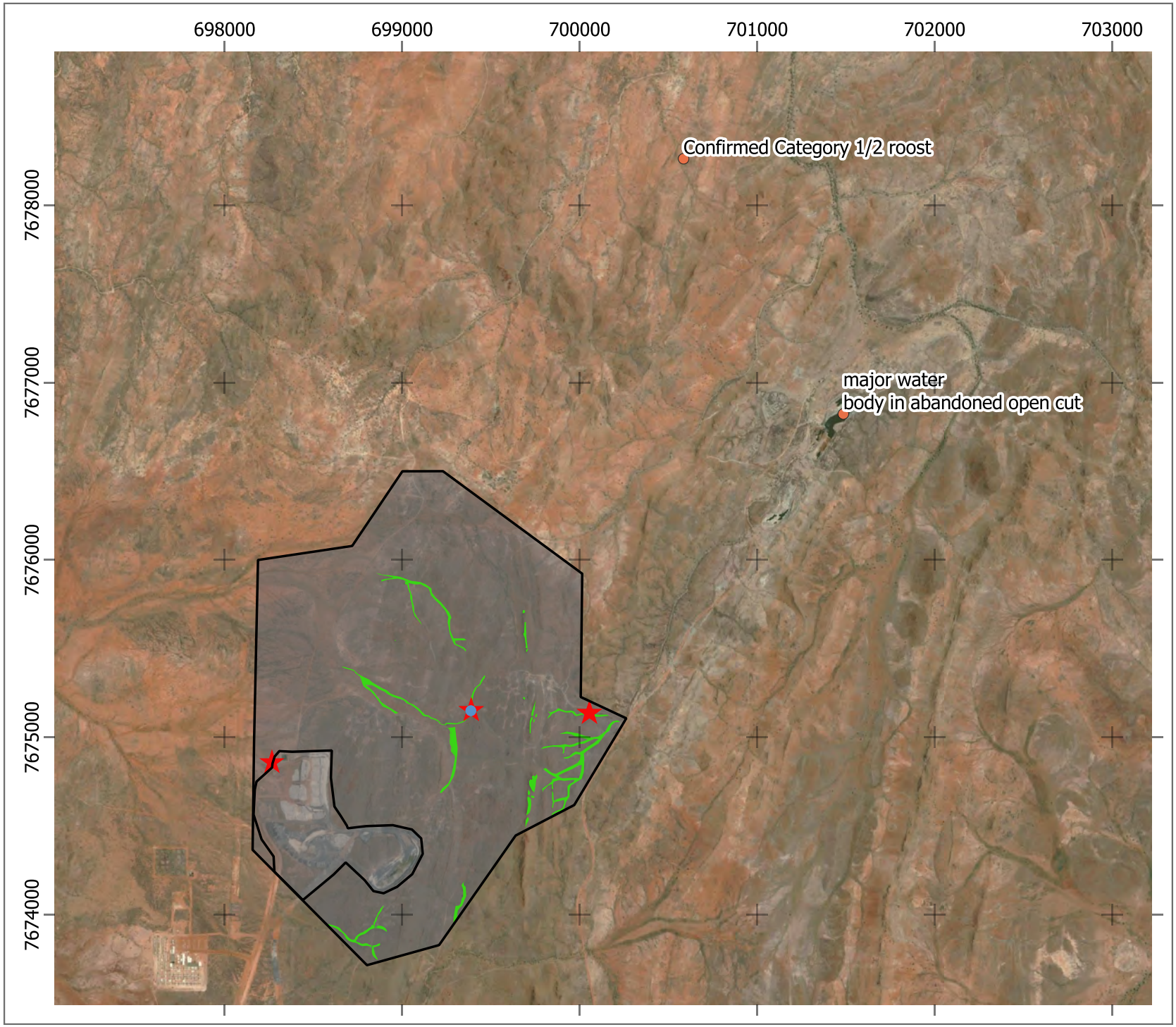
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Northern Quoll

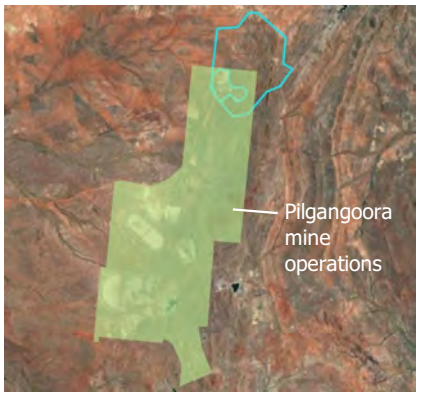
Prepared for:
Pilbara Minerals

Figure: 2-3



Legend

- Acoustic recordings of Pilbara Leaf-nosed Bat
- Moderate habitat rating
- Low habitat rating
- Database record from previous Targeted Survey



Scale: @ A4
1: 30,000

0 250 500 m

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator

Author: EH Approved: ML Date: 25/10/2022

Pilbara Leaf-nosed Bat

Prepared for:
Pilbara Minerals

Figure: 2-4

P: PO Box 454, Leederville WA 6903 | A: 604 Newcastle St, Leederville WA 6007 | T: 1300 251 070 | W: www.talisconsultants.com.au

690,000 692,000 694,000 696,000 698,000 700,000 702,000 704,000 706,000

7,678,000 7,676,000 7,674,000 7,672,000 7,670,000 7,668,000 7,666,000

ETRR
C6
C5
C18iv
C7iv
C12i
C11i
C6i
C16iv
C16iii
C11iii

Data source: Roads • Landgate, 2023. Imagery: ESRI, 2023.

LEGEND

- Lynas Find Mine Development Envelope
- Proposed Avoidance Area

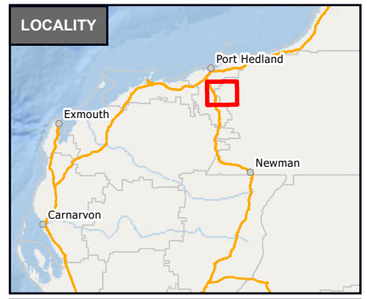
Ghost Bat Roost Sites

- Category 4 Roost
- Potential Category 2 or 3 Roost
- Potential Category 3 Roost
- Ghost bat camera capture

Western Australian Roads

- Minor Road

LOCALITY



0 200 400 600 800 1,000 km

GHOST BAT ROOST SITES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 500 1,000 1,500 2,000 2,500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:55,000

Prepared:	E Jackson	Date:	7/05/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

talis consultants

Figure 2-5

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2023\TE23060 - Pilbara Minerals Lynas Find Approvals\GIS\Maps\TE23060 - Pilbara Minerals Lynas Find Approvals\TE23060 - Pilbara Minerals Lynas Find Approvals.aprx

2.2 Potential Impacts

2.2.1 Direct impacts

2.2.1.1 *Vegetation Clearance and Loss of Habitat*

The nature of the Proposed Action requires the clearing of native vegetation be undertaken for the placement of infrastructure. Both the native vegetation as well as the natural rock formations in the area provide habitat for native fauna, and the proposed disturbance will result in impacts to the area.

A maximum of 87.1 ha of vegetation will be disturbed as a result of Proposed Action implementation. Of this 87.1 ha, up to 4.62 ha is considered to be high quality denning habitat for Northern Quolls and may also be used sporadically by CS bats in the area. The remaining vegetation consists of good condition vegetation, that is well represented in the surrounding areas.

2.2.1.2 *Habitat Fragmentation*

Habitat fragmentation occurs as a result of direct clearing of habitat, leading to smaller areas being suitable for habitation and limited connectivity between these areas. Currently populations of Northern Quolls are known to inhabit the rocky ridges to the east of the Pilgangoora (where the Proposed Action will impact), with another population located approximately 16km to the west near the Turner River (APM, 2023). Connectivity between these two populations may occur via creeks and channels providing greater vegetative cover, however there is no current evidence of this connectivity.

Northern Quolls are known to have home ranges of at least 35 ha, with individuals known to have travelled over 2 km in a single day (Schmitt et al., 1989), meaning Northern Quolls are able to move between denning habitat in the area easily. The proposed clearing works is unlikely to create significantly isolated fragments of NQ habitat in the area. The proposed clearing works may disrupt the potential connectivity between the population at Pilgangoora and the population at Turner River, however there is no current evidence of this connectivity, meaning the impact is unlikely to be significant.

The nearest PLNB roost is located approximately 3 km to the north of the Proposed Action area, and consists of an old mining shaft that houses a number of PLNB. Ghost bats have been located at an overhang approximately 2.4 km to the north of the Proposed Action area.

Both PLNB and Ghost bats have extensive foraging ranges of at least 20 km. There is no evidence that any area impacted by the Proposed Action is used as nesting habitat, other than for short rests during foraging activities.

2.2.1.3 *Increased Risk of Feral Animals, Weeds, and Fire Risk*

Implementation of the Proposed Action has the potential to increase the risk of feral animals, weeds and fire within the area, due to:

- An increase in vehicle movement within the area potentially spreading weeds;
- Increased vehicle movement and other human activity increasing risk of fire ignition;
- An increase in the susceptibility of vegetation to fire; and
- Domestic waste and mine site water sources attracting feral animals to the area.

2.2.1.4 *Direct Mortality*

The implementation of the Project may impact upon native fauna species via direct mortality through:

- Vehicle strike;
- Collision with fences (particularly for Ghost bats); and
- Entrapment in site infrastructure.

2.2.2 Indirect Impacts

2.2.2.1 *Increased Light Dust, Noise and Vibration*

The Project is expected to operate on a 24-hr basis, with an anticipated mining life of 3 years. The WRL will operate for a longer period, accepting waste rock from the greater Pilgangoora operations.

Given the proposed operation period, there will be a significant increase in the amount of noise, light, vibration and dust generated in the area, predominantly from machinery operations, as well as blasting activity. This may impact on native fauna through modification of behaviour to avoid the operations, which may also result in a reduction in habitat utilisation of nearby areas.

Changes in lighting patterns of the area may also result in behavioural changes to nocturnal species, which include the Northern Quoll, Ghost bat and PLNB. Lights may also attract invertebrates, which in turn may increase predation by bats, increasing the risk of further impacts such as vehicle strike.

Additionally, the increase in fugitive dust generation may impact upon local vegetation, decreasing the quality of both foraging area and habitat.

Increased vibration levels resulting from operation of heavy machinery as well as blasting activity may also impact fauna through avoidance of the area, as well as potential for habitat damage resulting from increased intensity of vibration in the area.

2.2.2.2 *Water Resources*

The Proposed Action is unlikely to have a significant impact on local water resources given it is located on a topographical ridge, which is the top of the local catchment and will only experience minimal surface water flows.

There are no permanent surface water features within the Proposed Action footprint. The construction of a water diversion bund around the proposed pit ensures that downstream surface water flows are maintained. Increased sedimentation of surface waters may result from water flows across cleared areas, as well as from the WRL. The WRL will be bunded to capture surface run-off and prevent mixing of run-off with natural creek waters.

Groundwater impacts are expected to be limited to changes in standing water level in the area immediately surrounding the pit due to groundwater drawdown. Given the inert properties of the waste rock, impacts to groundwater quality are not expected.

2.3 Risk Assessment

The risk assessment for the Proposed Action has been developed to identify the potential impacts of the Proposed Action on the conservation significant fauna species in the area, as well as potential management actions that can be implemented to reduce the potential impact.

The Risk matrix used is provided as Table 2-1, and the categories used to determine the likelihood and consequence of the risk has been provided in Table 2-2 and Table 2-3 respectively. The Risk Assessment has been adapted from the Northern Quoll Management Plan (NQMP) and Conservation Significant Bats Management Plan (CSBMP), and is provided in Table 2-4.

Table 2-1: Risk Matrix

		Consequence				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Rare	Low	Low	Low	Moderate	Moderate
	Unlikely	Low	Low	Moderate	Moderate	High
	Possible	Low	Moderate	Moderate	High	High
	Likely	Moderate	Moderate	High	Extreme	Extreme
	Almost Certain	Moderate	High	High	Extreme	Extreme

Table 2-2: Risk Likelihood Categories

Likelihood	Frequency	Description
Rare	Once in 20+ years	Event will occur in exceptional circumstances during the Proposed Action.
		Very few or no known occurrences.
Unlikely	Once in 10 years	Event is not likely to occur during the Proposed Action.
		Some occurrences known.
Possible	Once in 5 years	Event may occur in some instances during the Proposed Action.
		Occasional incidents known.
Likely	Once per year	Event likely to occur during the Proposed Action.
		Regular incidents known.
Almost Certain	Twice or more per year	Event will occur during the Proposed Action.
		High number of known incidents.

Table 2-3: Risk Consequence Categories

Consequence	Definition
Insignificant	Alteration or disturbance to an isolated areas with no effect on conservation significant fauna or ecosystem. No loss of Northern Quoll, PLNB or Ghost bat individuals.
Minor	Alteration or disturbance to <10% of rocky ridge habitat or ecosystem, resulting in impact recovery within 2 years. Loss of Northern Quoll, PLNB or Ghost bat individuals.
Moderate	Alteration or disturbance of 10-40% of a habitat ecosystem resulting in a recoverable impact within 2-5 years. Decrease of up to 50% of conservation significant fauna species level of activity and presence within Proposed Action area.
Major	Alteration or disturbance of 40-70% of a habitat ecosystem resulting in a recoverable impact within 5-15 years. Decrease of up to 80% of conservation significant fauna species level of activity and presence within Proposed Action area.
Severe	Alteration or disturbance of >70% of a habitat ecosystem resulting in a recoverable impact within >15 years. Decrease of >80% of conservation significant fauna species level of activity and presence within Proposed Action area.

Table 2-4: Risk Assessment

Risk Pathway	Description of Impact	Likelihood	Consequence	Inherent Risk	Controls/Risk Treatment	Likelihood	Consequence	Residual Risk
Vegetation clearing of rocky ridge habitat.	Decline in Northern Quoll population numbers. Fragmentation of habitat restricting movement through critical habitat areas. Isolation of Northern Quoll population.	Likely	Major	Extreme	Establishment of avoidance area surrounding rocky ridge habitat. Prior to ground-disturbing activities within denning habitat, pre-clearance trapping for Northern Quoll will be conducted. Further assessments of denning habitat will occur to map areas likely to host dens or potential future dens – this will include passive monitoring techniques (e.g. motion-sensor cameras) to establish quoll use. Disturbance to native vegetation will be minimised. A Clearing Permit will be obtained prior to clearing. Staged clearing. An internal Land Use Certificate (LUC) will be obtained prior to ground disturbance. No unauthorised off-track driving to occur. Conduct progressive rehabilitation where possible, using local provenance seed.	Possible	Major	High
Vegetation clearing and land disturbance of foraging and dispersal habitat.	Decline in conservation significant species population numbers due to reduced food sources. Fragmentation of habitat resulting in restricted movement to foraging and denning areas for the Northern Quoll.	Possible	Major	High	Prior to ground-disturbing activities, pre-clearance trapping for Northern Quoll will be conducted in foraging and denning habitat. Disturbance to native vegetation will be minimised where practicable. A Native Vegetation Clearing Permit (NVCP) will be obtained from DMIRS prior to clearing (if required). Staged clearing. An internal LUC will be obtained prior to ground disturbance. No unauthorised off-track driving to occur. Conduct progressive rehabilitation using local provenance seed to minimise the time between disturbance and rehabilitation.	Unlikely	Major	Moderate

Risk Pathway	Description of Impact	Likelihood	Consequence	Inherent Risk	Controls/Risk Treatment	Likelihood	Consequence	Residual Risk
Vegetation clearing and land disturbance. Vehicle movements. Human and mine site activities.	Introduction or spread of weed species resulting in: • an increase of the susceptibility of vegetation to fire and an increase in the intensity of fire. • degradation of foraging habitat.	Possible	Moderate	Moderate	A total LUC will be in place at the Project unless required for emergency response training (and in these cases only in low-risk weather conditions). Firebreaks of 5 m will surround all project infrastructure Roads and haul roads will act as fire breaks. No unauthorised vehicle or human access to exclusion areas or off main mine access roads. All vehicles will be clean of vegetation or soil material prior to mobilisation to site. Existing weed species and infestations within operational mining areas will be managed. Wash down bays will be installed for vehicles required to go off main mine roads (e.g., for environmental monitoring, exploration etc.). Where relevant, weed hygiene zones will be established around important habitat areas to maintain the integrity of Northern Quoll habitats. Monitoring of introduced flora will be conducted annually.	Unlikely	Moderate	Moderate
Vehicle movement and human activities increasing the risk of fire ignition.	Ignition of fires resulting in habitat loss and conservation significant species individual deaths. Reduction of population size.	Possible	Major	High	A total fire ban will be in place unless for emergency response training (and in these cases only in low-risk weather conditions). Fire breaks of 5 m will surround project infrastructure. Inductions will include fire safety and awareness, including not stopping hot vehicles over dry grass. Roads and haul roads will act as fire breaks. Firefighting equipment (e.g., extinguishers, fire blankets) will be located across site in fire risk areas including workshops, hydrocarbon and chemical storage areas, offices, camp site, mobile and fixed plant areas etc. All light vehicles will be fitted with firefighting equipment. Fire suppression equipment will be made available for all hot works. Hot work permits must be obtained prior to conducting work. Specific personnel will be trained in the use of fire extinguishing equipment and fire prevention in work areas. An emergency response team will be available to respond to fire where it is safe to do so.	Unlikely	Major	Moderate
Domestic waste, mine site water sources and human activities attracting feral fauna.	Degradation of habitat or habitat loss. Decline in population due to increased predation or competition for resources, disease transmission, poisoning from ingestion of cane toad. Health impacts from ingesting waste or contaminated water.	Possible	Moderate	Moderate	Inductions and training will address not feeding fauna, and reporting of Northern Quoll sightings by mine site personnel. Rubbish bins with lids located around site. Educational fauna signage in crib rooms and high traffic areas. Lined dams fenced with fauna egress points. Feral Animal Management Program-managed by PLS Environmental Team.	Unlikely	Moderate	Moderate

Risk Pathway	Description of Impact	Likelihood	Consequence	Inherent Risk	Controls/Risk Treatment	Likelihood	Consequence	Residual Risk
Mine site noise.	Reduction of habitat utilisation and corresponding reduction of population size and level of activity in the area. Behavioural changes.	Possible	Minor	Moderate	Engineering controls to minimise noise from plant and equipment. All plant and equipment designs will meet occupational noise standards.	Unlikely	Minor	Low
Generation of dust from mine activities.	Habitat degradation resulting in reduced use of denning / foraging habitat and subsequent level of activity in the area. Respiration issues resulting in reduction of population size and health.	Possible	Minor	Moderate	Use of water carts along roads and cleared areas to minimise dust generation. Staged clearing. Use of engineering controls to minimise dust. Use of sprinklers and deluge sprays where required. Vehicle speeds restricted on cleared tracks to minimise the generation of dust.	Unlikely	Minor	Low
Blasting and drilling at mine site.	Vibrations causing habitat destruction (e.g. cave/den collapse) and loss of significant habitat inside exclusion areas.	Possible	Major	High	Vibration impact zones will be mapped in relation to den habitat. Disturbance from blasting and drilling will be minimised where practicable. In close proximity, drilling should take place outside of the 'young in den' period.	Unlikely	Major	Moderate
Insufficient recording and reporting leading to lack of data on conservation significant species.	Impacts to conservation significant populations going unnoticed. Failure to identify all critical habitat or populations resulting in unintentional clearing of habitat and conservation significant species deaths. Reduction in populations of conservation significant species in the area.	Possible	Major	High	Camera trap monitoring to identify active denning and foraging areas. Ongoing bat monitoring to identify the presence of any conservation significant bats.	Unlikley	Major	Moderate
Vehicle movement and collision with conservation significant species.	Mortality to individuals through road kills.	Likely	Moderate	High	Vehicle speed will be restricted to 60 km/hr across site Vehicle speed will be restricted to 40 km/hr at night within 500m buffer zone of quoll habitat Roadkill will be moved off road to discourage scavenging and further strikes. Records of vehicle incidents involving fauna will be recorded.	Possible	Moderate	Moderate
Poor waste management.	Ingestion of waste material causing illness and mortality in individuals. Entrapment within waste material causing mortality in individuals	Possible	Moderate	Moderate	Inert and putrescible waste will be disposed of in a licensed landfill facility at the mine site. Waste will be regularly buried. Exposed waste to be compacted and covered at least weekly. Landfill will be fenced so as to preclude fauna. Rubbish bins will have lids to prevent dispersal of waste by wind and birds. Inductions will include fauna component and appropriate disposal of waste.	Rare	Moderate	Low

Risk Pathway	Description of Impact	Likelihood	Consequence	Inherent Risk	Controls/Risk Treatment	Likelihood	Consequence	Residual Risk
Attraction to mine site water sources.	Death via drowning of individuals in dams. Illness or death of individuals through consumption of contaminated water.	Possible	Moderate	Moderate	Fauna egress mats will be in place in dams. Dams to be fenced to preclude fauna.	Rare	Moderate	Low
Interaction with mine site personnel.	Feeding of Northern Quolls causing illness, mortality and reliance on human food sources resulting in a decline in population and health. Northern Quoll behavioural change.	Possible	Minor	Moderate	Training on the identification and reporting of Northern Quoll will be included in environmental inductions and toolbox training presentation. Feeding of Northern Quoll (and other native species) will be banned. This will be communicated to personnel in environmental inductions and environmental awareness sessions.	Unlikely	Minor	Low
Barbed wire fences and collision with bat species.	Mortality to individuals through collision with barbed wire fencing.	Possible	Moderate	Moderate	Minimise use of barbed wire fencing, where practicable. Investigate potential for different fencing designs to minimise risks to CS bats. Liaise with pastoralist regarding alternatives, where fencing is required	Rare	Insignificant	Low

3 Environmental Management Measures

3.1 Environmental Management Activities, Controls and Performance Targets

The key management measures to be implemented during the construction, operation and rehabilitation of the Proposed Action have been listed in Table 3-1 below.

Completion criteria for each management measure have been developed, and the monitoring and reporting requirements to ensure the performance or completion criteria are met have also been outlined in Table 3-3. Risks of implementation of each management measure and further measures to avoid these risks eventuating have also been identified.

The management measures outlined below have been developed to avoid impacts where practicable, and where avoidance is not possible measures will be implemented to minimise the potential impact on the surrounding environment and CS species. Rehabilitation measures have also been included, to minimise the Proposed Action impacts by reducing the time between disturbance and rehabilitation, and to ensure rehabilitation includes measures that are focused on maintaining the local populations of CS species.

Monitoring of the effectiveness of the proposed management measures is also key to ensure the expected outcomes are being met, and any issues with the current management approach can be fed back into this adaptive management plan.

Table 3-1: Management Measures

Management Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Establishment of avoidance area surrounding rocky ridge habitat.	No disturbance within avoidance area.	Disturbance data is reported on an annual basis through DMIRS MRF and AER systems.	Avoidance area incorrectly established leading to disturbance of rocky ridge habitat.	Avoidance area demarcation to be undertaken by qualified surveyors, and shape files checked against approved areas prior to disturbance.
Prior to ground disturbance or clearing, trapping for Northern Quoll will be undertaken within the denning habitat areas.	Trapping scheduled and undertaken for all clearing within denning habitat.	Records of fauna trapped as part of programs prior to clearing will be kept, and submitted to DBCA and DCCEEW as required.	Trapping unable to be undertaken prior to clearing due to lack of suitably qualified personnel, inclement weather or unsuitable access.	Clearing will be postponed until conditions allow for trapping to be undertaken.
Further monitoring and assessment of conservation significant fauna will be undertaken.	Targeted conservation significant species surveys to be carried out triennially.	Reports relating to conservation significant species surveys will be kept and submitted to DBCA and DCCEEW as required.	Conservation significant species monitoring unable to be undertaken due to lack of suitably qualified personnel, inclement weather or unsuitable access.	Monitoring events for conservation significant species are planned within 2 years of the previous monitoring event, to allow contingency for scheduling monitoring events.
Disturbance to native vegetation will be constrained within clearing boundaries, and minimised.	No clearing outside of approved areas.	Disturbance data is reported on an annual basis through DMIRS MRF and AER systems. A reconciliation of cleared vs approved areas is undertaken annually.	Clearing boundaries incorrectly established.	Clearing demarcation to be undertaken by qualified surveyors, and shape files checked against approved areas prior to disturbance.

Management Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Clearing will be undertaken progressively to retain habitat for as long as possible.	Clearing completed in a staged manner over the years of operation.	Disturbance data is reported on an annual basis through DMIRS MRF and AER systems. Records of timing of clearing will be kept.	Clearing not undertaken progressively, leading to a significant change in habitat in a short time frame.	Mine planning to ensure that clearing areas are completed in stages, separated by a minimum of 6 months between major clearing events of over 10 ha.
Internal Land Use Certificates (LUCs) will be required prior to clearing activities commencing.	No clearing undertaken without an approved LUC in place.	Records of all approved LUCs are to be maintained and used in the annual disturbance reconciliation.	LUC procedure not followed, leading to unauthorised clearing.	All staff are trained in the requirements for an approved LUC to be in place prior to disturbance activities.
Existing weed infestations on site will be effectively managed to reduce spread and overall density, and hygiene areas will be established around the avoidance zone.	No increase in weed infestations on site or within the avoidance zone.	Weed monitoring is to be undertaken annually to determine if there are any increases in weed infestations, and to ensure a targeted management approach.	Weeds not effectively managed and/or weed hygiene zone not enforced, leading to an increase in weed density and dispersion on site.	Weed management is undertaken on an ongoing basis dependant on season and plant physiology. Management timing and actions will be informed by results of annual weed monitoring events.

Management Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Feral animal management program to be implemented by site staff.	No increase in feral animal populations within the Development Envelope.	Records of all feral animal sightings on site to be maintained, and any increase over an annual period is to be investigated. Baseline data is to be established in the first year of construction. Fauna monitoring to be completed triennially and include an assessment of feral animal populations.	Feral animal management not undertaken, or measures are ineffective.	Best practice options for management of feral cats and foxes will be undertaken as required based on sightings in the area. Assessment as to requirements for feral animal management activities will be undertaken annually or more frequently depending on incidence of sightings.
Fires on site to be banned, except for emergency response training in low fire risk conditions.	No unauthorised fires on site.	Records of all fires or near misses to be maintained, and investigations into the cause of the fire to be undertaken.	Fires deliberately set outside of low risk conditions. Fire management procedures not followed leading to out of control fires on site.	Fire training to be undertaken by qualified personnel, with reference to fire risks at the time of training. Fire breaks and other fire management equipment to be inspected annually.

Management Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
In order to avoid fauna mortalities, only authorised vehicles will be permitted on site, and no vehicles will be permitted to enter the avoidance zone outside of emergency conditions.	Avoidance zone to be barricaded and signed to prevent unauthorised access.	Records of permitted access, as well as any cases of unauthorised access are to be maintained.	Unauthorised access to the avoidance zone leading to impacts on Northern Quoll habitat.	Procedure for access to avoidance zone to include sign-off by the HSEQ team. Barricades to be inspected every 6 months to ensure integrity is maintained. Speed limits of 40 km/hr within exclusion zones where access is necessary.
Equipment is designed to meet occupational noise standards (85 dB over 8 hours, or 140 dB peak), and minimise noise emissions where possible.	Noise emissions of plant and equipment to meet noise standards. No excessive noise emissions from site.	Records of equipment compliance with noise standards to be maintained.	Changes in equipment leading to increases in noise emissions.	Regular equipment maintenance undertaken to ensure operation of equipment is in line with manufacturer recommendations.
Progressive rehabilitation to be undertaken on landforms.	Rehabilitation planning to commence on WRL within 3 years of commencement of waste rock dumping.	Areas rehabilitated to be reported through the annual MRF submission. Monitoring of rehabilitation condition to be undertaken annually following establishment.	Progressive rehabilitation not commenced within 3 years due to changes in mine schedule or landform design.	Changes to mine schedule or landform design are to consider implications of rehabilitation, and ensure that progressive rehabilitation can be undertaken as a priority.

Management Measure	Performance or Completion Criteria	Monitoring and Reporting Requirements	Risks	Measures for Risk Mitigation
Rehabilitation of landforms and other cleared areas are to include fauna habitat creation, with investigation into areas suitable to support Northern Quoll.	Northern Quoll present in provided habitat and rehabilitated areas.	Monitoring of rehabilitation condition to be undertaken annually following establishment. Assessment of utilisation of rehabilitated areas to be undertaken following establishment of rehabilitation vegetation.	Northern Quoll may not use rehabilitated areas. Investigation into artificial habitat use may indicate designs are unsuitable.	Rehabilitation program design to be informed through trials undertaken at other mine sites with impacts to Northern Quolls. Assessment of establishment of trials to determine best practice measures for artificial habitat design.
Bunding of the Lynas Find WRL to prevent loss of sediment to local creek systems.	Bund/surface water diversion constructed around the perimeter of the WRL made of competent rock. Water to be captured and does not mix with water from the natural creek system.	Annual inspections to ensure integrity of the bund is maintained. Water quality to be monitored opportunistically following large rainfall events.	Bund integrity compromised through incorrect materials management.	Annual inspection of bund integrity. Materials management procedures to ensure correct material handling and placement.
Additional groundwater monitoring to further understand dewatering requirements.	Installation of 4 monitoring bores within the vicinity of the proposed pit.	Monthly monitoring of water levels and quarterly water quality sampling. Records to be maintained.	Results indicate dewatering volumes higher than anticipated.	Bores to be installed prior to project commencement, allowing time to develop water management strategies if required.

3.2 Environmental Management Programs

3.2.1 Site Disturbance Permitting Process

All disturbance on site is managed through the Land Use Certificate (LUC) Procedure, which outlines the process for ensuring all works are undertaken in accordance with applicable approvals, and disturbance and other impacts are minimised as far as practicable.

Under the procedure, site personnel complete a LUC application outlining the proposed activities. This application is assessed by the Environment Team to ensure compliance with all environmental approvals, permits and internal environmental management system, including this EMP. The environmental review will initially involve a desktop assessment against existing environmental data (i.e. approved disturbance boundaries, flora and fauna studies, avoidance areas, heritage surveys and pastoral boundaries).

If the LUC application proceeds beyond this step, conditions and controls will be attached to the LUC to manage environmental impacts and risks as required. The LUC Register is maintained to include the disturbance and any key operational changes. Compliance with LUC conditions may be audited during and following works being carried out, and any non-compliances are recorded as incidents and investigated. Further controls may be included in the LUC in response to incidents and non-conformances.

3.2.2 Water Management

Although the Proposed Action is unlikely to impact significantly on water resources, a number of water management measures are proposed to ensure the potential impact is minimised.

Surface water will be diverted around the proposed pit to maintain natural water flow volumes. Additionally, the proposed WRL will be bunded with water capture infrastructure to ensure that all surface run-off is captured and downstream sedimentation does not occur.

Groundwater levels are likely to reduce in the area immediately surrounding the pit following mining below the water table and groundwater abstraction. There are no groundwater dependant ecosystems or other groundwater users in the area that will be impacted by the Proposed Action. Groundwater monitoring will be undertaken as per Section 3.3.4.

3.2.3 Weed Management

Eight introduced flora species have been recorded locally with three species identified during field surveys of the Proposed Action area (Table 3-2).

Table 3-2: Introduced Flora within Proposed Action Area

Species	Common Name	Description (Florabase, 2022)
Aerva javanica	Kapok	Erect, much-branched perennial herb, 0.4-1.6 m high. Flowers white from January to October. Often found growing on sandy soils and along drainage lines.
Cenchrus ciliaris	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to

Species	Common Name	Description (Florabase, 2022)
		October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.
Cenchrus setiger	Birdwood grass	Erect, tussocky, stoloniferous perennial, herb or grass-like. Grows to 0.5 m high. Flowers cream to purple from April to May. Grows on brown sands, red loam, or pindan soils on sand dunes, plains, rangelands, stony hillsides, or floodplains.

Weed management will be undertaken in accordance with the site Weed Management Procedure, and actions will include:

- Management of site access to ensure all vehicles on site are free of weeds and soils;
- Restriction of access to avoidance areas;
- Management including physical removal of weed species and application of appropriate weed killer to weeds present on site;
- Wash down bays to be provided for vehicles required to travel outside existing site roads; and
- Establishment of weed hygiene zones around areas of Northern Quoll habitat where required.

3.2.4 Feral Animal Management

A number of introduced fauna species have been recorded within 30 km of the Proposed Action area (APM, 2022), including:

- Camel (*Camelus dromedarius*);
- Cat (*Felis catus*);
- Cattle (*Bos taurus*);
- Dog (*Canis lupus*);
- Donkey (*Equus asinus*)
- Fox (*Vulpes vulpes*)
- Horse (*Equus caballus*); and
- House Mouse (*Mus musculus*).

Of these, only cattle have been sighted during fauna surveys of the Proposed Action area.

Feral animals on site will be managed in accordance with the site Fauna Management Procedure. Generally, prevention of access to site is preferred over direct management including culling. Management measures for reducing feral animal numbers on site include:

- Inductions, training and site signage to educate site personnel on identification of likely feral species and reporting requirements and procedures;
- Records of all feral animal sightings to be maintained;
- All bins containing putrescible waste on site to have secure lids;
- Any open water storage will be fenced to prevent access; and

- Where numbers indicate an increasing feral animal population, baiting or trapping programs will be considered in consultation with the WA Department of Biodiversity and Conservation.

3.2.5 Fire Management

A number of actions will be taken to minimise the risk of an increase in fires in the area as a result of the Proposed Action, including:

- Firebreaks will be installed around all project infrastructure, with haul roads and access roads acting as a firebreak where possible;
- No vehicle access to areas off main mine roads (unless expressly authorised);
- Implementation of a hot works permitting process; and
- Weed management as per Section 3.2.2 to minimise fuel loads.

3.3 Environmental Monitoring

Ongoing monitoring of CS bats and Northern Quoll will be undertaken over the life of the Proposed Action. The monitoring plans are summarised below, and further information can be found in the NQMP and CSBMP.

3.3.1 Northern Quoll Monitoring

An annual Northern Quoll monitoring program will be undertaken during operation of the Proposed Action. Monitoring will be undertaken through a trapping program implemented over four nights between April and August on an annual basis. This timing will avoid periods when females may be caring for young in dens.

Monitoring will record numbers of Northern Quoll individuals, as well as measurement of the health condition index (HCI) of captured females. HCI is calculated as the cube root of body weight (g) divided by the short pes length (mm). This data will be used to assess the impact of the Proposed Action on the Northern Quoll population, as well as whether the environmental outcomes are being met. Table 3-3 below outlines the proposed environmental outcomes for the Northern Quoll, as well as trigger and threshold levels requiring further monitoring and mitigation actions to be imposed.

Table 3-3: Performance criteria and outcomes

Outcome	Performance criteria	Trigger	Threshold
No change to the local geographic distribution of the Northern Quoll.	Northern Quoll presence is confirmed during annual monitoring with a distribution that is not different to baseline.	Northern Quoll distribution is lower than baseline, with Northern Quoll not recorded at an equal number of sites to baseline, and the change is not attributable to climatic conditions or fire ignited from natural sources.	Less than 50% of transects return Northern Quoll compared to baseline, during annual monitoring, for two consecutive years

Outcome	Performance criteria	Trigger	Threshold
No change to the abundance of Northern Quoll in the local area.	Trap success is not statistically significantly lower than base line.	Trap success is statistically significantly lower ($p<0.05$) than baseline for two consecutive years, and the change is not attributable to climatic conditions or fire ignited from natural sources.	Trap success is statistically significantly lower ($p<0.05$) than baseline for three consecutive years
No decline in population condition.	Female HCI doesn't decline over time. Mean mass of males and females does not decline over three or more consecutive monitoring years.	HCI declines over two consecutive monitoring years, and the change is not attributable to climatic conditions or fire ignited from natural sources.	HCI declines at a statistically significant ($p<0.05$) rate over a period of three consecutive years

Monitoring results will be analysed annually, and should the trigger or threshold levels be met, the contingency actions outlined in Table 3-4 will be undertaken. Any trigger level exceedances will be reported to DCCEEW as part of reporting requirements under the EPBC Act, and any threshold level exceedance will be reported within 7 days of the exceedance, with an investigation report to be provided within 21 days of the exceedance.

Table 3-4 : Trigger and threshold exceedance actions

Outcome	Trigger level exceedance actions	Threshold level exceedance actions
No change to the local geographic distribution of the Northern Quoll	Undertake 10 person-hours of track and scat searches per site where Northern Quoll was not recorded. Audit NQMP and associated procedure/management plan management actions and remediate any non-conformances.	Repeat trapping monitoring program within 2 months if between 1 April and 30 September to avoid times when females may have young in their dens. If the 2-month period would result in trapping outside this timeframe, repeat monitoring should be conducted in April. Deploy Camera Traps. Location and number of cameras to be deployed will be determined following consultation with DBCA, DCCEEW and Fauna specialists. Consult the Regional Pilbara Northern Quoll Monitoring Program outcomes to investigate whether a Region wide decline is occurring. Consult with DCCEEW and DBCA. Review the NQMP, EMP and associated procedure/management plans. If any
No change to the abundance of Northern Quoll in the local Pilgangoora area	Audit NQMP and EMP and associated procedure/ management plan management actions and remediate any non-conformance	
No decline in population condition	Audit NQMP and EMP and associated procedure/ management plan management actions and	

Outcome	Trigger level exceedance actions	Threshold level exceedance actions
	remediate any non-conformance	revisions are required, the revised plan will be submitted to DCCEEW for approval.

3.3.2 Conservation Significant Bat Monitoring

Monitoring of CS bats at the Proposed Action area will involve a combination of three non-invasive methods to detect presence and level of activity. Acoustic-based monitoring will be conducted continuously to detect calls of the PLNB, and Ghost Bat calls at a known roost that lies out of the current Proposed Action area. Twice-yearly, an acoustic lure will be used to determine Ghost bat presence, and a camera trap will be set up to take periodic still images at caves within the vicinity of the area. Data from these non-invasive monitoring tolls will be uploaded every three to six months, and will be analysed on an annual basis by a suitably qualified zoologist.

Table 3-5 below outlines the outcomes and performance indicators for CS bat species in the Proposed Action area, as well as trigger and threshold levels that will require further monitoring or mitigation techniques to be investigated and deployed.

Table 3-5: Contingency Actions

Outcome	Performance Indicator	Trigger	Threshold
No detectable significant change to the level of activity or presence of conservation significant bats in the Proposed Action area	Measures of bat presence are equivalent to the established baseline	Measures of bat presence and activity are statistically significantly lower ($p<0.05$) than the established baseline for two consecutive years, and the change is not attributable to climatic conditions, fire ignited from natural sources, or disturbance to diurnal roosts outside the Pilgangoora Project area that are within the influence of other mining projects.	Measures of bat presence and activity are statistically significantly lower ($p<0.05$) than the established baseline for three consecutive years.

3.3.3 Habitat Monitoring

Confirmation of the extent of habitat types suitable for Northern Quoll denning will be undertaken in conjunction with annual Northern Quoll monitoring events. This will include passive monitoring techniques to establish quoll use of identified habitat areas and more detailed mapping of areas likely to host dens.

Any further expansions of the Project will include targeted searches for habitat types that may be critical to conservation significant species.

3.3.4 Water Monitoring

Groundwater monitoring bores will be established within the vicinity of the proposed Lynas Find pit and WRL to monitor water levels and water quality throughout construction and operation of the Project. Water levels will be monitored on a monthly basis and water quality will be tested quarterly. A baseline of at least 2 years of data relating to water quality and level will be established prior to commencement of mine dewatering. This baseline will be used to establish standards a that may trigger further investigation and implementation of environmental controls.

Additionally, the site water balance and groundwater model will be updated to include the potential impacts from dewatering of the Lynas Find pit. Contingency actions will be developed if any further impacts are identified during refinement of this groundwater modelling.

Table 3-6 outlines the proposed parameters for groundwater monitoring.

Table 3-6: Groundwater Monitoring Parameters

Parameter	Units	Monitoring Frequency	Parameter	Units	Monitoring Frequency
Standing water level	mbgl	Monthly	**Lithium**	mg/L	Quarterly
pH	pH units	Monthly (field sample)	**Magnesium**	mg/L	Quarterly
Electrical Conductivity	µs/cm	Monthly (field sample)	**Potassium**	mg/L	Quarterly
Ammonia	mg/L	Quarterly	**Silica (soluble)**	mg/L	Quarterly
Bicarbonate alkalinity as HCO3	mg/L	Quarterly	**Sodium**	mg/L	Quarterly
Calcium carbonate as CaCO3	mg/L	Quarterly	**Total nitrogen**	mg/L	Quarterly
Carbonate alkalinity as CaCO3	mg/L	Quarterly	**Total phosphorus**	mg/L	Quarterly
Nitrate NO3	mg/L	Quarterly	**Aluminium**	mg/L	Quarterly
Nitrite NO2	mg/L	Quarterly	**Antimony**	mg/L	Quarterly
Total alkalinity as CaCO3	mg/L	Quarterly	**Arsenic**	mg/L	Quarterly
Total dissolved solids (TDS)	mg/L	Quarterly	**Barium**	mg/L	Quarterly
Total hardness	mg/L	Quarterly	**Bismuth**	mg/L	Quarterly
Sulfate (SO4)	mg/L	Quarterly	**Boron**	mg/L	Quarterly
Calcium	mg/L	Quarterly	**Bromide**	mg/L	Quarterly
Chloride	mg/L	Quarterly	**Cadmium**	mg/L	Quarterly

Parameter	Units	Monitoring Frequency	Parameter	Units	Monitoring Frequency
Caesium	mg/L	Quarterly	**Phosphorus**	mg/L	Quarterly
Chromium	mg/L	Quarterly	**Rubidium**	mg/L	Quarterly
Cobalt	mg/L	Quarterly	**Selenium**	mg/L	Quarterly
Copper	mg/L	Quarterly	**Silicon**	mg/L	Quarterly
Fluoride	mg/L	Quarterly	**Silver**	mg/L	Quarterly
Hexavalent Chromium	mg/L	Quarterly	**Sodium**	mg/L	Quarterly
Iron	mg/L	Quarterly	**Strontium**	mg/L	Quarterly
Lead	mg/L	Quarterly	**Tantalum**	mg/L	Quarterly
Magnesium	mg/L	Quarterly	**Thallium**	mg/L	Quarterly
Mercury	mg/L	Quarterly	**Thorium**	mg/L	Quarterly
Molybdenum	mg/L	Quarterly	**Tin**	mg/L	Quarterly
Manganese	mg/L	Quarterly	**Uranium**	mg/L	Quarterly
Nickel	mg/L	Quarterly	**Vanadium**	mg/L	Quarterly
Niobium	mg/L	Quarterly	**Zinc**	mg/L	Quarterly

Surface water monitoring will be undertaken on an opportunistic basis, following large rainfall events where water may create local pools, and fill the proposed WRL bund. The parameters in Table 3-6 will be assessed for any surface water samples collected.

3.3.5 Weed Monitoring

Weed monitoring will be conducted annually, consisting of weed assessments and mapping. All environmental inspection templates will include an assessment of whether new weed infestations are apparent. Baseline data for weed infestations will be collected prior to commencement of clearing. Should any new weed infestation, increase in overall existing extent of weed location, or species not previously found on site be apparent following assessment, investigation will be undertaken, and appropriate management actions developed and implemented.

Records of weed management undertaken on site including location and method used will be maintained. Spatial records of weed locations within the Proposed Action area will be maintained and updated annually following weed assessments.

3.3.6 Feral Animal Monitoring

No specific feral animal monitoring events will be undertaken, however should threshold actions be required as per Table 3-4, deployment of camera traps will enable an assessment of feral animal populations within the Proposed Action area.

All sightings of feral animal species on site, including mortalities, are required to be reported internally. Preliminary assessment of feral animal numbers will be undertaken based on reports of sightings, with baseline data to be established in the first year of construction. Any sighting of an introduced species that has not previously been located on site (as per Section 3.2.3) will require investigation and potentially further monitoring.

4 Audit and Review

4.1 Environmental Auditing

Compliance with this EMP will be assessed in compliance reports required under EPBC approval conditions.

Internal audits against the PML Environmental policy and standards will be conducted on a regular basis, with frequency determined by the risk level. Audits will include an assessment of compliance with this EMP and other environmental management plans.

Any non-compliances identified will be addressed through implementation of corrective actions.

4.2 Environmental Management Plan Review

This EMP is intended to be adaptive, and as such will be reviewed in line with the site NQMP and CSBMP. These plans will be reviewed in the following circumstances:

- Every four years;
- In response to additional data indicating a change in the risk to terrestrial fauna species; or
- If ongoing monitoring suggests thresholds have been breached and objectives cannot be met.

5 References

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DCCEEW (2005). Northern Quoll (Dasyurus hallucatus) http://www.environment.gov.au/biodiversity/threatened/species/dasyurus-hallucatus.html

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APPENDIX G

Pilbara Minerals Land Use Clearance Procedure

Land Use Certificate

Procedure

21 September 2022

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CONTENTS

1. INTRODUCTION AND PURPOSE

Pilbara Minerals Pilgangoora Operations (POPL) includes lithium exploration, mining and ore processing at the Ngungaju and Pilgan sites (approximately 120 km south-southeast of Port Hedland); and road transport between these sites and Port Hedland where the products are exported to international customers. The location of the Pilgangoora Operations is shown in Figure 1.

The purpose of this Land Use Certificate (LUC) Procedure is to outline the process for managing work activities which disturb ground or vegetation as part of construction, commissioning and operation of the Pilgangoora Operations

The objectives of this LUC Procedure are to:

1. Ensure all work activities are undertaken within approved project boundaries.
2. Ensure all work activities are undertaken in accordance with project environmental requirements and approvals conditions.
3. Minimise the total footprint of disturbance as far as practicable for the safe and efficient completion of work activities.
4. Prevent excessive costs associated with over-clearing and subsequent rehabilitation.
5. Minimise potential impacts to fauna, fauna habitat and potential sensitive areas (including waterways and heritage sites).

This procedure applies to all Company personnel, including employees, agency staff, contractors subcontractors and consultants.

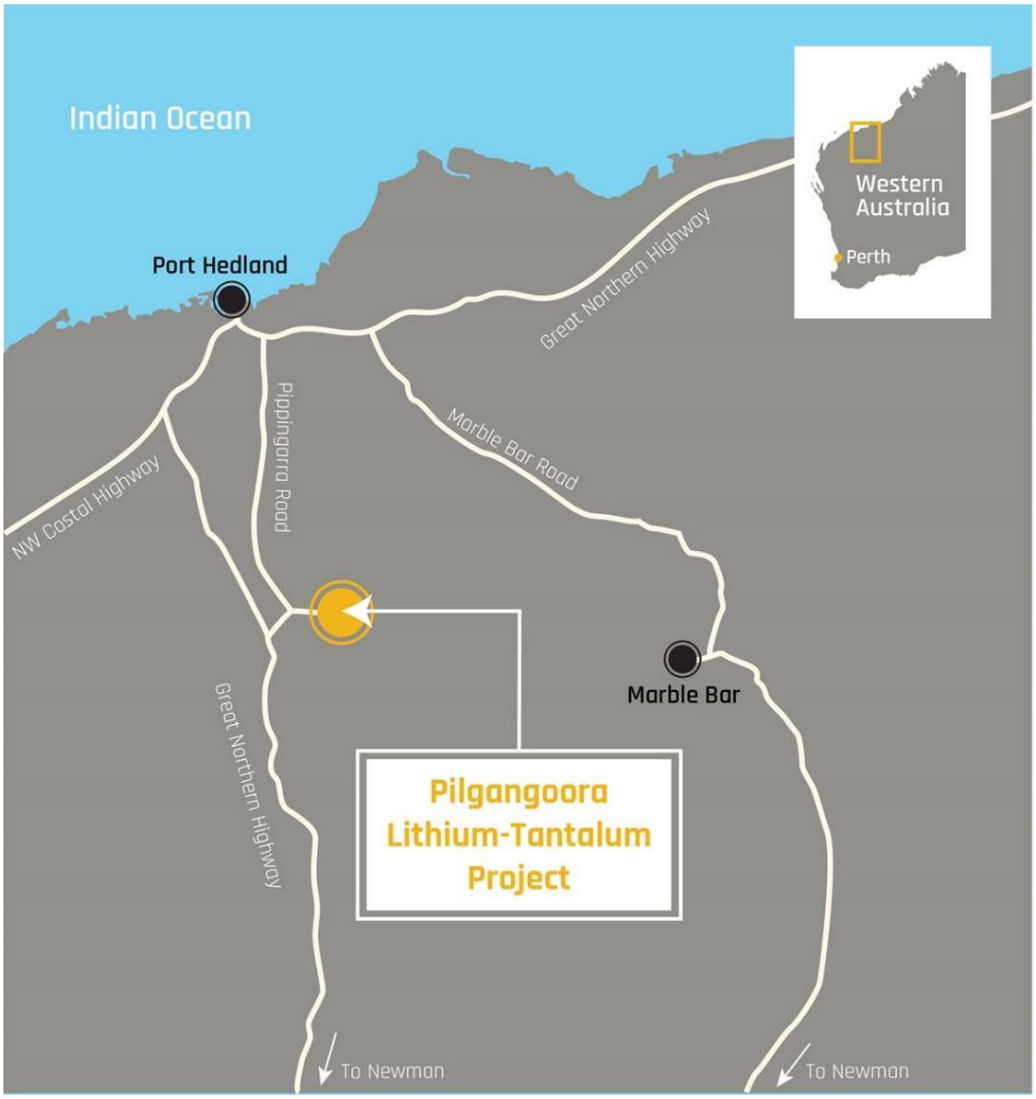

Figure 1 – Pilgangoora Lithium-Tantalum Project

2. DEFINITIONS

TERM	DEFINITION
Company	Pilbara Minerals Limited (PLS)
Contractor	Persons appointed to undertake the works as described in the Contract
GIS	Geographic Information Systems
GDP	Ground Disturbance Permit

EMP	Environmental Management Plan
JHA	Job Hazard Analysis, a risk assessment conducted for work activities
LUC	Land Use Certificate
PLS	Pilbara Minerals Limited
PTW	Permit To Work
SWP	Standard Work Procedure

3. WHAT ACTIVITIES REQUIRE A LUC

All work activities that are likely to disturb ground or vegetation or constitute a key operational change require a LUC in advance of the works commencing. These activities may include, but are not limited to:

- Driving or tracking equipment outside designated access tracks
- Creating new access tracks
- Maintaining, widening or installing drainage for existing access tracks
- Creating fire breaks
- Clearing topsoil and vegetation
- Excavation
- Trenching
- Earthworks, contouring and installation of drainage controls
- Borrowing material
- Stockpiling material
- Pot-holing for underground services
- Drilling bores or wells
- Geotechnical sampling
- Installing light poles, fencing and signage.

A LUC is also required for works that increase the capacity of an approved facility, change the purpose/usage of land or involve the installation of new buildings or equipment.

A LUC may be applied for in retrospect in the following emergency situations:

- Injury or risk of immediate injury to personnel

- Threat to life or property from fire or weather emergency
- Protection of sensitive habitats or waterways in the event of a serious environmental spill/release.

In addition to a LUC, a Permit to Work (PTW), may also be required for high risk work activities which involve excavation and penetration below 150mm depth.

4. ROLES AND RESPONSIBILITIES

4.1 OPERATIONAL AREA MANAGERS

- Comply with the requirements of the LUC and supporting procedure.
- Liaise and communicate with the work crews and reporting contractors and the PLS Environmental Advisor to facilitate implementation of the LUC Procedure.

4.2 LUC APPLICANT/PERSONNEL DIRECTING WORKS

- Ensure a GDP is in place prior to commencing any works that require clearing.
- Provide information for GDP applications regarding disturbance activities including start date, duration, location, description of all activities and total area of disturbance.
- Provide location pdf map showing the disturbance area, tenement boundaries, constraints (heritage sites, protected flora and fauna, infrastructure) and supporting survey file (string or dxf) for proposed disturbance area/s for GDP applications.
- Comply with GDP conditions for GDP activities.
- Communicate GDP requirements to applicable work crews.
- Ensure work activities do not extend beyond GDP boundaries.
- Ensure the disturbance footprint is minimised as far as practicable for the safe and efficient completion of GDP work activities.
- Provide information as necessary to enable recording of clearing areas and operational changes (see example Clearing Register in Appendix 1).

4.3 ENVIRONMENTAL ADVISOR

- Review LUC applications and determine regulatory compliance acceptability of request.
- Ensure appropriate controls/conditions are attached to approved LUC to meet environmental obligations.
- Conduct or coordinate field validation of survey and pegging of LUC areas, aside from remote exploration clearing.
- Conduct regular inspection of LUC work activities to ensure works are within LUC boundaries and conditions are being adhered to.
- Communicate and promote awareness of LUC requirements with the site workforce.
- Updating the Land Certificate Register (see example in Appendix 1) tracking cumulative disturbance and operational changes in accordance with regulatory requirements.

4.4 SITE SURVEYOR

- Generate survey map (pdf and accompanying string or dxf files) to support LUC applications.
- Flag and peg disturbance areas in the field to ensure clear delineation of area.
- Conduct a survey pick up of the cleared area after clearing and provide to the PLS Environmental Advisor.

5. PROCEDURE

The LUC procedure is detailed below:

5.1 APPLICATION FOR LUC

1. The applicant completes Section 1 and Section 2 of the LUC form (TFR-ENV-001) including:

- Name and company details
- Proposed start date of activities
- Duration of proposed activities
- Location of proposed activities
- Description of proposed activities
- Proposed total area (Ha) of disturbance

The applicant includes all activities which may occur within the proposed clearing area or that constitute a key operational change. The LUC will only be approved for the activities described and subsequent amendments may be required for additional activities.

2. The applicant prepares a location pdf map showing tenement boundaries with supporting survey string or dxf files of the proposed disturbance area/s. The location map should clearly identify the proposed area/s on a site layout map/s or aerial imagery.
3. The applicant submits the LUC and associated location map/s to the PLS Environmental Advisor.

5.2 LUC ASSESSMENT

The PLS Environmental Advisor reviews Section 1 and 2 of the LUC form and associated location map/s and will then complete Section 3 of the LUC to assess the acceptability of the proposed works and specify what controls must be adhered to. The PLS Environmental Advisor may contact the applicant to seek clarity of proposed activities and update Section 1 and Section 2 of the LUC to include further details.

The PLS Environmental Advisors assessment includes a review of external regulatory requirements and also internal company requirements. External regulatory requirements include but aren't limited to, reviewing Clearing Permits, Mining Proposals, Works Approvals, Licences to Take Water, Programs of Work, tenement conditions and type. Internal checks include but aren't limited to, reviewing flora and fauna surveys, heritage surveys and pastoral agreement conditions. The PLS Environmental Advisor should contact the PLS Health, Safety, Environment, Land Access and Approvals Manager or Senior Environmental Advisor for advice if required.

The PLS Environmental Advisor will attach conditions/controls to the LUC to manage environmental impacts and risks as required. These controls may include:

- Survey, pegging and flagging of the proposed area/s.
- Field validation of survey and pegging by site Survey.
- Field inspection by the PLS Environmental Advisor.
- Clearing and topsoil management requirements.
- Weed hygiene requirements for ground-engaging equipment and activities within a Weed Risk Zone, as per the Weed Management Procedure (PIL01-PRO-0000-G-010).
- Protection measures for sensitive areas in proximity to the disturbance area (e.g. establishing a buffer area to avoid potential impact to adjacent water courses or heritage sites).
- Any other specific controls deemed necessary.

The Environmental Advisor updates the Land Use Certificate Register to include the LUC disturbance area/s and key operational changes. This allows the accurate tracking of cumulative total project disturbances and key operational changes in accordance with approvals requirements.

The PLS Environmental Advisor will complete Section 3 of the LUC within 3 business days where reasonably practicable, subject to availability and provision of adequate information.

5.3 SITE ENVIRONMENTAL ADVISOR APPROVAL

- The PLS Environmental Advisor liaises with the applicant as required to discuss proposed LUC conditions.
- The applicant signs-off Section 4 of the LUC and returns to the PLS Environmental Advisor.
- The PLS Environmental Advisor will grant approval if appropriate under Section 4 and issue the LUC as final to allow works to commence.
- The applicant ensures all personnel (including contractors) involved in the works, sign-off on Section 5 of the LUC, to ensure they have read and understood the permit conditions outlined in Section 3.
- The applicant and PLS Environmental Advisor keep a record of the LUC.

5.4 END OF WORK AND CLOSURE OF LUC

The LUC will remain open in line with LUC conditions, external clearing permit timeframes and other regulatory requirements.

The PLS Environmental Advisor and site surveyor complete Section 6. The PLS Environmental Advisor signs-off to close the LUC.

6. TRAINING AND COMPETENCY

Training and awareness of LUC requirements includes:

- General and site inductions
- Toolbox awareness training

- Incorporation of specific LUC controls in Job Hazard Analyses (JHA's) or Standard Working Procedures (SWP's).

All personnel will be encouraged to raise any queries or concerns with their Supervisor and to check delineation of work boundaries if uncertain. A ground spotter may be used to assist plant operators in the delineation of boundaries if safe to do so, within direct line of sight and communication with operators.

7. AUDIT & MONITORING

Regular inspections and monitoring should be undertaken by the Works Supervisor, PLS Environmental Advisor or delegate to ensure:

- A signed LUC is in place for all work activities prior to commencement of works
- Work activities are confined to LUC boundaries
- All LUC controls are being implemented.

The PLS Environmental Advisor may conduct compliance auditing in accordance with the HSE Audit and Corrective Actions Procedure (PRO-WHS-AUD). All audit findings will be captured and corrective actions will be assigned to appropriate personnel to ensure a timely close out.

8. INCIDENTS, NON-CONFORMANCES AND REPORTING

All personnel should report any concerns, potential breaches or incidents immediately to their Supervisor. The Works Supervisor shall report concerns, potential breaches or incidents immediately to the PLS Environmental Advisor.

Non-compliance with LUC conditions or other clearing regulatory requirements will be regarded as incidents. Incidents and non-conformances will be investigated and reported in accordance with the Incident Non-Conformance and Action Management Procedure (PRO-WHS-INC).

A LUC may be updated or amended to include further controls in response to incidents and non-conformances.

9. REVIEW

This procedure should be reviewed and updated annually or as required in response to project changes and actions arising from incidents or compliance audits.

10. REFERENCES

PLN-ENV-EMP	Environmental Management Plan
PRO-WHS-INC	Incident Non-Conformance and Action Management Procedure
PLS-WHS-PRO	Site Induction Procedure
PRO-WHS-AUD	HSE Audit and Corrective Actions Procedure
TFR-ENV-001	Land Use Certificate Form
TFR-ENV-LAN-002	Environment Inspection and Test Plan
TFR-ENV-LAN-005	Topsoil Register
PIL01-PRO-0000-G-010	Weed Management Procedure

APPENDIX 1 EXAMPLE LAND CLEARANCE CERTIFICATE REGISTER

LUC NUMBER	DATE OF APPROVAL	AREA (HA) APPLIED FOR	DESCRIPTION OF ACTIVITY	DMIRS CATEGORY ACTIVITY	TENEMENT NO	HAS WORK COMPLIED WITH LUC? (YES/NO, DESCRIBE)	ACTUAL AREA CLEARED	COMMENTS	

APPENDIX H

Impact Reconciliation Procedure

Lynas Find Project *Environmental Protection and Biodiversity Conservation Act 1999* Impact Reconciliation Procedure (IRP)

1. The proposed action and condition requirements

1.1 The proposed action

The proposed action relates to the Lynas Find Project (EPBC 2023/09471).

1.2 Proposed action description

Pilbara Minerals operates the Pilgangoora Project, located approximately 80 km SSE of Port Hedland in the Pilbara region of Western Australia. The Pilgangoora ore bodies form one of the largest hard rock lithium deposits in the world, and is considered strategically important within the global lithium supply chain.

The Lynas Find Project (the Proposed Action) is a proposed open pit mine and waste rock dump (WRD) located to the north of the current operations, as well as miscellaneous supporting infrastructure including transport corridors and topsoil stockpiles. Ore removed from the Lynas Find pit will be processed at the current Pilgangoora site.

Implementation of the Proposed Action will require vegetation clearing of the proposed areas, as well as removal of a portion of rocky ridge that represents fauna habitat for the Northern Quoll (*Dasyurus hallucatus*). The Northern Quoll is listed as Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), and the Proposed Action was referred by the proponent on the basis of potential impacts resulting from a loss of habitat.

1.3 Purpose of the IRP

The purpose of this IRP is to outline the methods used to calculate the area of vegetation and fauna habitat impacted within the Interim Biogeographic Regionalisation for Australia (IBRA) Pilbara region. The entire Lynas Find Project is located within the Chichester subregion (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2023).

The area impacted is then used to determine the financial contribution required to the Pilbara Environmental Offsets Fund (PEOF), which has been created as a centralised body to deliver environmental offset projects in the Pilbara region (Department of Water and Environmental Regulation, 2019).

2. Procedure

2.1 Identification of the environmental values requiring offsets

The indicative area to be impacted by the Proposed Action has been surveyed to determine the vegetation types and quality in the area, as well as whether there are any conservation significant species located within the area of proposed disturbance (Animal Plant Mineral, 2022).

Within the Proposed Action disturbance footprint there is approximately 4.62 ha of rocky ridge habitat, which is considered to be an important habitat type for the Northern Quoll, and may also be used sporadically by the Pilbara leaf-nosed bat and Ghost bat. An additional 13.64 ha of rocky ridge habitat will be protected as part of an avoidance zone to be implemented by the proponent.

Additionally, the Proposed Action will result in impacts to approximately 5.56 ha of habitat for the Pilbara leaf-nosed Bat with a habitat rating of between 2 and 5. The remaining disturbance is within habitat with a low or poor habitat rating and does not require any offset.

Table 1 outlines the matters protected under the EPBC Act that have been determined to require offset, in the form of contributions to the PEOF.

Table 1: Protected matters from 2023/09471 - Lynas Find Project that require offsets

EPBC Act protected matter to be offset	Area to be offset (ha)	Protected matter value rating category	Environmental value justification	IBRA subregion	Offset rate ($/ha)*	Total to be offset
Northern Quoll	4.62	Critical habitat	Significant residual impact from reduction in the area of occupancy and impacts to critical habitat.	Chichester	$3,306	$15,273.72
Northern Quoll	82.72	Supporting habitat within 1 km radius of critical habitat	Significant residual impact from reduction in the area of occupancy and impacts to critical habitat.	Chichester	$1,653	$136,736.16
Pilbara Leaf-nosed Bat	5.56	Vegetation within 20 km of a Pilbara leaf-nosed bat Category 1, 2 or 3 roost, with a habitat rating between 2 and 5.	Significant residual impacts to critical habitat.	Chichester	$1,653	$9,190.68
Total amount to be Offset (Commonwealth requirement)						**$161,200.56**
Initial 10% contribution						**$16,120.06**

2.2 Areas that do not require offsets

Within the Proposed Action disturbance footprint there is approximately 6.88 ha of vegetation that has been determined to be completely degraded. Clearing within these areas is not subject to offsets.

Additionally, the areas within the Proposed action disturbance footprint with a Pilbara Leaf-nosed Bat habitat rating of 1 or zero do not provide sufficient value to the species to require offsetting.

2.3 Offset objectives

Offsets are measures that compensate for the residual impacts of an action on the environment, after avoidance and mitigation measures are taken. DCCEEW has provided a policy to provide guidance around best practice offset principles and provide more certainty and transparency in offset planning.

The offsets for the Lynas Find Project will be through contributions to the Pilbara Environmental Offsets Fund, which allows for large scale and long term environmental outcomes to be achieved through amalgamation of offsets for different Projects within the Pilbara region. The offsets are specifically chosen to counterbalance significant residual impacts of mining and industrial projects, and align with the aims and requirements of the DCCEEW Environmental Offsets Policy, including conservation outcomes, transparency of works undertaken, and scale of projects.

The offset funds will be provided to the Pilbara Environmental Offsets Fund to be used for projects with the following objectives:

- Reducing the rate of decline of *Dasyurus hallucatus*; and
- Ensuring that a viable population of *Dasyurus hallucatus* remain in the Pilbara region.

2.4 Method to determine impacts

Impacts will be determined through an assessment of the area disturbed through clearing of land within the reporting period. This area will be calculated annually by undertaking surveys of the cleared area, as well as an assessment of aerial photographs. This area will be compared to the baseline data provided as part of this IRP, to determine how much of each protected matter has been impacted.

Annual records will be kept to ensure the correct financial rate is applied to the clearing undertaken.

2.5 Impacts

The Proposed Action is likely to have the following impacts on native flora, vegetation and fauna:

- Direct impacts through clearing of native vegetation, including 4.62 ha of denning habitat for Northern Quolls. This habitat may also be used as short-term shelter for Pilbara leaf-nosed bats and Ghost Bats during foraging activity;
- Clearing of Northern Quoll habitat increasing the distance between suitable habitat patches, leading to potential habitat fragmentation impacts;
- The risk of direct mortality through vehicle strike and entrapment throughout Project operations;
- Behavioural changes caused by an increase in light and/or noise in the Project area during operations; and
- Increased dust levels degrading the quality of peripheral vegetation and reducing potential for foraging.

Mitigation strategies will be implemented in order to avoid or minimise impacts wherever possible. Clearing will be undertaken through a stages process and rehabilitation will be undertaken progressively over the Project life, to minimise the time between the initial clearing and the re-establishment of vegetation in the area.

3. Payments and Reporting

3.1 Frequency and timing

Table 2 below outlines the proposed reporting frequency of Impact Reconciliation Reports for the Lynas Find Project. Only two biennial periods have been included as all clearing for the Project is expected to be completed by 2027, however this may be extended if required.

Table 2: Reporting period and frequency of the Impact Reconciliation Reports

Reporting Stage	Action	Timing
Assessment Stage	Submission of the draft IRP	20 June 2024
Approval Stage	EPBC Act Approval issued	-
Post Approval Stage	Final IRP approved and implemented	-
	Commencement of Proposal	1 January 2025
Upfront payment	Initial payment required prior to commencement of action	Prior to 1 January 2025

Reporting Stage	Action	Timing
	Submission of evidence of payment to the Department of Climate Change, Energy, the Environment and Water	1 January 2025
Period 1*	First biennial reporting period	1 January 2025 to 30 June 2026
	Aerial survey/ground-truthing	July 2026
	Impact Reconciliation Report submitted to DCCEEW	30 October 2026
	Submission of evidence of payment to DCCEEW	30 October 2026
Period 2	Second biennial reporting period	1 July 2026 to 30 June 2028
	Aerial survey/ground-truthing	July 2028
	Impact Reconciliation Report submitted to DCCEEW	30 October 2028
	Submission of evidence of payment to the Department of Climate Change, Energy, the Environment and Water	30 October 2028

* Period 1 may be less than two years to align with a financial year reporting period.

3.2 Impacts and Reconciliation

The Lynas Find Project is expected to commence in early 2025, and the pit will be exhausted after approximately three years of operation, having produced approximately 2.5 million tonnes of ore. The Lynas Find Waste Rock Landform will continue to accept waste materials from the broader Pilgangoora Project, however all clearing for the Proposed Action is expected to be completed by 2028.

The majority of the clearing will likely be undertaken in the first reporting period, between January 2025 and June 2026. All clearing will be within the Chichester IBRA subregion.

Reconciliation Reports will include:

- An assessment of all impacts that have occurred during each financial year of the reporting period, including the total area of each environmental value impacted, as well as the relevant IBRA subregion. Where there is overlap in environmental values, the value with the higher offset rate will be used in the disturbance calculation;
- Information used to calculate the impacts, including aerial imagery and survey data. This will also contain baseline information on environmental values in the area, and areas that are excluded from offset contributions;
- Information regarding any additional clearing approvals within the MDE, including Native Vegetation Clearing Permits; and
- An assessment of any impacts expected to be reported in the subsequent reporting periods.

4. References

Animal Plant Mineral 2022, Lynas Find Project Biological Survey, Report Prepared for Pilbara Minerals, October 2022.

Department of Climate Change, Energy, the Environment and Water (2023) Australia's bioregions (IBRA). Accessed 24 Aug 2023,<https://www.dcceew.gov.au/environment/land/nrs/science/ibra#ibra>.

Department of Water and Environmental Regulation (2019) Pilbara Environmental Offsets Fund Implementation Plan. Accesses 24 August 2023, <https://www.wa.gov.au/system/files/2020-07/DWER-PEOF-Implementation-plan.pdf>.

5. Figures

6. Appendices

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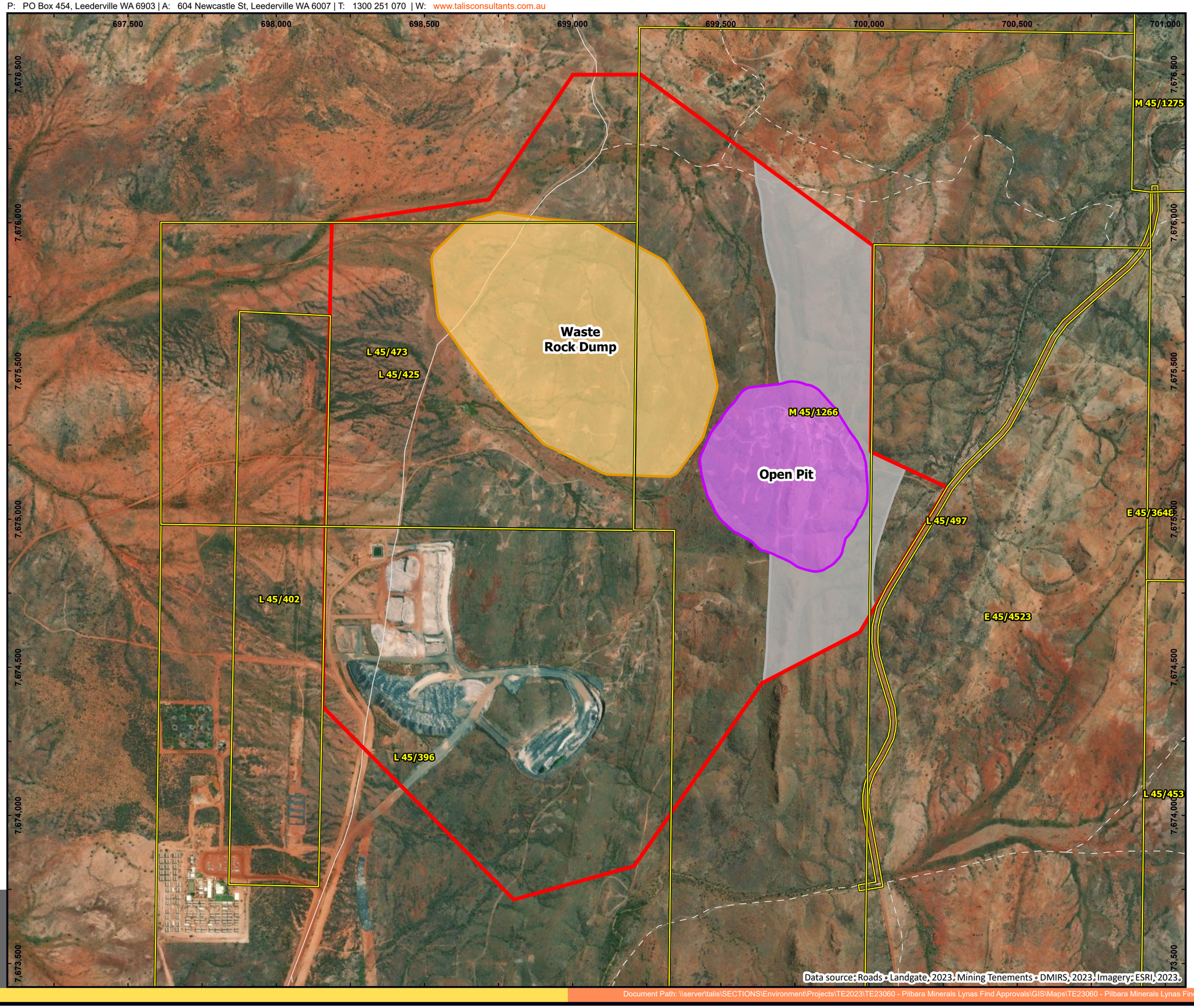

Data source: Roads - Landgate, 2023. Mining Tenements - DMIRS, 2023. Imagery: ESRI, 2023.

LEGEND

- Lynas Find Mine Development Envelope
- Mining Tenements

Site Layout

- Open Pit Footprint
- Waste Rock Landform Footprint
- Proposed Avoidance Area

Western Australian Roads

- Minor Road
- Other

LOCALITY

0 200 400 600 800 1,000 km

SITE LAYOUT

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	1/09/2023
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 1

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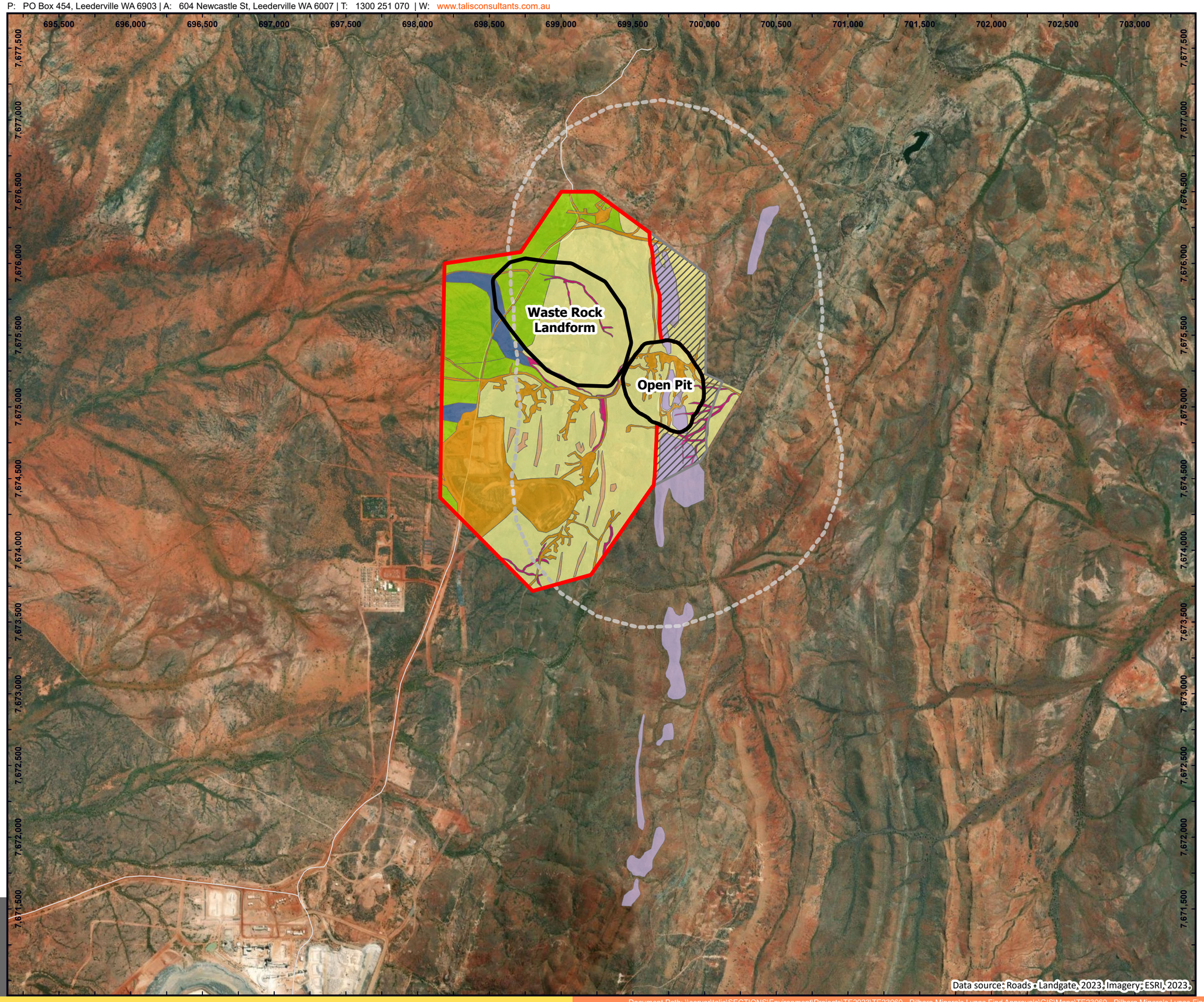


LEGEND

- Lynas Find Mine Development Envelope
- Site Layout
- Proposed Avoidance Area

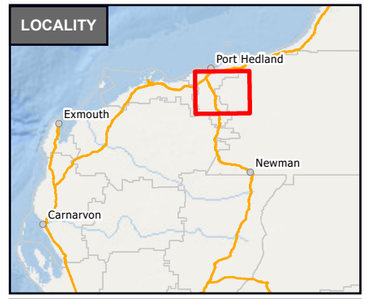
Fauna Habitat Types

- 1 km northern quoll critical habitat buffer
- D
- FH1
- FH2
- FH3
- FH4
- FH5
- FH6

Western Australian Roads

- Minor Road

LOCALITY



0 200 400 600 800 1,000 km

FAUNA HABITAT TYPES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N

0 200 400 600 800 1,000 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:25,000

Prepared:	E Jackson	Date:	6/05/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 2

Document Path: \\server\talis\SECTIONS\Environment\Projects\TE2023\TE23060 - Pilbara Minerals Lynas Find Approvals\GIS\Maps\TE23060 - Pilbara Minerals Lynas Find Approvals\TE23060 - Pilbara Minerals Lynas Find Approvals.aprx

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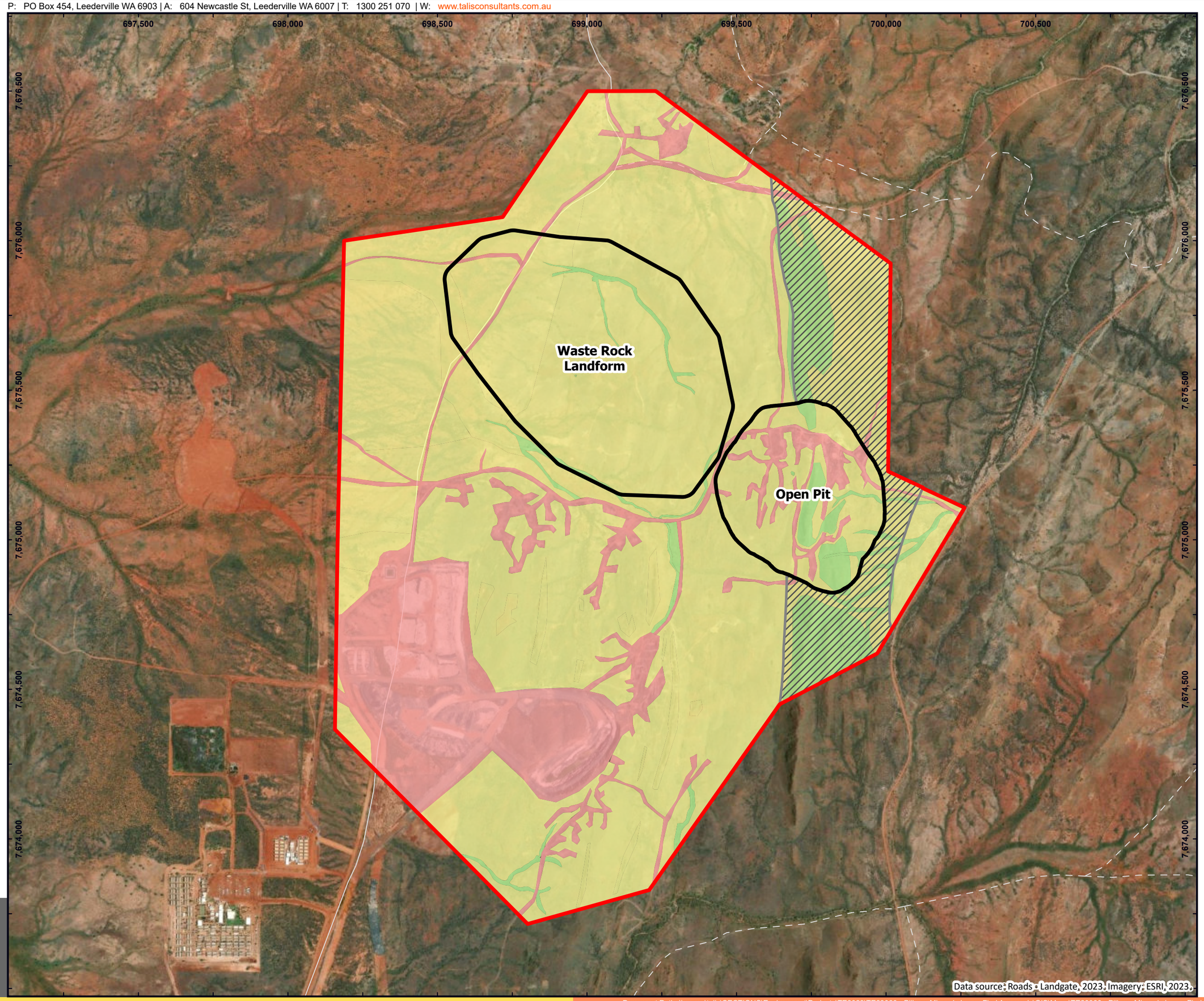


LEGEND

- Lynas Find Mine Development Envelope
- Site Layout
- Proposed Avoidance Area

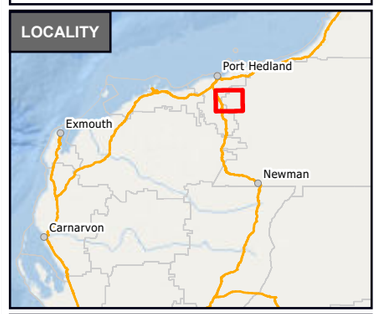
Fauna Habitat Rating

- HR0 - Degraded
- HR1 - Low Habitat Rating
- HR2 - Moderate Habitat Rating

Western Australian Roads

- Minor Road
- Other

LOCALITY



0 200 400 600 800 1,000 km

FAUNA HABITAT TYPES

Lynas Find Mine Site
EPBC and EPA Referral

Pilbara Minerals Limited

N 0 100 200 300 400 500 m

Coordinate System: GDA2020 MGA Zone 50
Scale @ A3: 1:12,000

Prepared:	E Jackson	Date:	4/10/2024
Reviewed:	A Jamieson	Revision:	A
Project:	TE23060		

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Figure 3

Assets | Engineering | Environment | Noise | Spatial | Waste

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