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Mt Gibson Ranges Targeted Malleefowl Survey

Mt Gibson Mining Limited

June 2014

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Executive Summary

Biologic Environmental Survey (Biologic) was commissioned by Mount Gibson Mining Ltd (MGX) to conduct a targeted *Leipoa ocellata* (Malleefowl) survey within specified areas at the Mt Gibson Ranges, hereafter referred to as the "Study Area" (Figure 1.1). The Mt Gibson Ranges are located approximately 350 kilometres (km) north east of Perth, approximately 80 km north from the town of Wubin and 70 km south of Paynes Find.

Malleefowl are listed as a Threatened Species and Migratory Species of fauna under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and as Specially Protected Fauna (Schedule 1) under the *Wildlife Conservation Act 1950* (WC Act), meeting the criteria for a "Vulnerable" species using the International Union for the Conservation of Nature standards.

The objective of this survey was to undertake a systematic targeted field survey for *L. ocellata* within the Study Area to provide an improved understanding of the presence and distribution of *L. ocellata* across the Mt Gibson Ranges, in context with the results of previous surveys at the Mt Gibson Ranges and the broader region. The survey also sought to determine the presence of other vertebrate fauna of conservation significance which may be present, including *Egernia stokesii badia* (a Threatened Species and Specially Protected Fauna), which has previously been recorded from the woodlands to the east of the Mt Gibson Ranges.

Two field surveys were undertaken; December 2013 and June 2014. Two recently active, seventeen inactive and one ancient nest mound were recorded within the Study Area.

Current and previous records from the area show a strong pattern of distribution with suitable habitat of dense to medium-dense vegetation on flat, lower slopes. The most common vegetation units (as described in Bennett, 2000) in which nest mounds were recorded were associated with dense Acacia thickets. The recently active nest mounds and scat were found in dense *Acacia* and *Allocasuarina* thickets on flat, lower slopes. The vegetation of the Study Area is not unique to the area, with similar habitat found in the surrounding area and the broader region beyond the Study Area.

The presence of recently active nest mounds indicate that *L. ocellata* actively breeds within the Study Area and surrounds. Disturbance of vegetated areas containing the recently active nest mounds may have the potential to impact the local population; however, this would be unlikely to have a significant environmental affect on the viability of the regional population.

No *E. stokesii badia* were recorded from within the Study Area; however, marginal habitat for this taxa does exist in the Study Area. A single Major Mitchell's Cockatoo (*Cacatua leadbeateri*), listed as Specially Protected Fauna (Schedule 4) under the WC Act was also recorded flying over the Study Area.

1 INTRODUCTION

1.1 Background

1.1.1 Project

Biologic Environmental Survey (Biologic) was commissioned by Mt Gibson Mining Limited (MGX) to conduct a targeted *Leipoa ocellata* (Malleefowl) survey within specified areas of the Mt Gibson Ranges. The Mt Gibson Ranges are located approximately 350 kilometres (km) north east of Perth, approximately 80 km north from the town of Wubin and 70 km south of Paynes Find (Figure 1.1). Two specified areas were identified by MGX (Figure 1.2), hereafter referred to as the "Study Area".

1.1.2 Scope

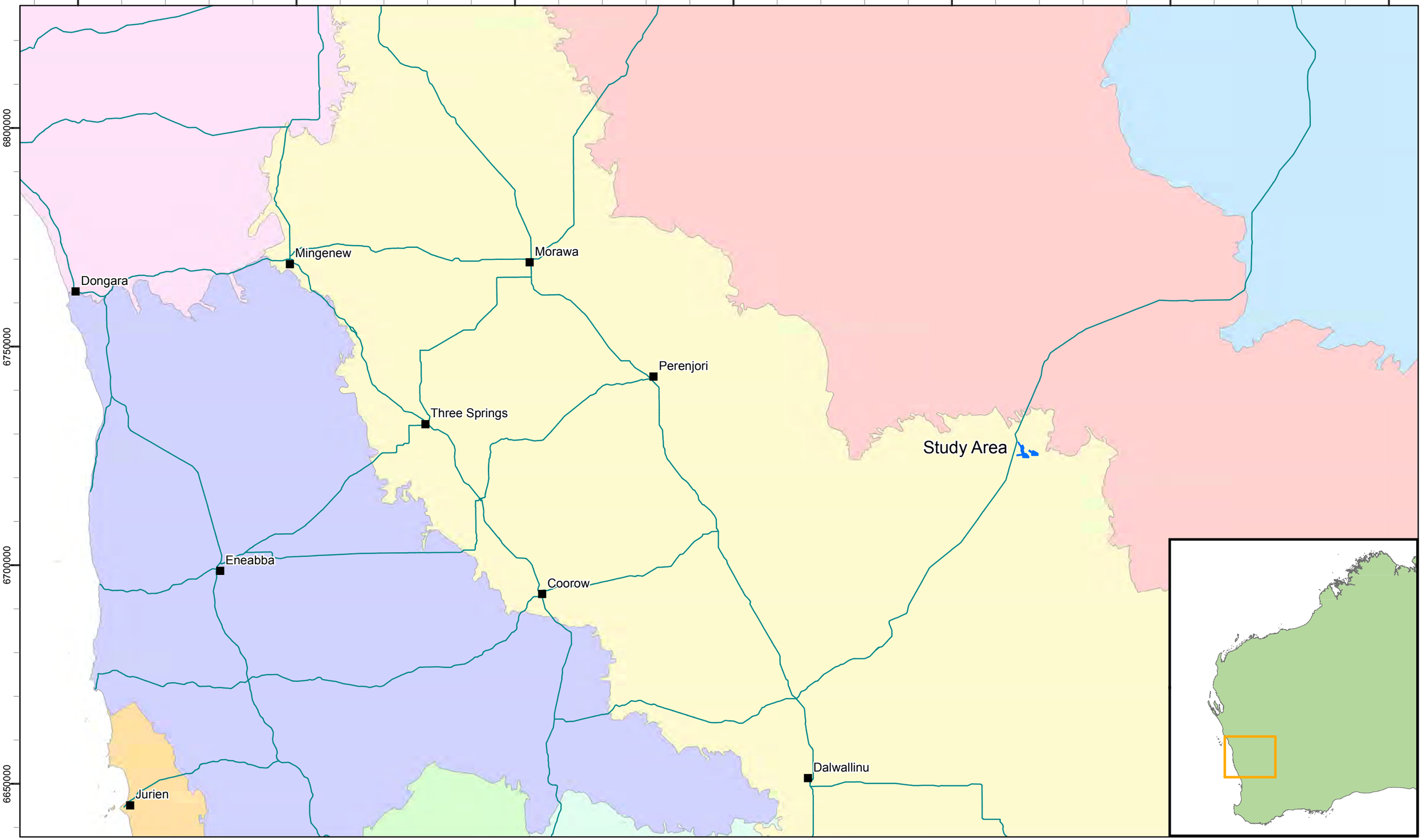
Previous survey works at the Mt Gibson Ranges have recorded *L. ocellata*. This report collates the survey results from the current field survey of the Study Area and the previous survey work, with a view to improve the understanding of the presence and distribution of *L. ocellata* across the Mt Gibson Ranges and surrounds.

This survey report incorporates information and data from the following reports and studies:

- ATA Environmental (ATA) – *Fauna assessment Mount Gibson*: Report to Mount Gibson Mining Limited (2005);
- ATA Environmental (ATA) – *Mt Gibson Iron Ore Mine and Infrastructure Project Public Environmental Review* (2006a);
- Mount Gibson Mining Ltd and Extension Hill Pty Ltd - *Mt Gibson Iron Ore Mine and Infrastructure Project Extension Hill and Extension Hill North Malleefowl Management Plan* (2008); and
- Terrestrial Ecosystems – *Terrestrial Vertebrate Fauna Monitoring Results for the Mount Gibson Iron Ore Mine and Infrastructure Project* (2014)

1.1.3 Leipoa ocellata

Malleefowl are listed as a Threatened Species and Migratory Species of fauna under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and as Specially Protected Fauna (Schedule 1) under the *Wildlife Conservation Act 1950* (WC Act), meeting the criteria for a "Vulnerable" species using the International Union for the Conservation of Nature standards.



Legend

- Local_towns
- Local_Highway
- Study Area

IBRA_sub-region

- Dandaragan Plateau
- Eastern Murchison
- Geraldton Hills
- Katanning
- Lesueur Sandplain
- Merredin
- Perth
- Southern Cross
- Tallering

1:800,000

0 5 10 20 30 km

N

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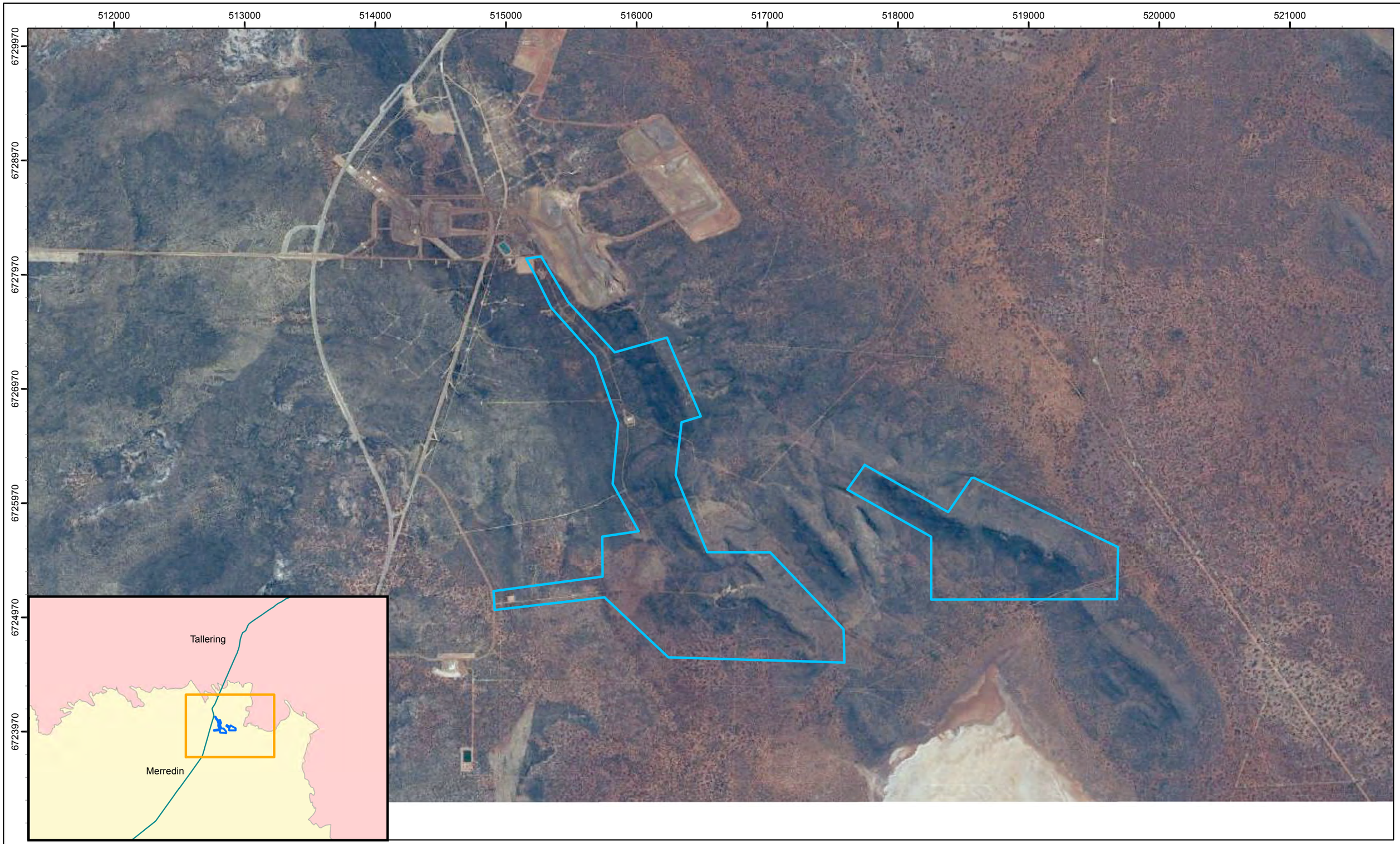
Fig. 1.1. Regional location and IBRA sub-regions

Created: 07-02-2014

Coordinate System: GDA 1994 MGA Zone 50

Projection: Transverse Mercator

Datum: GDA 1994



Legend

Study Area

1:30,000

0 0.225 0.45 0.9 1.35 km

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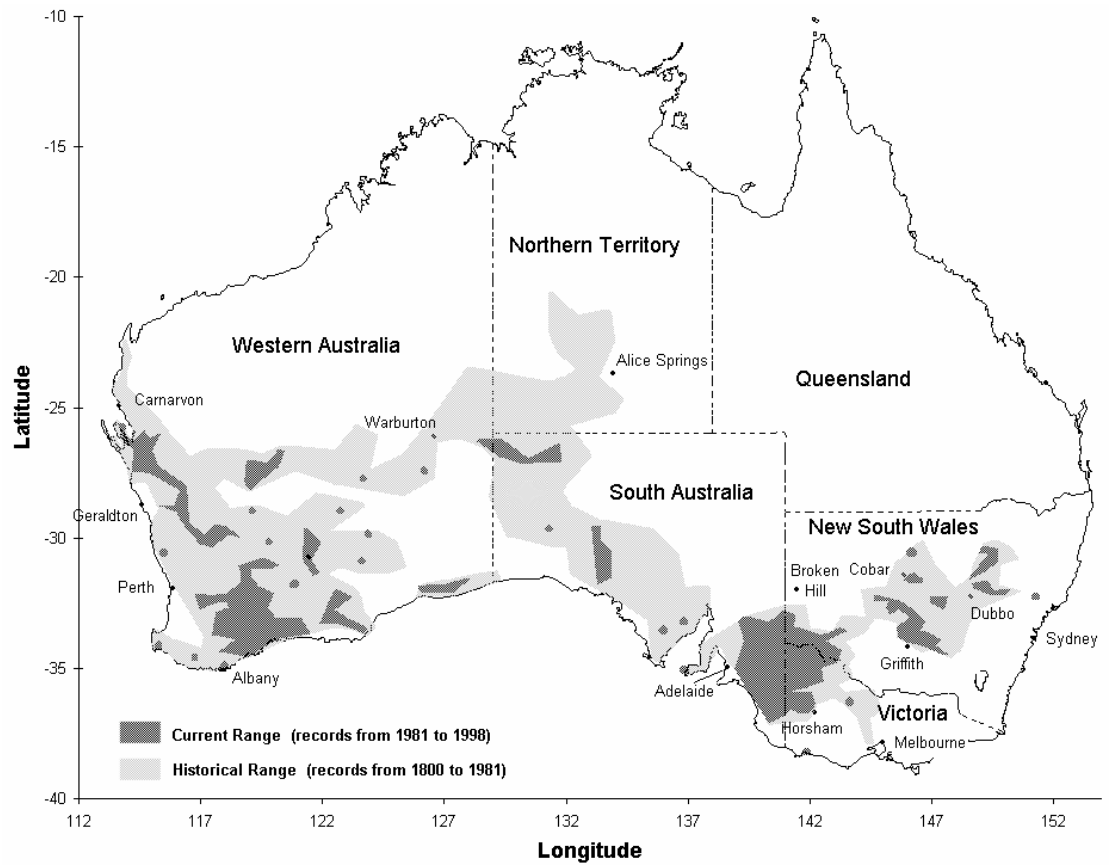
Fig. 1.2. Study Area and aerial photography

Created: 26/06/2014
Coordinate System: GCS WGS 1984
Datum: WGS 1984

In Western Australia, Malleefowl occur mainly in scrubs and thickets of Mallee (*Eucalyptus spp*.), Boree (*Melaleuca lanceolata*) and Bowgada (*Acacia linophylla*), and other dense litter-forming shrublands including Mulga Shrublands (Johnstone and Storr, 2004). The species' distribution was once broader and less fragmented; however, Malleefowl distribution and populations have reduced due to clearing of suitable habitat, degradation of habitat by fire and livestock, and fox predation. Malleefowl construct distinctive nests that comprise a large mound covering a central core of leaf litter, typically in areas of dense vegetation (Johnstone and Storr, 2004).

Figure 1.3 Historical and current distribution of Malleefowl (Benshemesh, 2000)



Malleefowl distribution in Western Australia extends as far north as Carnarvon, throughout the southwest, through much of the inland semi-arid areas below the 26° latitude, and in the coastal strip of Mallee south of the Nullarbor Plain between Cocklebiddy and Eucla (Benshemesh, 2000). Malleefowl has been recorded by various groups in the broader region surrounding the Mt Gibson Ranges, in the Yalgoo, Avon Wheatbelt and Coolgardie bioregions (MGM, 2008).

1.2 Existing environment

1.2.1 Climate

The Study Area is within a semi-desert Mediterranean climate, characterised by 9-11 months of dry weather, including hot, dry summers, and mild to cool, wet winters (Payne *et al.* 1998). The closest Bureau of Meteorology weather station is at Paynes Find, 80 km north west of the Study Area. Given the proximity of this weather station, this climatic data is expected to be generally reflective of the climate experience in the area of the Mt Gibson Ranges. Monthly average maximum temperatures range from approximately 18 °C in July to approximately 37 °C in January, and average minimum temperatures from approximately 5 °C in July to 21 °C in February. The average annual rainfall is approximately 280 mm, ranging from an average of approxiately 42 mm in June to approxiately 11 mm in November. Rainfall is infrequent throughout the year, with an average of only 22 days with greater than 1 mm (BOM, 2014).

1.2.2 Biogeography

The Study Area lies within the Avon Wheatbelt Bioregion (AW1 – Ancient Drainage subregion), as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell 1995). The Avon Wheatbelt Bioregion is an area of active drainage and a gently undulating landscape of low relief, with the subregion an ancient peneplain of disconnected drainage and remnant ancient drainage in the form of salt lake chains that function only during high rainfall years.

1.2.3 Land systems

Five land system units coincide with the Mt Gibson Ranges, as defined by Payne *et al.* (1998) and identified in Table 1.2.1.

Table 1.2.1. Land System units occurring at the Mt Gibson Ranges

Land System	Description
Illaara	Gently undulating plains and occasional low rises with mantles of ironstone gravels supporting Acacia/ Casuarina shrublands.
Joseph	Undulating yellow sandplain supporting very dense and diverse shrublands with some mallees, sedges and Spinifex.
Moriarty	Gently undulating stony plains, low rises with limonite and alluvial plains supporting Salmon Gum, Gimlet and Goldfields Blackbutt woodlands with halophytic and Acacia shrublands.
Pindar	Level plains with Eucalypt woodlands, surrounded by sandplain supporting Acacia shrublands.
Tallering	Prominent ridges and hills of banded ironstone, dolerite and sedimentary rocks with mixed shrublands.

1.2.4 Vegetation associations

Eleven vegetation units as mapped by Bennett (200) coincide with the Study Area, including thicket, mallee, woodland and heath. The vegetation units are described in Table 1.2.2.

Table 1.2.2 Vegetation Units coinciding with the Study Area

Vegetation Units	Description
Thicket Communities	
T1	Dense thicket of mixed species dominated by *Acacia* species, *Allocasuarina acutivalvis* subsp. *prinsepiana*, *Calcopeplus paucifolius* and *Melaleuca nematophylla* over low shrubland in jaspilite rocks with pockets of loam.
T2	Dense thicket dominated by *Acacia assimilis*, *A. stereophylla* var. *stereophylla*, *A. ramulosa* and *Allocasuarina acutivalvis* var. *prinsepiana* over low Shrubland of *Acacia acuaria*, *Hemigenia* sp. Paynes Find and *Baeckea* affin. *cryptandroides* in loam with scattered rocks on the surface.
T3	Dense thicket of *Acacia assimilis*, *Allocasuarina acutivalvis* subsp. prinsepiana and *Melaleuca nematophylla* over low shrubland of *Hemigenia* sp. Paynes Find and *Hibbertia crassifolia* in loam pockets in jaspilite rocks.
T4	Dense thicket of *Allocasuarina acutivalvis* subsp. *prinsepiana* with occasional *Eucalyptus oldfieldii* over an Open Scrub of *Acacia* species over open shrubland of *Hemigenia* sp. Paynes Find or open herbs of *Xanthosia bungei* .
T5	Thicket of *Allocasuarina acutivalvis* subsp. *prinsepiana* and *Grevillea obliquistigma* with emergent *Callitris glaucophylla* over low shrubland dominated by *Darwinia masonii* , *Hibbertia crassifolia*, *Melaleuca radula* and *Philotheca brucei* subsp. *brucei* over open herbs of *Xanthosia bungei* in loam pockets in dense jaspilite rocks.
T6	Thicket of *Acacia aneura* and *Acacia stowardii* over low shrubland of mixed species with large numbers of *Darwinia masonii* in loam with abundant rocks on the surface.
T9	Dense thicket of *Acacia* species, *Hakea* species, *Eucalyptus brachycorys* and *E. oldfieldii* with emergent *Callitris glaucophylla*, over open low shrubland of mixed species on sand.
Mallee Communities	
M1	Open tree mallee of *Eucalyptus brachycorys*, *E. hypochlamydea* subsp. *hypochlamydea*, *E. loxophleba* subsp. *supralaevis* and *Callitris glaucophylla* over thicket of *Acacia* species over low shrubland and herbs on loam.
M4	Very open shrub mallee of *Eucalyptus leptopoda* with emergent *Eucalyptus loxophleba* subsp. *supralaevis* over thicket of *Acacia ramulosa* over Herbland of Asteraceae species in loam.
Woodlands	
W1	Woodland of *Eucalyptus salmonophloia* (Salmon gum) over thicket of *Acacia* species over dense low heath dominated by *Atriplex bunburyana* on loam.
Heath Communities	

Vegetation Units	Description
HS1	Low heath of *Ptilotus obovatus* with emergent shrubs of *Acacia stowardii* and *Calcopeplus paucifolius* over herbs in loamy clay amongst large boulders.

2 METHODS

2.1 Compliance

This database review and field survey was carried out in a manner consistent with the requirements for the environmental surveying and reporting of fauna outlined by the Western Australian (WA) Environmental Protection Authority (EPA), WA Department of Parks and Wildlife (DPaW), including the following documents:

- Environmental Protection Authority (2002) EPA Position Statement 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection. March 2002.
- Environmental Protection Authority (2004) EPA Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. June 2004.
- Environmental Protection Authority and Department of Environment and Conservation (2010) Technical Guide: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. September 2010.
- National Heritage Trust (2007) National Manual for the Malleefowl Monitoring System: Standards, Protocols and Monitoring Procedures. Edited by Hopkins L.

2.2 Previous data

A database search of DPaW's *NatureMap* was conducted for records of *L. ocellata* and other conservation significant taxa in the vicinity of the Mt Gibson Ranges. A radius of 40km was searched, with the Study Area used as the centroid. The database search is included as Appendix C.

Previous reports on relevant survey work and all known mound locations from the area were supplied by MGX.

2.3 Field Assessment

2.3.1 Survey Team

The assessment was undertaken by four zoologists from Biologic, from the 3rd to the 11th of December 2013 and the 9th to the 12th of June 2014. The following personnel were involved in the field component of the project:

Name	Position	Fauna experience
Mr Brad Durrant	Principal Zoologist	18 years
Mr Jeff Turpin	Senior Zoologist	12 years
Dr Ruchira Somaweera	Senior Zoologist	8 years
Mr Jordan Vos	Senior Zoologist	6 years

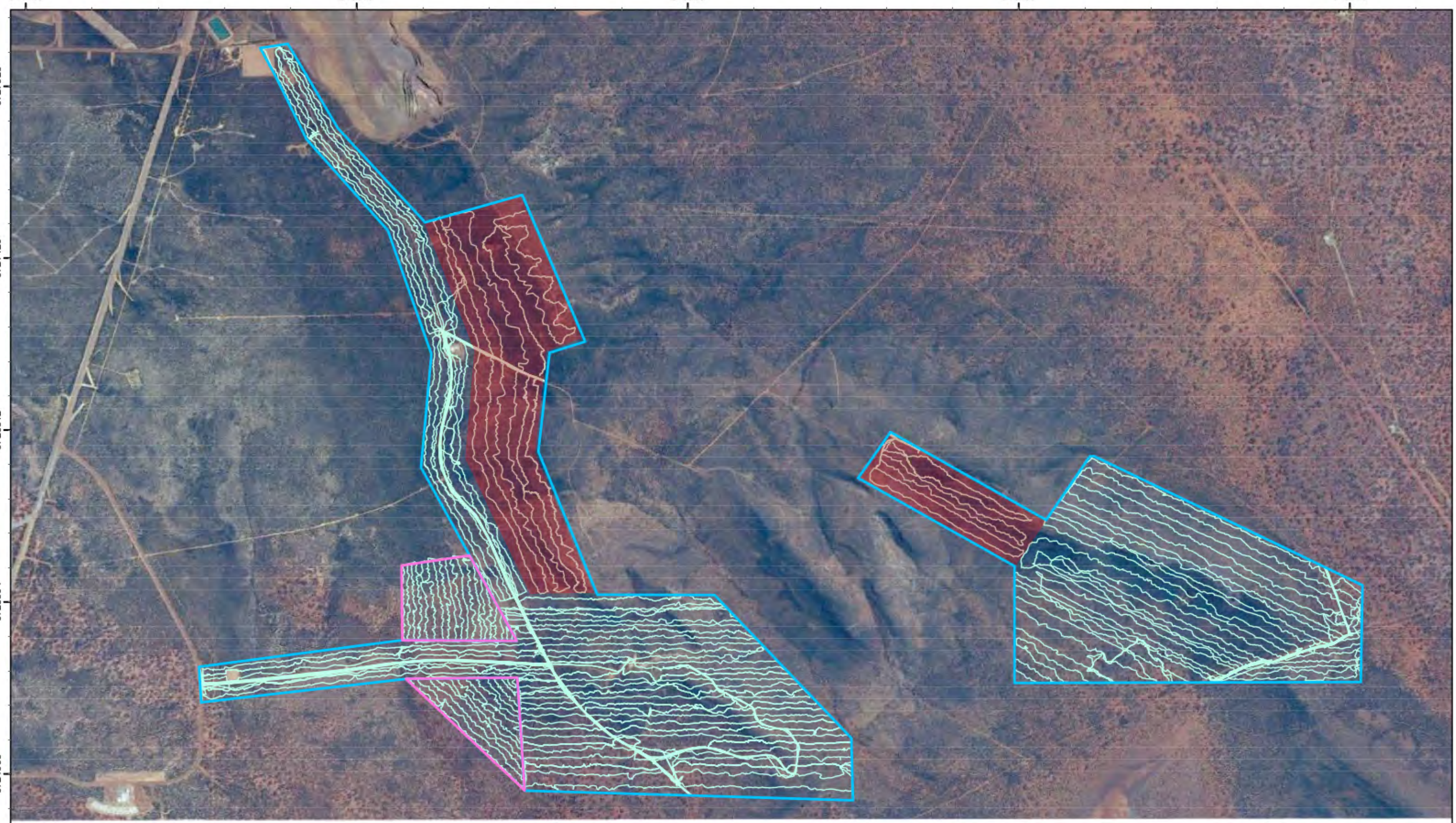
2.3.2 Current survey methods

Malleefowl

Targeted searches for nest mounds of *L. ocellata* were conducted in the Study Area. Transects were walked, ranging from 10 to 30 m in between, dependent on vegetation thickness. The transects undertaken within the Study Area (based on GPS track-logs) are shown in Figure 2.1. Two areas (highlighted in red on Figure 2.1) were searched at a lower density, focussing on other fauna, but Malleefowl mounds were recorded as opportunistic. Within these areas, there is a higher likelihood that a mound was missed.

Consistent with the document *National Manual for the Malleefowl Monitoring System: Standards, Protocols and Monitoring Procedures* (National Heritage Trust, 2007), where a nest mound was identified the following information was recorded and actions taken, in addition to location (geographic coordinates) and a photograph (Appendix A);

a) Assessment of the activity status, being:
   - “active” [containing eggs]
   - “recently active” [showing signs of disturbance]
   - “inactive” [not showing signs of disturbance]
b) Nest mound profile, being:
   - typical crater with raised rims (1)
   - crater dug out (deeply excavated) (2)
   - crater with vegetative litter (3)
   - mounded-up (no crater) (4)
   - crater sandy with peak in centre (5)
   - low flat mound without peak or crater (6).
c) Dimensions (total height and width) of each nest mound and, where the nest mound had been excavated, the diameter across the rim and the depth of the excavation from the rim;
d) Vegetation type in which each nest mound was identified;
e) If the surface of the nest mound has been scraped (showing signs of physical disturbance);



Legend

- Study Area Dec 2013
- Study Area Jun 2014
- Search transects

1:17,000

0 0.125 0.25 0.5 0.75 km

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Fig. 2.1. Search Transects within the Study Area

Created: 26/06/2014
Coordinate System: GCS WGS 1984
Datum: WGS 1984

f) If each of the outer surface or the inner surface of the nest mound has a crust, and estimate the percentage area covered by the crust;
g) If egg shells are visible on or around the nest mound;
h) If animal prints or scats are present (and, if possible, record if the prints or scats are from *L. ocellata*, or from other taxa (e.g. cats, foxes);
i) The presence of any moss, lichens, herbs, shrubs and/ or trees covering the nest mound, and the percentage cover of each and, on departure from each nest mound, two sticks were placed in the centre of the nest mound in an "X" formation to identify that the mound had been recorded.

Western Spiny-tailed Skink

While surveying in the Eucalypt woodland, fallen logs were searched for scats of the Western Spiny Tailed Skink *Egernia stokesii badia,* which is listed as a Threatened Species under the EPBC *Act 1999*. The Eucalypt woodlands provide habitat for *Egernia stokesii badia,* such as tree hollows, bark, and fallen logs. They are also known to occupy abandoned houses, sheds and old piles of corrugated iron.

Other Conservation Significant Fauna Taxa

In addition, the locations of other Conservation Significant Fauna within the Study Area, as listed below, were recorded:

a) Listed Threatened Species of fauna under the Environment Protection and Biodiversity Conservation Act (EPBC) 1999;
b) Specially Protected Fauna under the Wildlife Conservation (WC) Act 1950; and
c) Priority Fauna as classified by the Western Australian Department of Parks and Wildlife (DPaW).

2.4 Limitations

Consistent with EPA Guidance Statement 56 (EPA 2004), limitations of the survey are described below.

Table 2.1: Survey limitations, consistent with EPA Guidance Statement 56 (EPA 2004).

EPA (2004)	Biologic Comment
Competency/experience of the consultant carrying out the survey.	All personnel have previous experience with Malleefowl surveys.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions, e.g. pitfall trapping in waterlogged soils or inability to use pitfall traps because of rocky terrain or impenetrable subsoil)	There were no constraints on fulfilling the scope.

EPA (2004)	Biologic Comment
Proportion of fauna identified, recorded and/or collected.	It is highly unlikely that any malleefowl mounds were missed due to the coverage of the survey work, however, the two areas identified in red in Figure 2.1 were areas where the transect densities were lower. In these areas, it is more likely that a mound could have been missed.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	All previous survey data was made available.
The proportion of the task achieved and further work which might be needed.	100% of the scope was achieved.
Timing/weather/season/cycle;	Timing and weather did not impact on the survey work.
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey	No disturbances impacted on the survey work.
Intensity (in retrospect, was the intensity adequate)	The survey intensity was adequate (see below).
Completeness (e.g. was relevant area fully surveyed)	Approximately 120km of transects were walked within the Study Area at a 15m to 30m spacing, dependent on the density of the vegetation.
Resources (e.g. degree of expertise available in animal identification to taxon level)	There were no resource constraints.
Remoteness and/or access problems	There were no issues with access.
Availability of contextual (e.g. biogeographic) information on the region	All contextual information required was available and adequate.

3 RESULTS AND DISCUSSION

3.1 Previous Data

3.1.1 NatureMap records

Two hundred and five (205) records of seven conservation significant fauna species were identified from NatureMap within a radius of 40 km of the Study Area. Of these records, 131 were of Malleefowl, with some regional records dating back to 1984.

Other conservation significant fauna species listed on NatureMap and Terrestrial Ecosystems (2014) as potentially occurring within the Study Area include:

a) Western Spiny-tailed Skink *Egernia stokesii badia* (Threatened Species / Specially Protected Fauna);

b) Greater Stick-nest Rat *Leporillus conditor* (Threatened Species / Specially Protected Fauna) (extinct on the mainland);
c) Major Mitchell's Cockatoo *Cacatua leadbeateri* (Specially Protected Fauna);
d) Peregrine Falcon *Falco peregrinus* (Specially Protected Fauna);
e) Rainbow Bee-eater *Merops ornatus* (Migratory Species / Marine Species);
f) Hooded Plover *Charadrius rubricollis* (Marine Species / Priority 4);
g) White-browed Babbler *Pomatostomus superciliosus* (Priority 4); and
h) Crested Bellbird *Oreoica gutturalis* (Priority 4).

3.1.2 Previous survey work

Thirteen previous fauna surveys have been undertaken within the vicinity of the current Study Area, as listed in Terrestrial Ecosystems (2014) (Table 3.1), with many of these surveys recording the presence of Malleefowl. Previous records of Malleefowl nest mounds, held by MGX from these surveys, have been incorporated into this report to provide local context beyond the Study Area (marked in Table 3.1.1 with an *).

ATA (2005) conducted a baseline fauna survey at the Mt Gibson Ranges, during which two large areas were searched for Malleefowl nest mounds by targeted transects involving 5 people at between 5m and 50m spacing. The survey recorded sixteen inactive mounds, as well as sightings of one recently deceased bird and one live bird. The survey concluded that the Mt. Gibson mine site supports a breeding population of Malleefowl. The ATA (2005) survey also included 11 trapping (dry pit traps) and 29 foraging sites for the recording of other fauna taxa, of which three trapping sites and two foraging sites coincide with the current Study Area.

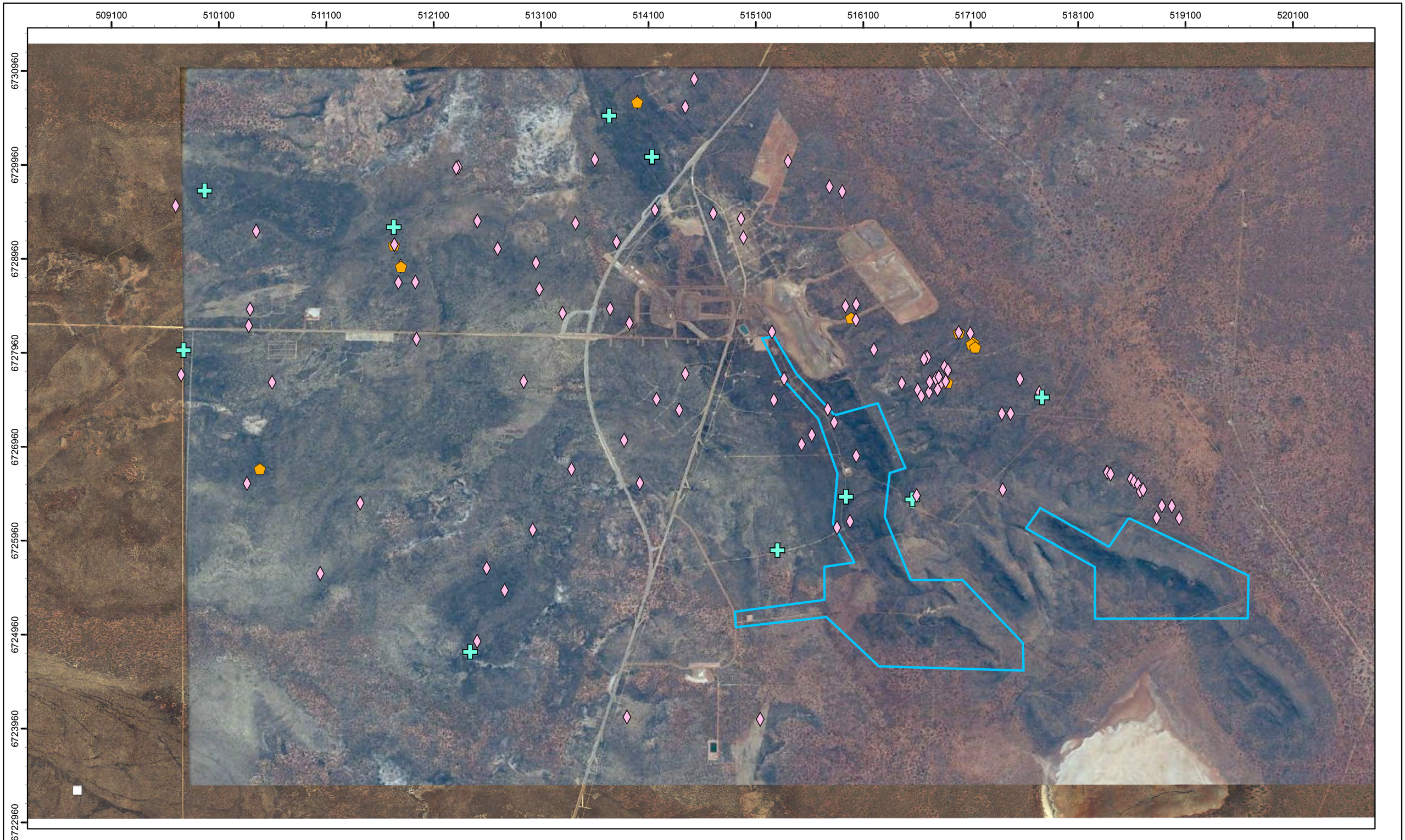
Terrestrial Ecosystems (2014) more recently conducted a vertebrate trapping program at the Mt Gibson Ranges, utilising 20 trap sites over 14 nights. The survey recorded a single Malleefowl crossing a road, as well as two individual *Egernia stokesii badia* at two locations to the east of the Mt Gibson Ranges. This survey was the third in a biennial monitoring program, following surveys in 2008 (Coffey Environments) and 2011 (Terrestrial Ecosystems).

As a regional context report, Alan Tingay and Associates (1996) utilised 11 trapping sites and active searches at Koolanooka, located approximately 100 km north-west of the Study Area. The survey recorded a single freshly moulted Malleefowl wing feather and an old nest mound.

Figure 3.1 shows the distribution of previous Malleefowl records from the area of the Mt Gibson Ranges. The previous records identify 10 recently active nest mounds and 98 inactive nest mounds from the area of the Mt Gibson Ranges. These records include 1 recently active nest mounds and 6 inactive nest mounds which coincide with the Study Area. Nine nest mounds have been removed by the current mine development (not shown).

Table 3.1.1. Previous surveys in the vicinity of the Study Area (*denotes surveys with report access) Reports taken from ATA Environmental (2005) and Terrestrial Ecosystems (2014).

Date	Company/Personnel	Survey
Surveys recording Malleefowl presence		
*2014	*Terrestrial Ecosystems	*Terrestrial Vertebrate Fauna Monitoring Results for the Mount Gibson Iron Ore Mine and Infrastructure Project
*2005	*ATA Environmental	*Fauna Assessment of Mount Gibson to Mount Gibson Mining.
2004b	ATA Environmental	Fauna Assessment, Koolanooka South. Report to Mount Gibson Mining. Report 2004/52.
2000	Hart, Simpson and Associates	Vertebrate fauna survey for the Mt. Gibson Area.
*1996	*Alan Tingay & Associates	*Environmental report to Kingstream Resources NL on the vertebrate fauna of Koolanooka.
1996a	Dell, J.	Vertebrate faunal assessment in June for Yandanooka.
1989	Burbidge, AA., Dixon, K.W. and Fuller P.J	The Flora and Fauna of vacant Crown land at White Well, Shire of Dalwallinu, Western Australia. Department of Conservation and Land Management.
Surveys not recording Malleefowl presence		
2008	Coffey Environments	Baseline Terrestrial Vertebrate Fauna Assessment Results for Mount Gibson. Perth.
2004	Bamford Consulting Ecologists	Fauna assessment for Blue Hills. Report to Mid-west Iron and Steel.
2004a	ATA Environmental	Fauna Assessment. Koolanooka. Report to Mid-west Iron and Steel. Report 2004/40.
2003	Bamford Consulting Ecologists	Fauna assessment for Tallering Peak. Report to Mount Gibson Mining.
2001	Mt. Gibson Biological Survey	Unpublished Report.
1996b	Dell, J.	Vertebrate faunal assessment in October for Yandanooka.



Legend

- Study Area
- **Previous_records**
  - Active
  - Inactive
  - Could not be located
  - not determined

1:36,000

0 0.25 0.5 1 1.5 km

N

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Fig. 3.1. Previous Malleefowl records in the local area

Created: 26/06/2014
Coordinate System: GCS WGS 1984
Datum: WGS 1984

3.2 Biologic Survey Results and Discussion

3.2.1 Malleefowl occurrence

Two recently active (Plate 3.2), 17 inactive and one ancient nest mound of *L. ocellata* were recorded in the Study Area during the current survey (Figure 3.2). This included re-recording all six nest mounds previously recorded within the Study Area, which included one recently active nest mound from previous surveys. One Malleefowl scat was collected from within the Study Area, in close proximity to one of the recently active nest mounds. A Malleefowl track was also recorded leading south out of the western Study Area.

The nest mounds were distributed throughout the Study Area, in particular on the western side of the Mt Gibson Ranges (western Study Area) and at the southeast of the Mt Gibson Ranges (eastern Study Area).

Malleefowl have been documented as renovating old mounds for nesting, years after they were last utilised, in place of constructing new mounds (NHT, 2007). As such, the inactive mounds recorded during the field survey may potentially be used for nesting in the future.

Over the course of a year, Malleefowl may range over several square kilometres with overlapping home ranges (Benshemesh, 2000).

Plate 3.2 Recently active Malleefowl nest mounds (Mound # 1 and 10) recorded from the Study Area

3.2.2 Habitat Associations

Malleefowl nest mounds from the current survey were distributed over seven vegetation units within the Study Area, based on vegetation mapping by Bennett (2000) (Figure 3.3). The most common vegetation units to contain nest mounds were:

a) T2 (dense thicket dominated by *Acacia assimilis);*
b) T9 (dense thicket of *Acacia* species, *Hakea* species, *Eucalyptus brachycorys*); and

c) M4 (very open shrub mallee of *Eucalyptus leptopoda)*.

The two recently active nest mounds and scat were found within the T2 and T9 vegetation units, both associated with the dense *Acacia* thickets typical of Malleefowl habitat. In the ATA (2005) survey, nest mounds were also recorded in the thickets on hill slopes and flat areas, but not in open Eucalypt woodlands.

Although Malleefowl habitat requirements are not fully understood, density of canopy cover for protection is an important factor associated with greater Malleefowl breeding densities (MGM, 2008), as grazed and sparse areas tend to have much lower population densities (Benshemesh, 2000). In addition, breeding areas need to be suitable for stable and long-term nest construction. Based on these Malleefowl habitat associations, the Study Area can be divided into two habitat categories (Figure 3.4);

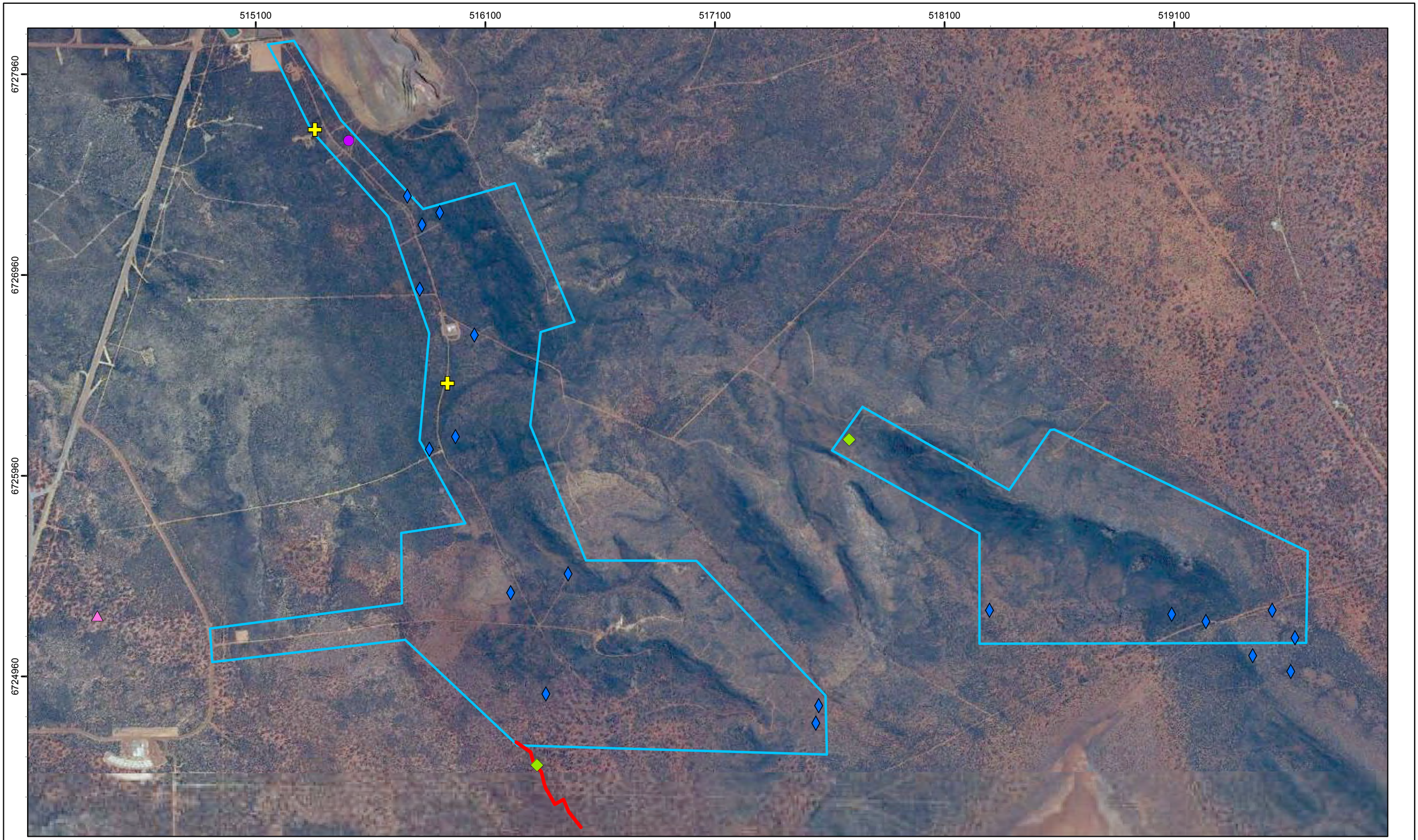
- Most Suitable Habitat: areas of dense and medium-density vegetation, and flat lower-slopes; and
- Less Suitable Habitat: areas of sparse vegetation, and mid- to upper hill slopes.

Of the 20 nest mounds recorded within the Study Area, 16 nest mounds were recorded in the Most Suitable Habitat and 4 nest mounds recorded in the Less Suitable habitat. An important observation is that the distribution of previous Malleefowl records from the vicinity of the Study Area also tends to occur within the Most Suitable Habitat (Figure 3.4).

3.2.3 Western Spiny Tailed Skink

The current survey undertook active searches in suitable Eucalypt woodland for *E. stokesii badia* (Threatened Species / Specially Protected Fauna). No individuals or scats of *E. stokesii badia* were identified; however, some potentially suitable habitat was recorded within the Study Area.

Terrestrial Ecosystems (2014) recorded two individuals of *E. stokesii badia* from two locations and numerous scats to the east of the Mt Gibson Ranges (beyond the Study Area). Terrestrial Ecosystems concluded that it was probable that more small colonies existed in Eucalypt woodland in the general area surrounding the Mt Gibson Ranges.



Legend

- Study Area
- Major Mitchell Cockatoo (fly over)

Malleefowl locations

- Recently active
- ancient
- Inactive
- scat
- Malleefowl_track

1:17,000

0 0.125 0.25 0.5 0.75 km

N

biologic

Mt Gibson Mining Ltd

Extension Hill Targeted Survey

Fig. 3.2. Malleefowl records (Biologic) within the Study Area

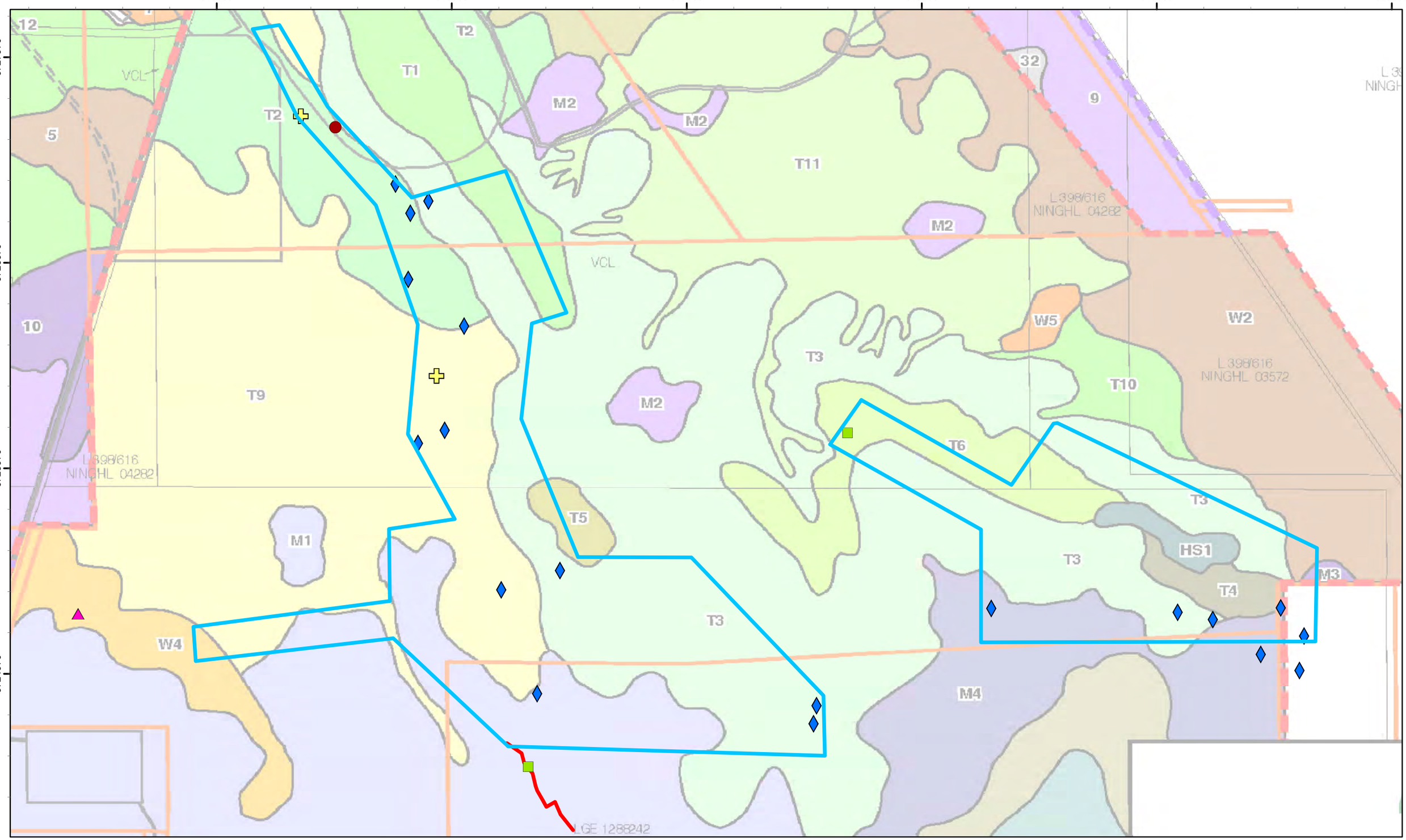
Created: 26/06/2014

Coordinate System: GCS WGS 1984

Datum: WGS 1984

3.2.4 Other Conservation Significant Fauna Taxa

Only one other species of conservation significance was recorded during the field survey, a single Major Mitchell's Cockatoo *Cacatua leadbeateri* (Specially Protected Fauna) flying over the Study Area. This species was also previously recorded from the area of the Mt Gibson Ranges by Terrestrial Ecosystems (2014) and Hart, Simpson and Associates (2000).



Legend

- Study Area
- Major Mitchell Cockatoo

Malleefowl records

- Recently active
- ancient
- inactive
- scat
- Malleefowl track

1:17,000

0 0.125 0.25 0.5 0.75 km

N

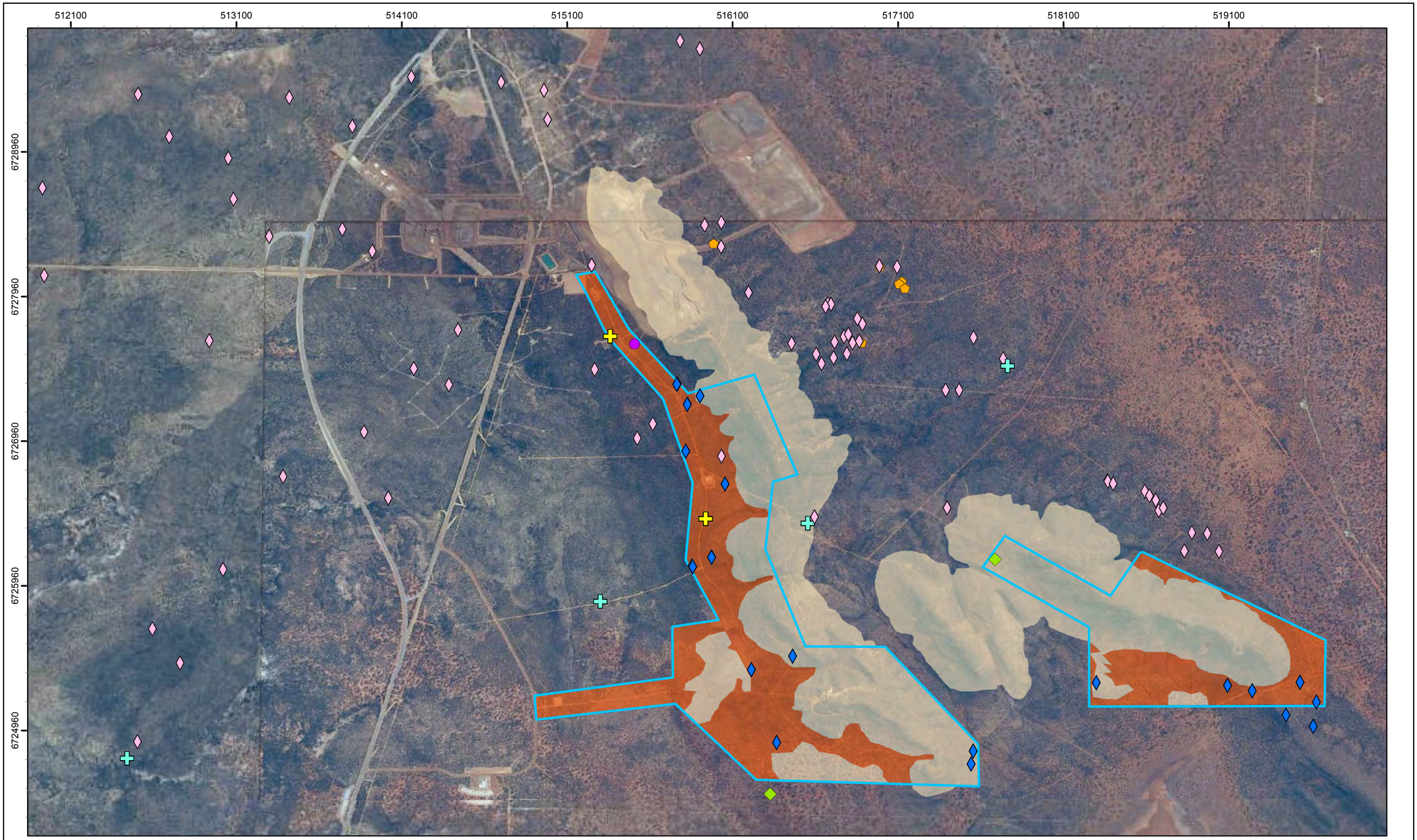
biologic

Mt Gibson Mining Ltd

Extension Hill Targeted Survey

Fig. 3.3. Malleefowl records (Biologic) and vegetation units

Created: 26/06/2014
Coordinate System: GCS WGS 1984
Datum: WGS 1984



Legend

- Study Area
- **Malleefowl habitat**
  - Less suitable
  - Most suitable
- **Malleefowl locations**
  - Recently active
  - ancient
  - Inactive
  - scat
- **Previous records**
  - Active
  - Inactive
  - Could not be located

1:23,574

0 0.175 0.35 0.7 1.05 km

N

biologic

Mt Gibson Mining Ltd

Extension Hill Targeted Survey

Fig. 3.4. Vegetation suitability for Malleefowl

Created: 26/06/2014

Coordinate System: GCS WGS 1984

Datum: WGS 1984

4 CONCLUSIONS

Biologic Environmental Survey was commissioned by Mt Gibson Mining Ltd to undertake a targeted survey for Malleefowl *Leipoa ocellata* within specified areas at the Mt Gibson Ranges Extension Hill mine operations in December 2013 and June 2014.

The objective of the survey was to undertake a systematic, targeted field survey for *L. ocellata* within the Study Area to provide an improved understanding of the presence and distribution of *L. ocellata* across the Mt Gibson Ranges, in context with the results of previous surveys at the Mt Gibson Ranges and the broader region. The survey also sought to determine the presence of other vertebrate fauna of conservation significance.

The current survey recorded 20 *Leipoa ocellata* nest mounds within the Study Area, comprising of two recently active nest mounds, 17 inactive nest mounds and one ancient nest mound. Of the 20 recorded nest mounds, six nest mounds had been previously recorded within the Study Area.

The nest mounds were distributed throughout the Study Area, with a strong distribution pattern within medium-dense *Acacia* habitat positioned on flat, lower slopes. The vegetation of the Study Area is not unique, with similar habitat occurring beyond the Study Area both locally and regionally. The presence of recently active nest mounds confirms that breeding occurs within the area of the Mt Gibson Ranges.

Malleefowl have been recorded renovating inactive mounds, instead of building new nest mounds. As such, any inactive nest mounds may present potential future breeding sites. Disturbance of vegetated areas containing nest mounds may impact the local population, however, this would unlikely have a significant environment affect on the viability of the regional population.

The current survey also undertook additional active searches in suitable *Eucalyptus* habitat within the Study Area for the Western Spiny-tailed Skink *Egernia stokesii badia* (Threatened Species / Specially Protected Fauna). No individuals of *Egernia stokesii badia* were found, however, patches of marginally suitable habitat were recorded. Terrestrial Ecosystems (2014) has previously recorded *Egernia stokesii badia* to the east of the Mt Gibson Ranges.

The current survey also recorded a single Major Mitchell's Cockatoo *Cacatua leadbeateri* (Specially Protected Fauna) to the west of the Study Area.

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Appendix A. *Leipoa ocellata* nest mound data (Biologic 2013) (It should be noted that data for the three nest mounds recorded along the opportunistic transects [Figure 2.1] do not have any data, and nest mounds 16 and 19 were recorded outside of the Study Area*).

Mound #	Profile	Location (Lat/Long)	Active	Width (m)	Height (cm)	Depth (cm)	Crater (m)	Substrate	Vegetation	Disturbance	Eggshell	Crust	Lichen	Mound vegetation	Landform	Photo
1	3	-29.59194, 117.16452	Recently active	5	40	30	3	Sand	Dense mixed Acacia/ Allocasuarina shrubland	Leaf litter raked into mound	Present	No	No	One small Acacia	Lower slope	
2	2	-29.59433, 117.16488	Inactive	8.5	100	50	2.5	Gravel	Dense mixed Acacia/ Allocasuarina shrubland	Shallow excavation - possibly goanna/rabbit	No	No	No		Lower slope	
3	6	-29.59491, 117.16371	Inactive	5	20			Sand	Acacia shrubland with some mallee nearby	None	No	No	No	Some small dead Acacia spp rooted into mound	Lower slope	
4	6	-29.60722, 117.18109	Inactive	12	30			Gravel	Burnt/Regrowth Acacia/Mallee	None	No	No	No	1m shrubs - Grevillia, Eremophila, Aluta.	Lower slope	

Mound #	Profile	Location (Lat/Long)	Active	Width (m)	Height (cm)	Depth (cm)	Crater (m)	Substrate	Vegetation	Disturbance	Eggshell	Crust	Lichen	Mound vegetation	Landform	Photo
5	1	-29.60643, 117.18122	Inactive	6.5	50	30	2	Gravel	Regrowth Acacia/ Allocasuarina shrubland	None	No	No	No	1 m Acacia shrubs	Lower slope	
6	1	-29.60590, 117.16895	Inactive	3.5	10	5	0.5	Loam / sand	Acacia shrubland with Eucalypt canopy	None	No	Yes 20%	Yes 5%	None	Lower slope	
7	1	-29.60134, 117.16737	Inactive	8	60	40	2.5	Gravel	Regrowth Acacia/ Allocasuarina shrubland	None	No	No	No	One small Acacia	Lower slope	
8	1	-29.60049, 117.16995	Inactive	7.5	50	35	2	Gravel	Mixed dense Acacia/ Allocasurina/ *Melaleuca uncinata*	None	No	No	No	Solanum, Eremophila = 30%	Lower slope	
9	6	-29.58770, 117.16328	Inactive	16	30			Gravel	Dense mixed Acacia/ Allocasuarina shrubland	None	No	No	<1%	Acacia, Allocasurina on mound	Lower slope	

Mound #	Profile	Location (Lat/Long)	Active	Width (m)	Height (cm)	Depth (cm)	Crater (m)	Substrate	Vegetation	Disturbance	Eggshell	Crust	Lichen	Mound vegetation	Landform	Photo
10	1	-29.58055, 117.15857	Recently active	5	70	30	2	Sand	Dense mixed Acacia/ Allocasuarina shrubland	Recently excavated but not active	Present	No	No	None	Lower slope	
11	6	-29.58480, 117.16338	Inactive	9	30			Gravel	Mixed dense Acacia/ Allocasurina/ *Melaleuca uncinata*	None	No	Yes 80%	Yes 5%	Covered in small Acacias = 30%	Lower slope	
12	1	-29.58352, 117.16272	Inactive	6.5	60	30	2.5	Loam / pebbles	Dense *Acacia ramulosa* shrubland	None	No	No	No	None	Lower slope	
13	6	-29.60215, 117.18890	Inactive	10	40			Gravel	Mixed dense Acacia/ Allocasurina/ *Melaleuca uncinata*	None	No	Yes 90%	Yes 5%	Covered in small shrubs = 50%	Lower slope	
14	1	-29.60233, 117.19709	Inactive	15	30	15	2	Gravel / loam	Dense *Acacia ramulosa* with scattered Mallee	Echidna diggings	No	Yes 80%	Yes 5%	None	Lower slope	

Mound #	Profile	Location (Lat/Long)	Active	Width (m)	Height (cm)	Depth (cm)	Crater (m)	Substrate	Vegetation	Disturbance	Eggshell	Crust	Lichen	Mound vegetation	Landform	Photo
15	6	-29.60264, 117.19863	Inactive	12	30			Gravel / loam	Dense mixed Acacia/ Allocasuarina shrubland	Echidna diggings	No	Yes 80%	Yes 5%	None	Lower slope	
16*	1	-29.60418, 117.20074	Inactive	16	50	30	2.5	Gravel / cobbles	Dense mixed Acacia/ Allocasuarina shrubland with *Hakea gilesii*	Signs of old excavation	No	No	No	None	Ridge top	
17	1	-29.60337, 117.20263	Inactive	10	40	20	2	Gravel / cobbles	Dense mixed Acacia/ Allocasuarina shrubland with Hakea gilesii and melaleuca sp.	Rabbit, Kangaroo diggings	No	Yes 20%	Yes 5%	Lots of dead Aluta on mound up to 1.5m high = 30% cover	Lower slope	
18	6	-29.60213, 117.20161	Inactive	8	20			Gravel	Dense mixed Acacia/ Allocasuarina shrubland with *Hakea gilesii* and *Melaleuca sp.*	Goanna diggings, fox scats	No	Yes 80%	Yes 5%	Tall Acacia and Melaleuca growing on mound, up to 3m, 60% cover	Mid slope	
19*	1	-29.60488, 117.20244	Inactive	13	50	40	2.5	Gravel	Dense *Acacia ramulosa*/*Melaleuca sp* shrubland	Recently excavated but not active	No	No	No	None	Mid slope	

Appendix B. Locations of Conservation Significant Species from the Study Area

Species	UTM	Easting	Northing	Observations	Survey
Birds					
Leipoa ocellata	50	515933	6726418	Recently active mound	Current survey
Leipoa ocellata	50	515967	6726153	Inactive mound	Current survey
Leipoa ocellata	50	515853	6726089	Inactive mound	Current survey
Leipoa ocellata	50	517534	6724723	Inactive mound	Current survey
Leipoa ocellata	50	517547	6724810	Inactive mound	Current survey
Leipoa ocellata	50	516359	6724871	Inactive mound	Current survey
Leipoa ocellata	50	516207	6725376	Inactive mound	Current survey
Leipoa ocellata	50	516456	6725470	Inactive mound	Current survey
Leipoa ocellata	50	515813	6726888	Inactive mound	Current survey
Leipoa ocellata	50	515357	6727681	Recently active mound	Current survey
Leipoa ocellata	50	515823	6727209	Inactive mound	Current survey
Leipoa ocellata	50	515759	6727352	Inactive mound	Current survey
Leipoa ocellata	50	518291	6725283	Inactive mound	Current survey
Leipoa ocellata	50	519084	6725262	Inactive mound	Current survey
Leipoa ocellata	50	519233	6725227	Inactive mound	Current survey
Leipoa ocellata	50	519437	6725057	Inactive mound	Current survey
Leipoa ocellata	50	519621	6725146	Inactive mound	Current survey
Leipoa ocellata	50	519522	6725283	Inactive mound	Current survey
Leipoa ocellata	50	519602	6724978	Inactive mound	Current survey
Cacatua leadbeateri	50	514406	6725263	Individual bird	Current survey

Appendix C. *NatureMap* results for Conservation Significant Species in the Study Area (40 km buffer).

Name ID	Species Name	Conservation Code
33902	*Aganippe castellum* (Tree-stem Trapdoor Spider)	P4
24722	*Cacatua leadbeateri* (Major Mitchell's Cockatoo)	S
24376	*Charadrius rubricollis* (Hooded Plover)	P4
25107	*Egernia stokesii* subsp. *badia* (Western Spiny-tailed Skink (interior WA & Shark Bay) - Gidgee Skink)	T
25624	*Falco peregrinus* (Peregrine Falcon)	S
33917	*Idiosoma nigrum* (Shield-backed Trapdoor Spider)	T
24128	*Lagostrophus fasciatus* subsp. *fasciatus* (Bernier Is. Banded Hare-wallaby - Mernine)	T
24557	*Leipoa ocellata* (Malleefowl)	T
24219	*Leporillus conditor* (Greater Stick-nest Rat)	T
24598	*Merops ornatus* (Rainbow Bee-eater)	IA

Conservation Codes

T - Rare or likely to become extinct

X - Presumed extinct

IA - Protected under international agreement

S - Other specially protected fauna

1 - Priority 1

2 - Priority 2

3 - Priority 3

4 - Priority 4

5 - Priority 5